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# AN ENQUIRY INTO THE RATIONALES OF ECONOMIC REGULATION AND PROVISION OF HIGHER EDUCATION


Programa Oficial de Doctorado en Ciencias Económicas y Empresariales

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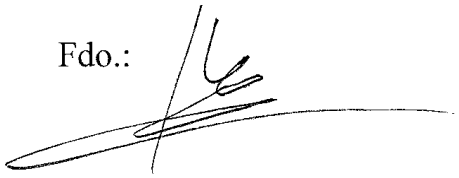

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# AN ENQUIRY INTO THE RATIONALES OF ECONOMIC REGULATION AND PROVISION OF HIGHER EDUCATION

Bralind Kiri

2012

*Ja dedikoj prindërve të mi*

*për mbështetjen e pafundme që më kanë dhënë.*

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## RESUMEN

Con el fin de alcanzar los objetivos que serán presentados posteriormente, esta tesis se divide en cuatro capítulos. En el primer capítulo se proporciona una revisión comprensiva de los conceptos teóricos de la regulación y la provisión de la educación superior en escala macro, seguido por una evidencia empírica actualizada. El segundo y el tercer capítulo complementarán la modelización teórica del monopolio y oligopolio del sector. Por último, el cuarto capítulo analizará los principales resultados de esta tesis, señalando las limitaciones y las posibles futuras ampliaciones. Los objetivos y la metodología correspondientes se desarrollaran como sigue:

**Capítulo 1:** "La regulación económica y la provisión de educación superior en macro-escala"

El objetivo principal de este trabajo es identificar los tipos de regulación y provisión en el sector de la educación superior y sus principales características. Esto estará seguido por una comparación entre los beneficios y los costos en términos de problemas de información y de rendimiento. Además, se quiere detectar las características de la provisión incorporadas en las denominadas variables estructurales, como es el tipo de financiamiento y el control legal de las instituciones de educación superior (IES), pudiendo estos afectar el rendimiento de los sistemas en macro escala. La metodología empleada trata de abordar el problema desde diferentes posiciones para una complementación reciproca: en primer lugar, una revisión del pensamiento económico aclarará acerca de los motivos por los que una provisión pública o privada se admite; en segundo lugar, se realizará una exploración del mundo real y una clasificación de algunos sistemas más representativos en función de su tipo de regulación, lo cual ayudará a comprender la importancia de las variables en el contexto del país; y en tercer lugar, se concluirá con un análisis empírico utilizando un conjunto de datos disponibles sobre la estructura y el funcionamiento de los sistemas en macro-escala que complementará nuestra referencia teórica. Se reconoce que los economistas influyentes se esforzaron en dar los motivos por los que la provisión pública o privada debe ser apoyada. Algunos de ellos estaban a favor de la iniciativa privada por motivos de eficiencia y eficacia mientras que otros favorecieron

la iniciativa pública basándose en los criterios de la formación de la ciudadanía, el efecto de vecindad y la preocupación paternalista. Después de una revisión breve de casos, se identificaran cinco modelos de identidad más importantes en la educación superior (ES), que son: Emergentes, En desregulación, Desregulados, Altamente regulados, y Regulados con orientación privada. Finalmente, a través de un procedimiento de pruebas estadísticas, se entenderá que las variables estructurales seleccionadas tienen una influencia significativa sólo sobre la tasa de entrada, mientras que el gasto privado tiene un efecto positivo sobre la tasa de entrada, la cobertura privada del mercado tiene un efecto negativo sobre ella.

**Capítulo 2:** "El monopolio público frente al privado en el mercado de la educación superior"

El trabajo presenta un modelo teórico de una universidad pública o privada, el cual se desempeña exclusivamente en el mercado y se esfuerza por maximizar su excedente en una economía ideal con los mercados de capitales perfectos. Se quiere identificar las diferencias en el equilibrio y la elección óptima entre los dos escenarios en el mercado de la educación superior, un monopolio público y otro privado. La comparación de los resultados será de utilidad para saber qué tipo de monopolio produce mejores resultados para una comunidad. También puede ofrecer a cualquier gobierno una buena guía para promover o estimular la más adecuada provisión. Apoyando nuestras expectativas, nos encontramos con el hecho que el bienestar social producido por el monopolio público es igual o superior de lo producido por el privado. A fin de que ésta se mantenga, la capacidad de los estudiantes aceptados y el coste de las cualidades ofrecidas están positivamente relacionados en el interior de las condiciones del contorno.

**Capítulo 3:** "Una comparación de la competencia Cournot y Stackelberg en un duopolio mixto en el mercado de la educación superior"

En un modelo de duopolio mixto de la industria de la educación superior, se analizará teóricamente el equilibrio del mercado a través de dos escenarios posibles de competencia. Se supone que el mercado está compuesto por dos universidades: una pública y una

privada. Ellas compiten entre sí en un marco de duopolio con el fin de satisfacer de la mejor forma sus preferencias. Si bien la institución pública tiene por objetivo maximizar el capital humano, la privada tiene como finalidad maximizar su beneficio. Otros jugadores en el mercado son las personas que se esfuerzan comportándose racionalmente para maximizar su utilidad, que dependerá positivamente de la dotación inicial y el capital humano adquirido, pero negativamente en el coste de matrícula. Suponiendo que las universidades compiten en la habilidad de los alumnos, se observa que la universidad pública es más selectiva en el escenario de la competencia de Cournot que en la de Stackelberg. Por el contrario, se observa que la universidad privada es igualmente selectiva entre las dos situaciones diferentes. Probablemente causado por la heterogeneidad de las preferencias, la institución pública siempre será más selectiva que la privada, que esencialmente acepta todas las aplicaciones. Por lo tanto, se concluye que el bienestar social producido en ambos tipos de competencia es igual. La comparación de los resultados será útil para saber el tipo de competencia que produce mejores resultados para una comunidad. Además, podrá proporcionar ideas a los reguladores para fomentar la provisión más adecuada.

## INTRODUCTION

With the great evolution in the human capital theory starting from the early 60s mainly because of the contributions of Nobel economists such as Theodore Schulz, Gary Becker and Milton Friedman, more light was shed directly or indirectly on the problems related to the regulation and the provision of higher education. Despite the views from different angles: development economics, investment theory or education economics; there is a wide consensus on the importance of higher education for the augmentation of the stock of human capital in the society.

Human capital is a broad concept that includes multifold elements embodied in the individuals, such as schooling, knowledge and health; and virtues such as punctuality, honesty, etc., (Becker, 1994). However, schooling is considered as an element of major weight that has cross effects also on the rest of components: a better educated person is more likely to be healthy, knowledgeable, punctual and honest.

Schultz (1981) pointed out the importance of higher education training in the developing countries in order to support economic growth and reduce poverty, in spite of the suspects to political influences and short-term commitments. In addition, Schultz was aware of the fact that for modern economies, natural resources, physical capital and raw labor are not sufficient. For competitive and sustainable economies or for those wanting to become soon, the stock and investment in human capital through higher education training is crucial.

Mincer (1958) threw the bedrocks for a theoretical and an empirical explanation of inter-occupational differences and income distributions according to different amounts and durations of investment in human capital. His models form the foundations to explain the income inequality and the private returns to education.

Friedman (1962) argued on the importance of general education for citizenship creation and the wide-acceptance of some common values, known as social returns. In the other side, vocational education especially contributes to the increase in private returns. Hence, the grounds of regulation have to be different.

Further recent studies have proved empirically the contribution of higher education in the creation of human capital. Abel and Deitz (2009) run an empirical study for the US, finding significant positive relationship between the university activities (*e.g.* degree

awarding, research, etc.) and the stock of human capital in several regions. In addition, they learned that colleges and universities can raise the level of human capital by increasing both, supply and demand for it. The latter is understandable due to the enormous cases of university spin-offs in the US.

Andersson *et al.,* (2004) went further also with an empirical study which identified significant effects of spatial decentralization in tertiary education on the productivity and output per worker. They found significant productivity gains in the Swedish regions, which had received more university-based investments as measured by the number of researchers employed or the number of students enrolled.

On the other hand, the gains from investment in education are not only market-type but there are also remarkable non-market gains. Helliwell and Putnam (2007), using a broad range of evidence showed that the increases in education levels improve trust and do not reduce political and social participation. Furthermore, according to their study, the concepts of trust and social engagements are two main components in the creation of the social capital.

Annual publications from OECD "Education at a Glance" report the existence of social outcomes such as: life satisfaction, civic engagement, electoral participation, and trust.

All aforementioned studies underline higher education as a key factor in the creation of human and social capital. There is no doubt that higher education contributes positively to the creation of both, however there are many points to argue regarding the manner of regulation and provision that ensures the maximum production of human and social capital for a given level of invested resources. Consequently, we go back to the classical economic problem, defining and reaching the production-possibility frontier.

It is also understandable that the forms of regulation and provision of higher education can be an important tool for the governments to affect the composition, the level and the quality of human and social capital. To our knowledge, there is no much research either macro or micro that is exclusively focused on the relationship between the higher education market composition and the performance of the systems. As composition we refer to the type of regulation (*e.g.* deregulated, highly-regulated). The concept of regulation is strongly related to the level of participation, either public or private, in terms of levels of spending per GDP, market coverage, etc.

In the first instance, we will see the problem of provision or regulation from a macro-perspective. An enquiry into the grounds on which either a public or private provision of higher education should be supported, will explain more about the issue. The enquiry will include: classical and neoclassical economic thought, theoretical background on information problems, real-world case review, and empirical evidence. In order to classify the biggest representative systems, variables such as: quality control, tuition fees, selectivity, and regulation strategies, will be employed. The classification will complement our empirical analysis, in order to find possible relationships between the denominated structure variables and the variables that at least theoretically define the performance (*e.g.* entry rate, graduation rate, student-professor rate).

In the other side, referring to the relevant literature, we have the following contribution to the micro level:

Romero and Del Rey (2004) showed the reward of a mixed duopoly in comparison with a state monopoly in the provision of higher education. In a three stage game with a vector of variables that includes: quality, prices and student ability; their found *equilibria,* is the market partition in which the public university provides higher educational quality than the private one. In synchrony with the classical micro theory, they found that competition raises total welfare.

On the other hand, in a similar framework, Romero (2005) studied the effect of borrowing constrains over public and private monopoly. In case of public, quality and ability standards were not affected, but in case of private a loss in quality and a decrease in prices or tuition fees was produced.

We go further, inside the micro-perspective offering a comparison between the public and the private monopoly in the higher education market. Adopting a similar framework of preferences' distributions, costs, and human capital production, we will try to give more insights into the social welfare produced and the relationships under the boundary conditions, the points where public and private social welfare become equal.

In addition, we compare the equilibrium results under two types of duopoly competition: Cournot and Stackelberg, assuming that universities are under strict regulation for price and quality standards. Consequently, they will be able to compete only in student ability level.

We believe that both micro scenarios will complete a little more our understanding about monopolistic and oligopolistic competition in the higher education market.

In sum, we believe that our study is wide-inclusive as it involves a route from a macro to a micro perspective. It permits to spot the policies that can work at the macro-scale within certain limits due to complexity, heterogeneity, country contexts, etc. The micro-perspective complements more the literature and establishes the basis for the incorporation of several additional elements related to the human capital creation. Additionally, it can create the fundaments for a more interdisciplinary view in the future through a possible adoption of the concepts of bridging and bonding capital (Putnam, 2000) born in Political Sciences, which can further enrich our understanding of higher education sector.

## ABSTRACT

In order to pursue the objectives presented in the previous section, this thesis is divided into four chapters. The first chapter provides a comprehensive theoretical review of the concepts of regulation and provision of higher education in the macro scale and it will be followed by updated empirical evidence. The second and the third chapter complement a little more to the theoretical monopolistic and oligopolistic modeling of the sector. And finally, the fourth chapter discusses the main results of this thesis, pointing out the limitations and the possible future extensions. The corresponding detailed aims and methodology are described as follows:

**Chapter 1:** "Economic Regulation and Provision of Higher Education in Macro-Scale"

The aim of the paper is to identify the types of regulation and provision in the higher education sector and their main characteristics. This will be followed by a trade-off between benefits and costs in terms of information problems and performance. In addition, we want to detect which characteristic of provision embodied in the denominated structure-variables, such as type of financing and legal ownership of higher education institutions (HEIs), may affect the performance of the systems in macro-scale. Our employed methodology tries to approach the problem from different positions trying to complement one finding with the others: first, a review of economic thought will enlighten something more about the grounds on which either a public or private provision is supported; second, a real-world examination and classification of some representative systems according to their type of regulation will help to understand the importance of country-context variables; and third, an empirical analysis based on available datasets about structure and performance of systems in the macro-scale will complement our theoretical baseline. We recognize that influential economists endeavored to give the grounds on which either public or private provision has to be supported. As some of them favored the private initiative on the grounds of efficiency and effectiveness, others favored the public one on the grounds of citizenship creation, neighborhood effect, and paternalistic concern. Subsequent to a brief case review, we identity five major models in the higher education (HE) provision: Emerging, In Deregulation, Deregulated, Highly Regulated and Regulated

with private orientation. Finally, through a statistical testing procedure, we learn that the selected structural variables have significant influence only over the entry rate: whilst private spending has a positive effect on the entry rate, the private market coverage has a negative effect on it.

**Chapter 2:** "Public versus Private Monopoly in the Higher Education Market"[1]

The paper shows a theoretical model of a public or private university which plays solely in the market and endeavors to maximize its surplus in an ideal economy with perfect capital markets. We want to see the differences in the equilibrium and optimal choices between two scenarios in the higher education market - a public and private monopoly. The comparison of outcomes will be useful to know which type of monopoly produces better results for a community. It can also offer to any government a good guide to promote or stimulate the most adequate one. Supporting our expectations, we find that social welfare produced by the public is higher than or equal to the private. In order for this to be maintained, the ability of students accepted, and the cost of qualities offered by both are positively related inside the boundary conditions.

**Chapter 3:** "A Comparison of the Cournot and Stackelberg Competition in a Mixed Duopoly of the Higher Education Market"

In a mixed duopoly model of the higher education industry, we theoretically analyze the *equilibria* of the market across two possible competition scenarios. We assume that the market is composed by two universities: a public and a private one. They compete with each other in a duopoly framework in order to satisfy their preferences in the best manner. While the public institution aims to maximize the human capital, the private aims to maximize its profit. Other players in the market are the individuals who behaving rationally endeavor to maximize their utility which depends positively on the initial endowment and the acquired human capital but negatively on the tuition fee. Assuming that the universities compete in students' ability, we observe that the public university is

[1] Kiri, B. (2012)."Public versus Private Monopoly in the Higher Education Market". In John E. Kesner (Eds.). Education: Evaluation, Policy and Reforms (pp. 201-218). Athens: ATINER

more selective in the Cournot competition scenario than in the Stackelberg one. In contrast, we see that the private university is similarly selective among the two different situations. Probably caused by preferences' heterogeneity, the public institution is always more selective than the private one, which essentially accepts all the applications. In addition, we theoretically find out that the social welfare produced under these types of competition is the same. The comparison of outcomes will be useful to know which type of competition produces better results for a community. It can also provide some indications to regulators for encouraging the most adequate one.

# CHAPTER 1

## ECONOMIC REGULATION AND PROVISION OF HIGHER EDUCATION IN MACRO-SCALE

## 1. Introduction

Despite the importance of economic doctrines, specific types of provision or regulation are not always a result of government's belief in them rather than economic rationales: the only route to deal with the budget constraints. Decisions about higher education regulation and reforms cause different feelings to different economic agents in the society.

Nowadays, the social environment offers frequent confrontations among regulators and other implicated agents for reforms in process or for intended reforms.

The decision of Chilean government to reduce subsidy for the universities provoked protests and vandalism in the country's streets. Government argued that universal state funding is a subsidy to the rich. In the other side, students quarreled about it, indicating that education is a public good and the whole system should be free (The Economist, 2011).

British government took the decision to raise the annual tuition fees from the current £3,290 to £6,000 with an upper tier of £9,000 starting from the year 2012. This generated annoyance within the opposition parties and the student-unions. According to Labors, the reform is a tragedy for a whole generation of young people. Student-unions called for protest and for a common voice against the reform which clearly plays against the social cohesion. On the other hand, government representatives said that the reform "put universities' finance on a sustainable footing with extra freedoms and less bureaucracy" (Coughlan, 2010).

In Spain cuts will be carried on in the whole higher education system due to budget deficit – raising tuition fees by a 540€ per year and diminishing the scholarships for students coming from less advantaged socio-economic backgrounds (García, 2012). According to the regulators this will increase the quality of the system and will induce academic achievements, avoiding so the waste of scarce resources. For the opposition and other agents involved in the sector, the reform will produce segregation, deteriorate the social cohesion and decrease incentives to invest in human capital.

As can be realized, the majority of interventions in the system have a direct or an indirect price for the society in general. The point here is, whether these reform-costs will be compensated or not with the sustainability of the system, the gains in performance, and the social cohesion.

Many objectives represented by HEIs, firms, students, parents, etc., compete and constantly stand in front of the regulator in the moment of framing the legal and regulatory framework. Hence, the regulator has to be sure to achieve a socially efficient equilibrium which better serves to each economic agent.

This article, rather than indicating either public or the private provision as the best solution, will try to offer some insights into the good practices of provision, its characteristics and the relativity of explicit assertions in situations linked with diverse historical, political and economic contexts as Sayegh (1994) pointed out. Identifying the complexity of the good means being more careful in presenting our conclusions, underlining the limitation in space and time.

There are many contemporary studies that directly or indirectly have touched the issue of provision. It has been widely accepted, theoretically and empirically that education in general and higher education in specific brings notable returns to the individual and to the society.

Psacharopoulos (2009) demonstrated by detailed evidence the existence of returns to investment in higher education. The study clarified the distinction among different types of returns, such as: social, public, private, fiscal, etc.

Teixeira (2006) brought in one paper the diverse and sometimes controversial views of the fathers of economics about the provision of higher education. His aim was to find the rationales behind the recent developments through employing the methodology of reviewing the history of economic thought in order to observe the importance of the time-factor in the process of the framing the economic policies about education. Identification of complexity, peculiarity and the classification of the economists' views according to their position are the main contributions which make his study a good foundation for any further analysis.

Furthermore, Dill (2005) distinguished the concept of "public good" from that of "public interest", underlining that public provision of the good based on the grounds of a better protection of public interest is not always the case. Reforms which take into account new market conditions should be undertaken. These policies should be framed in full synchrony with legal, social and socio-economic conditions in the places where these institutions operate. He explained the deregulatory trend in the US tertiary education with the recent developments in the funding structure and the blurring distinction between

public and private institutions. According to him, a good provision would be the one that better serves to public interest maximizing so in an efficient and equitable manner the knowledge, skills and the values of the graduates.

In addition, Levy (1995) drew a line between public goods and those goods which are provided with public funds. In most of Western European countries, education is frequently called by the politicians to be a public good. This is very misguiding and leads to wrong approaches in facing changing situations for the preservation of the sustainability in the sector. The decision to supply the education with public funds is a political choice. Higher education is not like national defense or mosquito abatement where exclusion is not possible. In education like in health care, exclusion and the private provision based on the ability to pay are fully possible. The issue is that such services are considered of higher importance for the positive externalities they generate, and most of the states give the suitable diligence, usually by internalizing the externalities through a tax-system.

There are authors that even question the existence of markets in the higher education sector. Becker (2009), in his discussion paper "The market for higher education: does it really exist" tried to define the boundaries of the relevant markets for higher education. Classically speaking, the market consists of products and services whose prices are derived by either supply-side or demand-side arbitrage and whose prices are not directly affected by the prices of goods (or services) outside the collection. Tertiary education as a good appears to be very heterogeneous with many feasible combinations, horizontally and vertically. Hence, the existence the markets based on the classical criteria is harshly questioned. Supporting the latter argument, Clotfelter (1999) pointed out that elite institutions in the US compete on national basis for students and less selective institutions compete on regional or local basis. The market for places in college does not clear in the usual sense and the equilibrium is characterized by non-price rationing: excess demand for places is the necessary condition for selectivity in admissions. Market clearing depends on many factors simultaneously: prices, financial aid, selectivity, and campus facilities.

Finally, some important regulation aspects have been pointed out also by Clotfelter (1999). He described that elite private institutions have probably benefited from the growing inequality of income as their primary customers are better able to afford their bills. Deregulated-systems of education might be the cause of inequality of income between different socio-economic groups. However, further empirical evidence is

necessary to test whether the high power of private higher education in a country is the cause or the effect of income inequality. The regulation's aim in these cases must focus on saving the social cohesion and ensuring equal-opportunity access to all socio-economic groups in the society.

Implicitly, the complexity of the sector is followed by complexity in the studies. Most of the authors have approached the problem of provision and regulation in one-way manner without integrating different approaches in the same study.

We take the opportunity to make a contribution with an analysis which is innovative for the following reason:

Our article tries to approach the problem from different starting points. In metaphoric terms we will play the role of an army which surrounds the enemy in a circular way in such a form that the circle slowly becomes smaller in radius approaching the center (our problem/enemy is: higher education provision and regulation).

The first starting point will review some important aspects mentioned in the economics literature about education, focusing on influential economists, who have been recognized for their outstanding contribution in many sub-fields within economics.

The second starting point will try to locate higher education in good's (services') map. This would be one of many approximations that will provide useful theoretically-based insights.

The third starting point will recognize the informational problems in the sector and their origin. Knowing the origin of the problems is crucial to offer a cure similarly to that of a doctor-patient relationship.

The fourth starting point will be the systems in their state of the art. The representative systems of different regions of the world will be described, pointing out their main characteristics in terms of structure, regulation, prices and quality. Explanation on the basis of country-context events will be provided. This would be helpful for the classification of the systems according to the criteria of their regulation.

Finally the last starting point in our circle will be a macro analysis based on the empirical data mainly obtained from OECD (2011) for the financial and the legal structure of the systems. Possible relationships between structural variables and performance variables will be tested using parametric tests based on the hypothesis-testing procedures.

We do not pretend to arrive at the very center of the problem. However, a further step in approaching it from all the points that we mentioned above will help to understand something more about the correct provision and regulation in the sector. In addition, it will permit us to identify the major driving forces which ensure the performance of our educational systems. All these issues take even more importance in time of economic crises where the sustainability of the sector becomes increasingly vulnerable.

The rest of article is structured as follows: Section 2 presents the ideas of some influential economists about the provision of education. Section 3 points out the informational problems in the sector. In section 4, we show the location of higher education in the set of goods and services. In section 5, the variety of systems is described in details, followed by section 6, where the classification of systems according to their regulation form is discussed. In the section 7, we perform an empirical analysis based on statistical tests. Section 8, contains results and discussion.

## 2. Provision of Education according to Influential Economists

### *2.1. The liberal view of Adam Smith*

Adam Smith argued that in order to promote efficiency and excellence, rivalry and competition should lead the education provision process. Hence, he was more in favor of private initiative rather than the public one. Smith also preferred learning processes with a strong practical emphasis, which he thought, were normally disregarded by the public institutions. This matches with his ideas on the individualism, the labor division and the accumulation of capital. Having an absolute individualistic system, the cost and the gains from any economic decisions are completely connected with the individual, so the cost of education is also fully charged to the individual.

Alternatively, in a collection of classical works by Lai (1999) Smith argued that the state in a society that has progressed in commerce and industry should give the most diligent care to the schooling of people.

> *"The state should, before the poor start to work, require them to study and it should institute the obligation to acquire the most essential parts of education for the majority of the population, forcing every man to take an exam or test so as to obtain the mastery in a corporation or the license to exercise a trade in a village or annexed city". Smith cited by Lai (1999, p. 173)*

He continued further stating that Greek and Roman Republics "gave the population the means to practice military and gymnastic exercises; by encouraging such exercise, imposing on the nation the necessity of learning these skills, they were cultivating the martial dispositions of the citizen."

Smith (1776) pointed out that the lack of competition in the system of salaries, wipes out the teachers' incentive to perform their work properly.

> *…the diligence of public teachers is more or less corrupted by the circumstances which render them more or less independent of their success and reputation in their professions. (1776, p. 591)*

In the seventeenth century, the living times of Smith, despite the cases when the private instruction *de facto* might have been better than the public one, *de jure* was considered of the lowest possible reputation. The key was that only public institutions could issue legally recognized certificates and diplomas, thus the market forces were constrained.

We can say that Smith had a complex vision about the education and the role of the state on it. He pointed out the efficiency and the effectiveness of the private management besides the supporting role and the care that the state should give based on the grounds of citizenship creation. However, similarly to other classical economists, Smith's analysis remained only on philosophical level and did not go through concrete suggestions for the participation of each player in the sector. His genius appeared in the fact that he was one of the first economists who indicated the social and non-market benefits of education.

### *2.2. Mill's view on the educational diversity*

In his classical book *Principles of Political Economy,* Mill underlined that education improves the behavior of the human being through making him more honest, trustworthy, and more refined in his tastes. Furthermore, the choices of the educated person will be more rational-based.

Regarding the industrial point of view, Mill was aware of the disadvantages of a monopolistic state provision of education. The following passage confirms his position:

> *…this is already one of glaring evils of the existing state of society, notwithstanding a much greater diversity of education and pursuits, and a much less absolute dependence of the individual on the mass, than would exist in the Communistic regime. No society in which eccentricity is a matter of reproach, can be in a wholesome state. (1848, p.130)*

According to Mill, elements such as the diversity of tastes and talents, variety of opinions and intellectual points of view, instead of being shortcomings, are the grounds of mental and moral progression. Therefore, the education system should inspire and enforce this diversity in order to extract important outcomes for the individual himself and for the society in general.

However, Mill had a more interventionist view of the phenomena. According to him, a natural monopoly in favor of skilled workers exists who being better remunerated, can afford the cost of schooling. Mill cited by Teixeira (2006), underlines the crucial role of state to ensure the satisfactory quantity and quality of education. Furthermore, Mill believed that quality is a very vulnerable aspect in the private provision of education. As the private main concern is profit, it would be very likely that the private will provide a minimum of quality, such as the service can be marketable, so the cost will be as small as they can generate a good profit for a certain amount of revenue.

### *2.3. Marshall´s idea of education as a collective good*

In contrast with Smith, Marshall supported general education as an important factor to develop the intelligence and the pro-social behavior of the individuals.

In his famous book *Principles of Economics,* he pointed out the need of some people to abandon their studies because of the need to earn a living. These people according to Marshall are engaged during long hours in exhausting tasks and lack the minimum conditions affecting so the development of their mental faculties.

He also wrote about the position of some politicians who spoke themselves as "economists" opposing the expenditure on the education of the masses and defending exclusive class privileges.

> *…they maintain that position in spite of the fact that living economists with one consent maintain that such expenditure is a true economy, and that to refuse it is both wrong and bad business from a national point of view. (1890, p.45)*

Furthermore, according to Marshall, the right to have a free education is the same as the right to have civil and military security, the right and the opportunity to make use of public property and institutions of all kinds, such as roads, gaslights, etc.

In addition, he integrated the opportunity to get good instruction in the concept of the real wealth.

> *…other thing being equal, one person has more real wealth in its broadest sense than another, if the place in which the former lives has a "better climate, better roads, better water more wholesome drainage; and again better newspapers, books and places of amusement and instruction. (1890, pp. 58-59)*

We can easily understand that Marshall saw education in general as a collective good which should not be in private ownership.

It is very innovative for that time the parallelism he drew between: the case of investment in which a group of landowners combine their efforts to make a railway that will greatly raise the value of their land and the case of investment of a nation in building up its own social and political organization by promoting the education. This is very

meaningful and demonstrates the importance that Marshall assigned to education as a sector which defines the long term development of a nation. It may look an ordinary argument of contemporary times but for more than hundred years ago it could have not been easy to foresee it in the way he did.

### *2.4. Friedman and the limited intervention of government in education*

The Nobel Prize economist Milton Friedman is known for his liberal theories and for his position on the limited role of the state in the economy. In his well-known book *Capitalism and Freedom* he dedicated a whole chapter to the education policy.

Friedman was aware of the fact that formal schooling is subsidized and almost entirely administered by the government bodies. According to him, this situation is taken for granted and it is paid little attention for possible reforms even in countries that are leaders on free-enterprise and *laissez-faire* philosophy.

Friedman argued that government intervention in education can be rationalized on two grounds: neighborhood effect and paternalistic concern.

The neighborhood effect refers to the costs or gains that cause certain actions of an individual on other individuals for which is not feasible for him or them a direct compensation. On the other hand, the paternalistic concern refers to the fact that individuals are not able to foresee what is good or bad for them, so government should play the role of imposing some decisions which are assumed to be in favor of the citizen himself, but also in favor of the society in general.

Education contributes in creating stable and democratic societies by providing a minimum degree of literacy and knowledge and so a widespread acceptance of some common set of values. Considering that the gain cannot be isolated to a single child or to his parents, it means that also other members of the society gain. Furthermore, it is not possible to identify a particular individual or family who was benefited and so, charging them for the service. The existence of neighborhood effect is inevitable.

Moreover, Friedman supported the subsidy system over the direct payment from the parents, only for the extreme cases, stating that this would eliminate the government machinery required to collect tax funds from all residents during their whole of their lives and then pay it back, mostly to the same people during the period of their schooling.

Another important aspect of his work is the line he drew between vocational and general education. Vocational education mostly increases the productivity of the individual who acquires it, contributing so in the increase of her/his wage. It does not make sense that the society or community should pay for that through the tax system. On the other hand, for the general education the benefits are from an individual but also from a social point of view, hence subsidizing can be supported on the grounds of neighborhood effects.

> *… subsidizing the training of veterinarians, beauticians, dentists, and a host of other specialists, as is widely done in the United States in governmentally supported educational institutions, cannot be justified on the same grounds as subsidizing elementary schools or, at a higher level, liberal arts colleges. (1962, p.88)*

One of the most difficult issues here is to find out the level of subsidization according to proportional gains: private and social.

In Friedman's opinion, denationalizing schooling, and individual rather than institutional subsidization would increase the choices of parents and would make the system work better. It means that the competition among institutions would increase generating positive effect in the process of establishing a more merit-based framework in all sub-markets related to this sector (*e.g.* labor markets). However, there are some cases such as the rural areas of a country where the "technical monopoly" is present and so, a state monopolistic provision of education would be more efficient than a competitive one.

## 3. Information Problems in the Education Sector

In contemporary views, both state intervention and liberalization (deregulation) of markets are in most of cases encouraged based on the criteria of the informational issues observed in specific industries. For the followers of deregulation, it is believed that the state which is a highly-hierarchical mechanism cannot manage to make the correct allocation of resources when the production process becomes too complex and large. State's failure appears in the provision of a vast majority of consumer goods (*e.g.* communist economies). Furthermore, wider becomes the horizontal and vertical product

differentiation, more complicated becomes for the central-planner to define the efficient allocation of resources in synchrony with the welfare theorems. The lack of price signals might contribute to make the situation worse off, however, even with the existence of price signals, the state is less-perceptive and slower in the reaction process due to lower incentives.

Thus, as our educational system become complex and large, deregulated systems would be more acceptable in terms of equity and efficiency.

We should also add that distortions are widespread in highly regulated systems. As we will see in the following sections, despite decentralization attempts, states tend to define strict rule about pricing, admissions, etc., transforming the system into a rigid one. According to the economic theory this leads to constant shortage or excess supplies. In sum, this is bad for the economies in general since the labor markets depend on the graduate supply and its quality. In addition, subsidizing in accordance with the ownership criteria undermines the competition and gives wrong signals to the market deteriorating even more the situation.

In contrast, according to interventionists, the investment in high-cost educational programs (*e.g.* Robotics, Bio-technology, etc.) is limited in deregulated systems. For both supply and demand side, the uncertainty of returns is continuously present. The possible student failure would imply more costs than in cheaper degrees (*e.g.* Humanities). Hence, a mutual participation in cost-coverage or an intervention of state can be a possible solution. This intervention can be supported on the grounds of nation´s need to have specialist on these important fields for our modern economies.

In addition, the public provision of goods and services or intervention in the process, is principally supported on the grounds of the information imperfection or totally lack from demand and supply side. In the demand-side, the lack of information may appear in two forms: first, when we have to do with highly technical goods and services such as health or medical care, where treatment is not a choice of the individual and information on costs are too limited; second, the socio-economic gradient as defined by Barr (2004) and which means that people coming from disadvantaged socio-economic backgrounds are less likely to be well informed about the cost and returns of a specific economic decision (*e.g.* investment in human capital). This may cause an economic-behavior different from that predicted by the standard economic theory, and then indirectly a wrong allocation of

resources which is bad for social welfare. On the other hand, in the supply side it may appear in such ways that the supplier does not like to get involved into too risky activities (*e.g.* R&D projects) not only for the high costs they incur but also for the uncertainty whether the product will be profitable or not.

Furthermore, according to Brown (2011, p. 22) a private provision of higher education based on the market principles would require the following conditions to hold: a) full access to information timely for the quality of comparable programs offered by different institutions; b) the information must be interpreted in a rational manner by the student or/and those advising them; c) it must lead to actions by providers to adjust price or/and quality; d) the information need to be provided in advance.

These restrictive conditions and their incompatibility with many real-world systems shift the focus on favor of the regulation and the state intervention.

In sum, a reasonable procedure to address all these problems would be a comparison of benefits and costs in terms of information flow between the two types of provision taking into account individual characteristics of higher education institutions (HEIs) and their stakeholders in the places where these institutions operate.

## 4. Higher Education as a Good

In the process of offering an answer for the correct provision of higher education, we should try to define it as a good. Despite having ambivalent views, we have not yet a complete theory which defines education as a good like for example national-defense is widely recognized as a public good. Based on the criteria of excludability and rivalry, education would be considered a private good.

According to the economic theory, a private good yields benefits to the person who acquires it within a rivalry environment and this excludes the others from the acquisition due to its scarcity property. It is true that the selection made from higher education institutions based on the student ability or even the willingness to pay fits with the rivalry and the excludability criteria. Furthermore, the individual has direct private benefits from obtaining a degree because this would increase his chances to earn a better salary. The table below proves the assertion for the US labor market.

**Table 1.1** Median weekly earnings

| **Education attained** | **Median weekly in 2010 ($)** |
|---|---|
| Professional degree | 1,610 |
| Master's degree | 1,272 |
| Bachelor's degree | 1,038 |
| Associate degree | 767 |
| Some college, no degree | 712 |
| High-school graduate | 626 |
| Less than a high school diploma | 444 |

*Source:* Bureau of Labor Statistics, Current Population Survey: (http://www.bls.gov/emp/ep_chart_001.txt)
*Note:* Earnings are for full-time wage and salary workers in the US, aging 25 and over.

Hence, the empirical evidence supports the private good's characteristics of education. However, that is not the whole story. As pointed out from influential economists (Smith, 1776; Marshall, 1962) education contributes in creating stable democracies, establishing a common set of values, and improving the behavior and the intelligence of people. In addition, it is proved even empirically that education generates important positive externalities or social benefits.

According to Psacharopoulos (2009) these benefit are classified like market and non-market. In market social benefits, he indicated: higher productivity, higher net-tax revenues, and less reliance on government social support. In the other side, like non-market social benefits, he pointed out: reduced crime, better health and social cohesion.

As the market benefits can be measured easier than the non-market benefits, the literature offers broad evidence about private and social market benefits. The table below shows the market private and social return to education for some countries.

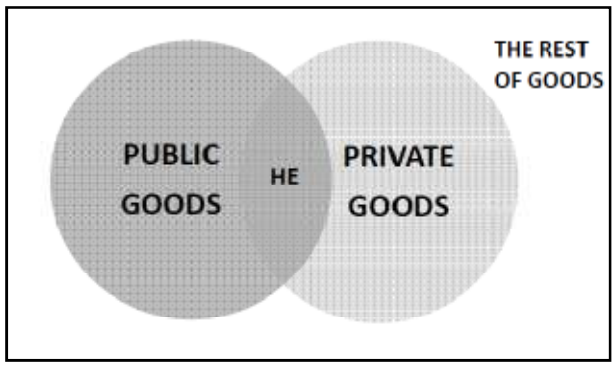
**Table 1.2** Private and social returns to HE

| Country | Private (%) | Social (%) |
|---|---|---|
| Belgium | 12.7 | 10.6 |
| Czech Republic | 26.5 | 8.9 |
| Germany | 6.4 | 8.4 |
| Denmark | 4.3 | 1.5 |
| France | 7.9 | 7.4 |
| Norway | 8.1 | 4.1 |
| Poland | 20.7 | 14.6 |
| Spain | 8.2 | 5.8 |
| Sweden | 4.7 | 3.7 |

*Source:* Adopted from Psacharopoulos (2009)[1].
*Note*: The returns refer to the year 2004.

Education so, is a specific good with characteristics of both private and public goods. If we would have two sets of goods as represented below in Figure 1.1, HE-higher education would be located in the intersection of the two sets: the shaded area between.

**Figure 1.1** Position of HE as a Good




*Source:* Own Compilation.

Teixeira (2006) defines HE as a merit good because of having two main characteristics: the need to have it and the positive externalities it generates.

The main difference between public and merit goods derives from the cost-analysis, as in public goods the costs remain constant for consumption from a large number agents (*e.g.* national defense), in case of merit goods the cost changes (increasing) when it is

[1] Returns to education are estimated based on an econometric approach developed by Mincer (1974) and correlates earnings to years of education, labor, market experience and tenure. Social returns are based on productivity differentials and include only market benefits.

consumed/used by more than a definite number of agents (*e.g.* classrooms). Economists support the provision of merit goods based on the concept of the necessity to have them. Moreover, the externalities they produce are more important than the restrictions on ability or willingness to pay. As people would not buy sufficient amount of the good even in the case they could afford it, the regulator should make sure to ensure a socially efficient level of usage.

As a result, totally subsidized systems and totally private ones (based on the ability to pay) can be criticized on the grounds of efficiency and equity. Theoretically, a fair system would be that one which takes into account these mixed characteristics of the good.

## 5. The Variety of Systems

### *5.1. East-European System*

Higher education in Eastern-Europe was considerably affected because of the dramatic socio-economic and political changes during the early 90s.

Previous to that, their education systems were designed to satisfy the needs of highly planned economies where the individual's preferences were irrelevant for the planner. In the early 90s they faced the new challenges of the new market-oriented economies.

In spite of small differences across specific countries, the general tendency has been almost similar in the whole region. This tendency has gone uniquely towards a process of privatization and liberalization of the market.

Private institutions mushroomed, outnumbering the public institutions, for example: Poland from 5.4% of private institutions over the total number of institutions in the academic year 1990/1991 to a 70.8% in the year 2005/2006 (see Prophe, 2011). However, the figures in terms of level of enrollments, which comprises the real coverage of the market, appear to be more limited than in terms of numbers of private HEIs.

Enrollments in the private HEIs of: Czech Republic, Hungary, Poland, and Romania during the period between the years 1990 to 1997, experienced an annual growth rate of nearly 60% each year (see Giesecke, 2005).

**Table 1.3** Percentage of Market Share of Private HEIs in Eastern-Europe

| **Country** | **Year** | **Market Share** | **Year** | **Market Share** |
|---|---|---|---|---|
| **Czech Republic** | 1996-1997 | 0.5 | 2004-2005 | 8.9 |
| **Hungary** | 1996-1997 | 13.9 | 2006-2007 | 13.6 |
| **Poland** | 1996-1997 | 24.5 | 2007-2008 | 34.1 |
| **Romania** | 1996-1997 | 26.6 | 2007-2008 | 33.8 |
| ***Four Countries Mean*** | *1996-1997* | *16.3* | *2004-2008* | *22.6* |

*Source:* Own compilation based on Giesecke (2005) and Prophe Dataset: Europe's Private and Public Higher Education Shares (2002-2009).

As we can observe from the table, only in one decade, the market share has expanded significantly but it is still below 50% at least in terms of enrollment. If we analyze the market in terms of number of private HEIs over total number of institutions, the figures exceed the 50% (*e.g.* Poland 70.8%, Romania 50.5%, Hungary 56.3%).

Referring to Duczmal (2005), this growth in the sector was due to demographic factors and the rising importance of higher education training for the labor market.

Most of the HEIs in the region are small and their educational programs are restricted to fields which are considered "cheap" as they require a relatively low investment in infrastructure and teaching technology, but they are attractive for a new market-oriented environment.

As it can be easily understood, the revenues of private institutions in Eastern-Europe are heavily derived from tuition fees that are relatively low comparing to the Western or the US standards but they are still significant referring to proportional living standards in the region.

### *5.2. United States System*

The US system of higher education is very complex and diverse. As Eckel and King (2004) pointed out, it has been shaped by the following elements: (a) the ideas of limited government and freedom of expression, states and religious communities; (b) beliefs in the rationality of markets; (c) widespread commitment to equal opportunity and social mobility.

The system comprises three main types of HEIs: public, private not-for-profit and private for-profit. This division is becoming trivial due to decentralization, accreditation and commercialization of services in order to promote full competition.

The diversity of the US system of higher education can be explained by the following factors: first, a totally decentralized system exists where there is no national hierarchy of institutions that impose curricular direction, admission policies or tuition fees. Second, the authorization to operate as an institution of higher education, whether public or private, is granted by the states, a system of voluntary non-governmental accreditation allows institutions to maintain a significant amount of independence and autonomy. Moreover, the application of the voucher system that makes possible funding of individuals (students) instead of institutions, promotes a more competitive environment. Voucher system also avoids double taxation, considering that individuals can accumulate their tax credit and after spend it for their own education or the education of their children.

The latter policy was principally inspired by the Nobel economist Milton Friedman and it was one of the most revolutionary policies undertaken in the US higher education system.

The late story of American education system has been a story of deregulation. The proportion of university budgets coming directly from the states has continued declining, but at the same time the proportion of income coming from tuition fees, endowments, private gifts, and commercial activities has steadily increased.

According to Dill (2005), the whole deregulatory trend has made possible the shift of the US universities from the status of state agencies to that of public corporations. This means that these institutions are currently controlled by a mix of stakeholders who have direct or indirect interest in the performed activities. In addition, the mix of interest that stands behind their institutional missions reflects the way these institutions behave in the marketplace.

This process of liberalization is proved by the empirical evidence: the number of private institutions, the private market coverage, the private budgets, etc. The following table gives a comparable picture of the market in three different moments of the last three decades.

**Table 1.4** Percentage of Market Share of PHEIs in US

| | **1980** | **2000** | **2008** |
|---|---|---|---|
| Number of private institutions/Total number of institutions | 53,7 | 59,4 | 62,0 |
| Not-for-profit institutions | 48,6 | 40,5 | 34,9 |
| For-profit institutions | 5,1 | 18,9 | 12,0 |
| Private enrollments/Total enrollments | 21,8 | 23,2 | 26,9 |
| Not-for-profit institutions | 20,9 | 20,3 | 19,0 |
| For-profit institutions | 0,9 | 2,9 | 6,1 |

*Source:* Own compilation based on Prophe (2011): Private Higher Education in the US.

As we can observe, the private sector plays a considerable role in the US and its share has increased little by little since the 80s. The latter increase has not been as impressive as in Eastern-Europe although it has been steadily constant over the past years.

The division between "not for-profit" and "for-profit" is somehow specific for the US system. According to Dill (2005), the terms "not-for-profit" and "non-profit" sometimes can cause misunderstanding. In his view, the goal of contemporary universities is to earn profit, or in accounting terms, a surplus of revenues over expenditures. The only difference is that some institutions prefer to reinvest the profit and others to distribute it to its shareholders. In contemporary standards, both public and "not-for-profit" private institutions can be considered as "not-for-profit" rather than "non-profit".

We believe that the division "non-for-profit" and "for profit" can be understood more in terms of incentives to pursue an objective rather than a rigid division that is continually saved.

Since the 80s, the private funding has taken a considerable weight both in public and private institutions. In the private sector it comprises around 80% of their total funding and in the public it has not fallen below 40% during the last decades (see Prophe, 2011).

The previous points strengthen our belief in the existence of a new-environment in the US higher education where institutions are being treated in the same way despite their status. The application of voucher system may have strongly helped in this evolution.

### *5.3. Japanese System*

Japanese higher education experienced a high level of development in the mid-70s. Japan now has a 78% of private higher education enrollments which is a unique case in the developed world.

The following table shows the evolution of the private market share since the 80s. As we can observe, the changes from one decade to the other are not significant. The effective share (enrollments) has been saved within the range (70%; 80%).

**Table 1.5** Percentage of Market Share of PHEIs in Japan

| | **1980** | **2000** | **2008** |
|---|---|---|---|
| Number of private institutions/Total number of institutions | 83,0 | 86,3 | 89.6 |
| Private enrollments/Total enrollments | 78,0 | 77,1 | N/A |

*Source:* Own compilation based on Prophe (2011): Private Higher Education in U.S.

Japan's higher education market includes 4-year universities (75% private), 2-year junior colleges (87% private), colleges of technology (0.05% private) and specialized training colleges (90% private). So, we can say that Japan has a highly diversified structure of tertiary education, including a huge weight of private sector.

The low participation of private sector in technology colleges may be explained with the high costs of infrastructure and teaching materials that require training and research in fields such as Robotics, Aeronautics, Biotechnology, etc.

Universities are the principal players in the sector since they offer a wider range of study programs, starting from bachelor and ending to doctorate degrees. Like in the US system, PHEIs are named "non-profit" but we would prefer to call them "non-for-profit" for the reason that we described in the previous section.

Funding comes from private resources such as tuition fees, contracts, gifts, etc. Only 10% of revenues derive from government subsidies.

From the year 2004, it is taking place an initiative of further deregulation by which in public institutions will be gradually introduced a corporate style of management, which may lead to a process of full privatization in the near future.

In sum, excluding some elite-institutions, the most important barrier for students to enroll in the Japanese higher education institutions is their economic condition measured

by the ability to pay. Selection exams based on the valuation of the ability, play a second role in the coverage of the market, especially in junior colleges.

### *5.4. West–European Systems*

#### *5.4.1. Spanish System*

Due to the political and the socio-economic changes from the 1970s to the 1990s, the Spanish-higher education system was affected significantly.

The changes transformed the sector from an elite system until the 60s with a central planning organization and uniform study programs decided by the state to a massification stage in the 70s and afterwards during the 90s with considerable increase in the enrollment figures.

Higher education establishments includes: university education (public and private) and a non-university sector of music academies, advanced vocational training and advanced sport technicians schools.

The Spanish HE system was totally centralized before the big-changes. The University Act of 1983 gave start to a process of decentralization and even regionalization of higher education in the country. Similar to other places where similar processes took place, the aim was to promote a more effective use of resources and provide a service according to the student's needs.

Initially known as non-state or church-run institutions, there were only four private higher education establishments (Deusto, Pontificia de Comillas, Pontificia de Salamanca and Navarra) that were fully recognized legally with the same University Act of 1983.

This recognition made possible a remarkable increase in the number of private institutions since the 90s. According to Prophe (2011) the percentage of the number of total HEIs is around 30%, in spite of an only 12% in the enrollment figures[2].

The National Agency for Quality Assessment and Accreditation ANECA[3] created by an Organic Law 20th of December 2001, contributes for quality improvement, certification and accreditation of university degrees, programs, teaching staff, and overall institutions.

[2] The value is calculated from the database available at: http://stats.oecd.org/# (Students enrolled by type of institution, last update: 20 May 2012).

[3] Abbreviation from Spanish: *Agencia Nacional de Evaluación de la Calidad y Acreditación (ANECA).*

The main responsibilities that form the pillars of the system are shared among: Central Government, Autonomous Communities, and Local Administration.

Central government is responsible for: minimum requirements for admission, general policies to encourage research in high priority fields, large scale international cooperation, general planning of education and regulating of academic and professional qualifications, top-level inspection, policies for study fellowships, ownership and administration of public institutions abroad, legal basis for foreign institutions in Spain, educational statistics for the central government, etc.

Autonomous communities are responsible for: administration of ownership within their jurisdiction, policies of educational planning based on community-priorities, financial support and subsidies for relevant research projects.

And the last but not the least, Local Administration is responsible for assuring the necessary financial and legal facilities for a successful operation of institutions within their jurisdiction (*e.g.* provision of sites for university buildings, maintenance, etc.).

Despite a highly bureaucratic model of responsibilities in large scale, at a micro level, universities and other HEIs have full autonomy to manage their own funds and their academic duties. For example, as central government requires the possession of a secondary level degree and a successful mark in the admission exam[4] as the minimum admission requirement for undergraduate studies, specific universities or faculties can assign their own further minimum requirements for admission.

### *5.4.2. German System*

During the last decades, reflecting the socio-economic and the political changes, the German higher education has undergone through a large number of reforms with the aim to enhance domestic and international competitiveness. In spite of a remarkable evolution of the private sector, the public one remains dominant in terms of market coverage.

Referring to available statistics, there are around 384 state-approved higher education institutions, from those 100 are private, which means around 26%.

[4] In Spain, this exam is commonly known as: *Prueba de Acceso a la Universidad* or *Selectividad*. The admission depends on the cutting mark or *nota de corte* which is a combination of the average mark obtained from secondary education exams and *Selectividad* exams. The cutting mark is the principal variable for admission in public universities.

Similarly to other developed countries, the system is very heterogeneous, not only in terms of ownership but also in terms of focus of teaching and research. The following table demonstrates the heterogeneity in terms of type, ownership and focus.

**Table 1.6** Diversity of German HEIs

| **Type** | **Number of Public** | **Number of Private** | **Focus** |
|---|---|---|---|
| University | 82 | 13 | General |
| University of Applied Sciences | 101 | 51 | Vocational |
| Colleges of Art/Music | 45 | 2 | Art |
| Colleges of Medicine | 36 | N/A | Medicine |
| Indept. Colleges of Theology | 15 | N/A | Religion |

*Source:* Own compilation based on the data provided by Lutran (2007, pp. 69-85).

The private sector legally can take one of several forms, starting from foundations, non-profit limited companies to foundations under the public law. Its main sources of funding are: tuition fees, research fundraising, consultancies, workshop fees, donations, bank loans, etc.

Private tuitions fees are relatively high comparing with public, which in most of the cases does not charge any fee. However, similarly to the US system, we can say that private higher education in Germany is considered to be an elite education for the following reasons:

- its focus on innovative teaching/learning methods;
- its strong links with the business sector;
- its short cycle programs with international orientation;
- its treatment of students as customers.

In terms of market coverage, private enrollments have more than doubled within the last decade, from a 2% in the academic year 2003/2004 to a 4,9% in 2008/2009.

With the legislation changes that took place principally in the years 1998 and 2002 the system has been transformed from a central oriented one into a system where the regions or municipalities have acquired more decision-power. This power is shown in the crucial process of accreditation, which is mandatory for all-state recognized HEIs. According to Bologna process already underway, the accreditation has to run through two levels: study programs accreditation and institutional accreditation. Private institutions are the first subjects to supervision from regional authorities.

Despite recent tendency of marketisation in the sector by introducing elements of new public management, there is a strong belief in Germany that education is a public good and that funding education is a priority of any government.

### *5.4.3. UK System*

According to Lutran (2007, p. 128) there are around 130 HEIs recognized by the Royal Charter or an Act of Parliament. Being officially recognized, they are given the right to award degrees in specific fields.

Furthermore, there are 550 Colleges and other institutions that are not recognized by the government and do not have awarding powers.

In addition, there are around 3000 independent providers of education programs usually in Business Studies, Management, Information Technology, etc., recognized by British Accrediting Body (BAB), but without the right to provide their own degrees. Most of them are registered legally as Limited Corporations or Charitable Trusts.

A solution for the second and the third group is to sign an agreement with an institution from the fist group in order to have the possibility to sell their service and participate in the market. We would name it a sort of franchising in the higher education sector.

The UK higher education system is difficult to define. Its degree-awarding institutions in spite of being public, they are independent to manage their own funds, run their research project and pursue market-based activities. Thus, to consider it as totally public or private has been difficult for many experts on the field. As the system is legally public-owned, its behavior in the marketplace is similar to that of a private institution. Most of the financial resources in the sector are generated from pure market activities such as tuition fees, contracts, consultancy, etc.

Despite charging high tuition fees, student selection is one of the most competitive in the world, where minimum scores in tests, language skills, etc., are required. Moreover, the UK system includes some of the most prestigious centers in the world, such as Cambridge and Oxford recognized internationally for their remarkable tradition in research, teaching, and high selection levels.

### *5.4.4. Swedish System*

There are some important reforms which have framed the Swedish tertiary education system in the way it looks today. With the reform of 1977 large part of higher education institutions have been integrated into a single system governed by a common regulation. In this reform, emphasis was given to vocational training.

Furthermore, in 1997 the Swedish National Agency for Higher Education set-up the general criteria required for entrance to study programs leading to professional degrees.

In addition, in 2007 adjustments were made in the system according to Bologna Accord which was signed by Sweden and other founding European countries in 1999.

The public establishments dominate the sector with: 12-State Universities (incl. Karolinska Institute and Royal Institute of Technology), 12-University colleges, and 7-Colleges of Arts.

On the other hand, we cannot speak about a pure private sector in Sweden as the rest of institutions known as Independent Higher Education Institutions are fully integrated in Swedish HE System. There are 12-Independent establishments recognized by Swedish Authorities from which: 3- universities, 7- colleges, and 2- colleges of arts. Universities and colleges are authorized to award undergraduate degrees and only universities are eligible to award postgraduate degrees.

Higher education institutions in Sweden are free of charge for Swedish students and students coming from the European Union and the European Economic Area (Swedish National Agency for Higher Education, 2012).

Tuition fees in the non-state sector are restricted if the institutions receive public grants.

## 6. Classification of HE-Systems according to their Regulation

We will classify the most representative tertiary education systems taking into account the description made in the previous section. Our classification is principally based on the regulation and its economic characteristics (*e.g.* tuition fees, quality control and structure of financing).

**Table 1.7** Regulation and characteristics

| System type | Example | Regulation/Structure | Variables |
|---|---|---|---|
| **Emerging** | East-Europe (e.g. Hungary, Poland, Czech Republic, etc.) | Emerging private sector; Fragile regulation and quality control; Uncompleted decentralization; Total spending/GDP lower than OECD-average[1]; Public spending higher than private[1]. | High tuition fees in the private sector; Low fees in the public sector; Low admission standards in the private sector; High admission standards in the public. |
| **In Deregulation** | United States | Consolidated private sector; Self-regulation; Decentralized; Total spending/GDP higher than OECD-average[1]; Private spending higher than public spending[1]. | High tuition fees with high variation between elite-institutions and the rest; High variation also in admission standards. |
| **Deregulated** | Japan | Dominant private sector; Total spending/GDP equal to OECD-average[1]; Private spending higher than public spending[1]. | High tuition fees; Admission varies a lot according to the prestige of institutions. |
| **Regulated with Private Orientation** | UK | Dominant state sector with private behavior; High state regulation; High competition due to "franchising"; Total spending/GDP lower than OECD-average[1]; Balance between public and private spending[1]. | High tuition fees in general and exceptionally high in prestigious institutions; High admission standards. |
| **Highly Regulated** | West-Europe (Spain, Germany, Sweden, etc.) | Dominant state sector; High state regulation with shared responsibilities between central and local governments; Total spending/GDP approximately equal to the OECD-average[1]; Public spending much higher than private[1]. | From zero to low tuition fees; High admission standards with few variations. |

*Source:* Own Compilation.
*Note:* [1]OECD (2011). Public and Private Expenditure over GDP: Expenditure on educational institutions as a percentage of GDP, by source of fund and level of education (2008), Table B2.3: (http://dx.doi.org/10.1787/888932463802).

The first column defines the system type or the model, starting with Emerging and ending with Highly Regulated. The second column contains typical examples of the correspondent model taking into account the description made in the section 5. The third column provides information about the main characteristics of the model in terms of expenditure source and regulation of public and private provision. Finally, the last column gives the main variables which clear the markets and the sub-markets in the sector.

We comprehend the following elements:

First, the Emerging model is characterized by fragile regulation and accreditation procedures where the private interest frequently contradicts the public interest and the possibility for altruistic behavior takes place.

Second, the model - In Deregulation has the property to be in continuous change downwards, where the responsibilities: starting with academic and ending with financial become more decentralized. This system is appropriate for cases where higher education institutions have demonstrated to have the ability for self-regulation (*e.g.* US).

Third, Deregulated model is that one which permits the institutions to act totally independently as any independent economic agents would. The private initiative drives the behavior in the marketplace. Here, states only establish the general legal framework, which should be respected by the all players.

Fourth, the Highly Regulated model refers to a model where the state strictly defines the confines of autonomy. The socially efficient quantity and quality is principally ensured by the central planning.

Finally, the Regulated with Private Orientation consists in a mix of private initiative, and state surveillance. In addition, the state defines the general rules, assigns the strict rights and liabilities and makes use of the competition among participants in the market in order to pursue the public interest.

### *6.1. Possible Institutional Explanations of HE Regulation Systems*

According to the Economic Regulation literature, there are five theories which explain certain type of regulation. These theories are the following: Public Interest, Interest Group, Private Interest, Force of Ideas and Institutional. Moreover, a state which wants to regulate in order to pursue a certain objective can employ one of the subsequent regulatory

strategies: command & control, self-regulation, incentives, market harnessing controls, direct action and right's protection (see Baldwin and Cave, 1999).

The model of regulation with private-orientation employed in the UK can be explained with market harnessing strategy and uses franchising, which is defined as a system of control which replaces competition in the market with the competition for the market. The latter strategy has the following strengths: enforcement is low cost to the public and respects managerial freedom. Moreover, managers rather than carrying out the simple bureaucrat, can directly respond to market preferences. On the other hand, there are some weaknesses such as the uncertainties to impose costs on consumers, the need to enforce terms of franchising. It also requires competition for franchise but perhaps few bidders are interested (Baldwin and Cave, 1999, p. 60). Considering that the UK higher education has an old life, several causes may have shaped the system in the way it looks today. However, the evidence suggests that a mix of the following theories: force of ideas (*e.g.* Thatcherism), private interest and public interest may explain much of the evolution. By all means, the UK system promotes competition, the private returns to education and also recognizes the public interest and the positives externalities through a system which carefully preserves the quality.

In US, self-regulation is the most likely employed strategy to explain the recent developments in the sector. This type of strategy is applicable for countries where the institutions have acquired such experience and reputation that they are able to make re-arrangements on their own in order to pursue their interest without endangering the interest of other involved stakeholders. It has a low cost for the government and the re-arrangements are quicker. In addition, HEIs have stronger commitments to fulfill their own rules, pursue flexible changes, understand the rules and deal with the complaints. In the other side, self-serving sometimes involves lack of transparency and accountability. These troubles emerged from the case of collusion in fixing tuition fees and discounts by the members of the Ivy League which comprises a group of elite universities such as: MIT, Harvard, Princeton, Yale, etc., (The Chicago Tribune, 1992).

The theories: force of ideas, and private interest may strongly explain the nowadays regulation in the US tertiary education. This roots of nowadays' voucher system can be found on the liberal ideas of Smith:

*The charitable foundations of scholarships, exhibitions, bursaries, etc. necessarily attach a certain number of students to certain colleges, independent altogether of the merit of those particular colleges. Were the students upon such charitable foundations left free to choose what college they liked best, such liberty might perhaps contribute to excite some emulation among different colleges. A regulation, on the contrary, which prohibited even the independent members of every particular college from leaving it, and going to any other, without leave first asked and obtained which they meant to abandon, would tend very to extinguish that emulation. (1776, p. 580)*

In Western-Europe (*e.g.* Spain, Germany, Sweden, etc.), regulation and provision is principally based on the theory of public interest. Moreover there, it is widely accepted that the public provision and regulation is the most suitable manner to pursue the public interest. The explanation can be found in Germany since the eighteenth century with the *Sozialstaat* or the so known "welfare state" introduced by the Chancellor Otto von Bismarck. The aim of *Sozialstaat* was that of the state which plays a paternalistic role, by employing mechanisms such as: pension funds, accident insurance and unemployment insurance. This revolutionized the role of state and threw the foundations of the modern welfare states. Although criticized by the liberals on the grounds of *laissez-faire* principles and efficiency, welfare state system has been vastly expanded in the modern Western-states and forms the pillars for poverty reduction, social inclusion and cohesion. In synchrony with their economic models, Western-European countries have fully adopted public provision for the primary and the secondary education level and have a prevalent publicly funded tertiary education. In addition, the strategy of command and control is principally employed, so the regulatory standards are set by government departments and then enforced by the regulatory bureaucracies.

For Japan, the evidence suggests that the strategy of market harnessing controls is employed to ensure competition, quality, and sustainability. Moreover, this ensures responses to the market driven by institutions of higher education rather than by bureaucrats. The market orientation of education sector is in full synchrony with the Japanese economic model, which has been very friendly and supportive with the private initiative since the Meiji era ($19^{th}$ century). The pro-private position was enforced during the US occupation (1945-1952). As a result of market harnessing strategies, Japan

succeeded to recover rapidly from the war devastations. Labor unions, left-ring parties, and so on, have always had a low force in Japan. All these historical aspect may have helped to have a privately dominant higher education, where the private initiative defines the most important characteristics of the system in macro-scale. The theory of private interest is the most suitable to explain the Japanese deregulated system. Despite the notable achievements in quality as we find Japanese elite universities ranked among the 50 best in the world (see QS World University Rankings, 2011), the system can be criticized in terms of social inclusion as the entry rate and the graduation rate are amongst the lowest in the developed countries (OECD, 2011).

Finally, we can explain the emerging model of Eastern-Europe with the general perspective of the transition economies in that region. Having a short experience with the market-economy these countries face serious difficulties to balance the market evolution with the appropriate government intervention. The evidence suggests that their systems lack to represent a noticeable form (*e.g.* US, UK, West-Europe, etc.). The resultant regulation strategies are in the most of cases based on the mix of: ideological movements, political positions and adoption of models from abroad. In addition, the latter adoption is not product of a reasonable country-context initiative. The emerging of private sector is supported on the grounds of the theories of the private interest and the force of ideas. In the other side, the attempt to adopt the West-European standards of *Sozialstaat* through the command and control strategy usually falls in common failures like: capture, legalism, standard setting and enforcement.

## 7. Empirical Analysis

Our assessment will be based on the data which we have gathered principally from OECD (2011) and that are shown in the dataset of the appendix 1. The aim of the analysis is to check for any possible relationship between structure variables (*e.g.* Public Spending/GDP, Private Spending/GDP, Private Enrollments/Total Enrollments, etc.) and system's performance variables (*e.g.* Entry Rate, Graduation Rate, Student/Professor Ratio). Statistically speaking, an OLS-estimation would not be reliable in terms of

probabilities, considering that the number of observations in the best case is 35 (see appendix 1).

With the aim to get some reliable insights into our data, we find more reasonable to employ some parametric tests for the sample mean. The procedure will be the following: first, in a spreadsheet[5], we select a pair of variables from our dataset: a structure variable and a performance variable; second, we calculate the mean of the structure variable and we sort the variable's data from the lowest to the highest. The corresponding values of the performance variable will appear next to those of the sorted structural variable. Based on the mean-value of structure variable we split the sample into two sub-samples. For values equal or lower than the mean, we will obtain the top-sample, and for those, higher than the mean, the bottom-sample. The top-sample will refer to low levels of the structure variable (*e.g.* low private market coverage, low private spending/GDP, etc.). In contrast, the bottom-sample will refer to high levels of the structure variable (*e.g.* high private market coverage, high private spending/GDP, etc.). As aimed, the division line at the average point of the structure variable will also permit us to cut the data of the performance variable next to it, into two sub-samples. The top one will refer to levels of performance corresponding to low contribution of the structure variable and the bottom one with levels of performance corresponding to high contribution of the structure variable.

For a better understanding of the procedure, it would be the case to give a numerical example. Let's analyze whether high levels of private market coverage are related positively or negatively to the entry rate levels.

First, we calculate the average level of private market coverage (private enrollments/total enrollments) which corresponds to the fifth column of our dataset in the appendix 1. The average value is: 27,2%. The values lower or equal to this value will comprise the first sub-sample, and those higher, the second sub-sample. Symmetrically to these two sub-samples, we will get two corresponding sub-samples of the entry rate, one referring to high private market coverage and another to the low one. We follow calculating the mean of each one of the sub-samples of the Entry Rate. The means are as follows: $\mu_1 = 61{,}8$; $\mu_2 = 48{,}3$. According to this estimation, the low levels of private market coverage are related to high levels of entry rate, since $61{,}8 > 48{,}3$. This is only a first impression which cannot be credible until the moment that we perform some sort of

[5] We have used spreadsheets of the program Microsoft Office Excel 2007.

parametric test. Following Sheskin (2000, p. 75), the correct test about the difference of two independent sample means for interval/ratio data would be a t-test (Test 11). The assumption for running this test are the following: a) Each sample has been randomly selected from the population it represents; b) The distribution of data in the underlying population from which each of the samples is derived is normal; and c) The third assumption, which is referred to as the homogeneity of variance assumption, states that the variance of the underlying population represented by Sample 1 is equal to the variance of the underlying population represented by Sample 2 (*i.e.*, $\sigma_1^2 = \sigma_2^2$), (Sheskin, 2000, p. 270).

We are sure for the fulfillment of the point a) as the data have been randomly selected. In order to know the distribution of the analyzed data and whether the underlying population from which the data has been selected is normal, we run two known tests for checking normality: the Jarque-Bera test and the Lilliefors test. Both tests give p-values higher than the significance level-α, for α=0,01 or 0,05 (see appendix 3). Thus, the null hypothesis $H_0$: The data are normally distributed; cannot be rejected.

Regarding the last assumption c) we run the test for the homogeneity of variances, known as Hartley's F-test:

$$F_{max} = \frac{s_L^2}{s_S^2} \qquad \{1\}$$

where $s_L^2$ stands for the larger of the two estimated population variances;
and $s_S^2$ stands for the smaller of the two estimated population variances.

After calculating the $F_{max}$ value for any pair of sub-samples, we compare the calculated value with the tabled critical value for the numerator and denominator degrees of freedom: $df_{num} = n_L - 1$ and $df_{den} = n_L - 1$ and, with the significance level- $\alpha$. If the calculated value is lower than the critical value, then the null hypothesis for the homogeneity of variances is not violated. In appendix 4, we show the results in terms of p-values for all pairs of sub-samples. The results suggest that the null hypothesis is not violated except the case when we observe the effect of Total Spending/GDP over the Graduation Rate, leading to the two-tailed p-value = 0.00836 meaning that the variance

difference between samples is significant. This case will require a further test, the Cochran and Cox test, which is developed for cases with heterogeneity of variances (Sheskin, 2000, p. 281) that will be employed successively in this section.

Having proved the soundness of the assumptions we can follow with hypothesis testing:

$H_0$: $\mu_1 = \mu_2$ (private market-coverage has no effect in the entry rate).

$H_0$: $\mu_1 > \mu_2$ (private market-coverage has a negative effect in the entry rate).

Referring to the descriptive statistics in the appendix 2: $n_1 = 22$ and, $n_2 = 12$. The estimated values for the standard deviations are the following: $s_1 = 14{,}7$ and $s_2 = 20{,}8$. Thus, we know the value of each variable in order to get the value of t-statistic[6] (see footnote).

According to the standard statistical procedure, if the value $t = 2{,}207$ falls in the rejection area with the significance level $\alpha = 0{,}01$ or $\alpha = 0{,}05$, we can reject the null hypothesis, and thus accept the alternative hypothesis. The one-tailed critical value of t with degrees of freedom: $df = 22 + 12 - 2 = 32$ for $\alpha = 0{,}01$ is 2,448 and for $\alpha = 0{,}05$ is 1,693.

Therefore, the null hypothesis will be accepted with the level of significance $\alpha = 0{,}01$ as $2{,}207 < 2{,}448$. On the other hand, the null hypothesis will be rejected with the level of significance $\alpha = 0{,}05$ as $2{,}207 > 1{,}693$.

In sum, we can say that private market coverage has a negative effect on the entry rate with $\alpha = 0{,}05$ level of significance.

The procedure will be similar for any pair: {Structure variable; Performance variable}. Based on the values of the means taken from the independent samples we can frame the rest of null and alternative hypotheses.

In order to avoid repetition, the null hypotheses will always save the following general form:

$H_0$: There is no effect between structural variable –x and performance variable –y .

where ,“x” can be any of the structural variables in the table of appendix 1. And “y” can be any of the performance variables in the same table.

[6] $t = \frac{\mu_1 - \mu_2}{\sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}(\frac{1}{n_1}+\frac{1}{n_2})}}$, thus $t = \frac{61{,}8-48{,}3}{\sqrt{\frac{(22-1)14{,}7^2+(11-1)20{,}8^2}{22+12-2}(\frac{1}{22}+\frac{1}{12})}} = 2{,}207$

Given the values of descriptive statistics in the appendix 2 (where $\mu_1$ and $\mu_2$ are the means of the top and the bottom sub-sample for the performance variable), the rest of alternative hypotheses may take any of the following forms:

$H_1$: Private market coverage has a negative effect on the Graduation Rate.

$H_1$: Private market coverage has a positive effect on the Student-Professor Rate.

$H_1$: Private Spending over GDP has a positive effect on the Entry Rate.

$H_1$: Private Spending over GDP has a positive effect on the Graduation Rate.

$H_1$: Private Spending over GDP has a negative effect on the Student-Professor Rate.

$H_1$: Public Spending over GDP has a negative on the Entry Rate.

$H_1$: Public Spending over GDP has a positive effect on the Graduation Rate.

$H_1$: Public Spending over GDP has a negative effect on the Student-Professor Rate.

$H_1$: Total Spending over GDP has a positive effect on the Entry Rate.

$H_1$: Total Spending over GDP has a positive effect on the Graduation Rate.

$H_1$: Total Spending over GDP has a negative effect on the Student Professor Rate.

$H_1$: Private Spending over Total Spending has a positive effect on the Entry Rate.

$H_1$: Private Spending over Total Spending has a positive effect on the Graduation Rate.

$H_1$: Private Spending over Total Spending has a negative effect on the Student-Professor Rate.

The summary of results for hypothesis testing is presented in the following table:

**Table 1.8** The results from hypothesis-testing

| | | Performance Variables | | |
|---|---|---|---|---|
| | | **Entry Rate** | **Graduation Rate** | **Student-Professor Rate** |
| **Structure Variables** | **Private Enrollments /Total Enrollments** | $H_1: \mu_1 > \mu_2$<br>*t=2,207*<br>*$t_{0,01}(32)=2,448$*<br>*$H_0$: accepted*<br>*$t_{0,05}(32)= 1,693$*<br>*$H_0$: rejected* | $H_1: \mu_1 > \mu_2$<br>t= 1,050<br>$t_{0,01}(25)= 2,485$<br>$H_0$: accepted<br>$t_{0,05}(25)= 1,708$<br>$H_0$: accepted | $H_1: \mu_1 < \mu_2$<br>t= -1,167<br>$t_{0,01}(24)= 2,492$<br>$H_0$: accepted<br>$t_{0,05}(24)= 1,71$<br>$H_0$: accepted |
| | **Private Spending/GDP** | $H_1: \mu_1 < \mu_2$<br>*t= -2,415*<br>*$t_{0,01}(26)= 2,478$*<br>*$H_0$: accepted*<br>*$t_{0,05}(26)= 1,705$*<br>*$H_0$: rejected* | $H_1: \mu_1 < \mu_2$<br>t= -0,805<br>$t_{0,01}(22)= 2,499$<br>$H_0$: accepted<br>$t_{0,05}(22)= 1,713$<br>$H_0$: accepted | $H_1: \mu_1 > \mu_2$<br>t= 0,242<br>$t_{0,01}(21)= 2,517$<br>$H_0$: accepted<br>$t_{0,05}(21)= 1,72$<br>$H_0$: accepted |
| | **Public Spending/GDP** | $H_1: \mu_1 > \mu_2$<br>t= 0,084<br>$t_{0,01}(29)= 2,462$<br>$H_0$: accepted<br>$t_{0,05}(29)= 1,699$<br>$H_0$: accepted | $H_1: \mu_1 < \mu_2$<br>t= -0,394<br>$t_{0,01}(24)= 2,492$<br>$H_0$: accepted<br>$t_{0,05}(24)= 1,71$<br>$H_0$: accepted | $H_1: \mu_1 > \mu_2$<br>t= 1,287<br>$t_{0,01}(23)= 2,499$<br>$H_0$: accepted<br>$t_{0,05}(23)= 1,713$<br>$H_0$: accepted |
| | **Total Spending/GDP** | $H_1: \mu_1 < \mu_2$<br>t=-1,215<br>$t_{0,01}(27)= 2,472$<br>$H_0$: accepted<br>$t_{0,05}(27)= 1,703$<br>$H_0$: accepted | $H_1: \mu_1 < \mu_2$<br>t= -1,309<br>$t_{0,01}(22)= 2,478$<br>$H_0$: accepted<br>$t_{0,05}(22)= 1,705$<br>$H_0$: accepted | $H_1: \mu_1 > \mu_2$<br>t= 1,719<br>$t_{0,01}(21)= 2,517$<br>$H_0$: accepted<br>$t_{0,05}(21)= 1,72$<br>$H_0$: accepted |
| | **Private Spending/Total Spending** | $H_1: \mu_1 < \mu_2$<br>*t=-2,040*<br>*$t_{0,01}(27)= 2,472$*<br>*$H_0$: accepted*<br>*$t_{0,05}(27)= 1,703$*<br>*$H_0$: rejected* | $H_1: \mu_1 < \mu_2$<br>t= -0,386<br>$t_{0,01}(22)= 2,508$<br>$H_0$: accepted<br>$t_{0,05}(22)= 1,717$<br>$H_0$: accepted | $H_1: \mu_1 > \mu_2$<br>t= 0,055<br>$t_{0,01}(21)= 2,517$<br>$H_0$: accepted<br>$t_{0,05}(21)= 1,72$<br>$H_0$: accepted |

*Source:* Own Compilation.
*Note:* Alternative hypotheses are framed from the descriptive statistics presented in the appendix 2. One-tail critical values with the corresponding degrees of freedom are obtained automatically by the statistical open-source software Gretl: (http://gretl.sourceforge.net/index.html).

As we mentioned before, we need a further test for the case: $H_0$: Total Spending over GDP has no effect on the Graduation Rate; considering that the assumption for the homogeneity of variances is violated (see appendix 4).

The Cochran-Cox test will help us to deal with the problem. The test is represented with the following formula:

$$t' = \frac{t_1\frac{s_1^2}{n_1} + t_2\frac{s_2^2}{n_2}}{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \qquad \{2\}$$

where, $t_1$ is the tabled critical t-value at the specified level of significance for $df_1 = n_1 - 1$, and $t_2$ is the tabled critical t-value at the specified level of significance for $df_2 = n_2 - 1$.

As, $n_1 = n_2 = 12 \Longrightarrow df_1 = df_2 = 11$ then, $t_1 = t_2$ and for a specified level of significance-$\alpha$: $t_1 = t_\alpha(df_1)$.

For $\alpha = 0{,}01$ we have $t_1 = t_2 = t_{0.01}(11) = 2{,}718$. On the other hand, for $\alpha = 0{,}05$ we have $t_1 = t_2 = t_{0.05}(11) = 1{,}795$.

As we have known all values, we can get the value of $t'$-test[7] for $\alpha = 0{,}01$ (see footnote).

Similarly, $t' = 1{,}795$ for $\alpha = 0{,}05$.

As the $t'$ values are higher than the two-tailed t-values when the homogeneity of variances is assumed: $t_{0{,}01}(22) = 2{,}478$ and $t_{0{,}05}(22) = 1{,}705$ it means that the $t'$ test is a more conservative test than t.

Following the standard procedure since the absolute value of $t = -1{,}309$ (Table: 8) is smaller than both: $t' = 2{,}478$ and $t' = 1{,}705$ we still cannot reject the null hypothesis: $H_0$: Total Spending over GDP has no effect over the Graduation Rate.

Summarizing the results, at the level of significance: $\alpha = 0{,}01$ we can reject none of the null hypotheses meaning that the difference between the two samples is not significant. In the other side, at the level of significance $\alpha = 0{,}05$ we can reject three null hypotheses, which means we accept the following three alternative hypotheses: $H_1$: Private market-coverage has a negative effect on the Entry Rate[8]; $H_1$: Private Spending over GDP has a positive effect on the Entry Rate; $H_1$: Private Spending over Total Spending has a positive effect on the Entry Rate.

By observing our dataset, representative countries of below-average private market-coverage and high entry rate are: US, UK, Portugal, Iceland, Norway, Sweden, Australia,

[7] $t' = \frac{2{,}718\frac{152{,}3}{12} + 2{,}718\frac{27{,}4}{12}}{\frac{152{,}3}{12} + \frac{27{,}4}{12}} = 2{,}718$

[8] This result was obtained in the detailed example at the beginning of this section.

etc. In addition, countries with above-average private spending and high entry rate are: Russian Federation, Portugal, Korea, UK, US, etc. As some observations coincide we can also conclude that not always the low private market-coverage is related with low private spending. However, further tests would be necessary in order to prove the last assertion.

## 8. Results and Discussion

We have approached the problem of provision and regulation in the higher education from different points: theoretical, real-world case review and empirical.

In our theoretical review, we underlined the opinions given by some influential economists such as Smith, Mill, Marshall and Friedman who are widely recognized for their immense contribution in economics and other related-disciplines. Most of them paid exclusive attention to the competition in the system as a mechanism to improve quality. As Smith criticized the public system since the professors are less concerned for their performance obligations and suggested the equal treatment by the state of public and private institutions, Friedman went further saying that the individual subsidization is better than the institutional one as a tool to induce competition. They all agreed on the issue that the state should assign special diligence to the education of people as a mean for citizenship creation, saving the social cohesion, and ensure the sufficient quantity and quality of graduates. However, Mill pointed out that education should not fall in the common mistake of Communist regimes that make the individual dependent on the masses. Thus, the diversity of talents, tastes and opinions should be promoted by our education systems. A notable step in the economic thought about education was done with the division between the vocational and general training (Friedman, 1962). This raised the argument that the provision of the two cannot be based on the same grounds. In addition, the arguments of Friedman gave rise to further studies about returns to education and the re-positioning of the higher education in the general map of goods and services.

Complementing our theoretical baseline, we emphasized the informational problems in the sector and their origin. Both highly regulated and deregulated systems comprise information problems coming from the supply and demand side. The regulator's concern

should focus on the comparison of these problems in a country-context framework. We strongly believe that an adequate provision should be based on the latter trade-off.

Furthermore, we recognized the public and private properties of higher education as a good, followed by the empirical evidence on private returns for the US labor market and also by the evidence provided by Psacharopoulos (2009) for the private and the social returns to education.

After a real-world case review, we concluded with a classification of the following regulation models: Emerging (*e.g.* Eastern-Europe), In-deregulation (*e.g.* US), Deregulated (*e.g.* Japan), Regulated with private orientation (*e.g.* UK) and Highly Regulated (*e.g.* Western-Europe). Our classification takes into account the main variables which contribute in clearing higher education markets and the strategies employed by the regulator to pursue certain objectives (see Baldwin and Cave, 1999). Market harnessing strategies are frequently used in the following systems: Deregulated, In-deregulation and Regulated systems with private orientation. In addition, Highly Regulated models are achieved through the command and control strategies. In the other side, Emerging models try to accommodate their selves along the transition route. They attempt to stick strategies which better fit to their circumstances avoiding common failures such as: capture, legalism and high enforcement costs.

The explanation of our models is mainly based on the theories of: public interest, private interest and force of ideas (*e.g.* Liberalism, Institutionalism, Thatcherism, etc.).

We believe in this approach as a manner to deal with the great complexity of tertiary education models. It permits us to know where we are and where we should go. In addition, we think it comprises the main models of education system that nowadays exist in the world. However, we can count on this framework only in macro-scale. The rigid division between groups is not realistic as long as small characteristics of one, although in a very micro-scale may appear in the other.

Regarding the empirical analysis, entry rate at a level of significance $\alpha = 0{,}05$ is affected negatively by the private market coverage and positively by the private spending. No-significant effect of the structural variables over graduation rate and student-professor rate was observed. The findings suggest that the optimal economic regulation should spot provision solutions with both: high public participation and high private spending (*e.g.* UK, US, etc.). This cannot be easy due to the fact that the usual correlation between public

participation and private spending is negative. We reckon that in countries like US, UK, Australia, etc., the high level of private spending is principally generated by the strong links university-business and through the easy conversion of academic results into economic outcomes (*e.g.* patents, contracts, spin-offs, etc.) as Conti and Gaule (2011) indicated.

Finally, we believe that we have contributed to the literature of economics of education with a comprehensive study which includes manifold insights: theoretical, descriptive, historical and empirical. All these aspects have been included in a framework where findings complement each other.

Aware of the shortcomings, in further studies we must include further theoretical evidence from the economic thought referring to different economic schools (*e.g.* Classical, Neo-classical, Institutionalism, Keynesian, etc.). In addition, further evidence from real-world cases of provision and regulation which have not been included here (*e.g.* Balkans, Africa, Latin America, etc.) would expand our analytical methodology.

Furthermore, we must identify more structural variables and observations which may better describe the effects on performance variables (*e.g.* graduation rate, student-professor rate, etc.). This has to be followed with an attempt to decompose the performance variables according to different socio-economic gradients (*e.g.* low/high income parents, immigrants, etc.). The latter would provide more understanding about the contribution of a specific provision and regulation model to social cohesion and inclusion.

# CHAPTER 2

## PUBLIC VERSUS PRIVATE MONOPOLY IN THE HIGHER EDUCATION MARKET

## 1. Introduction

As a consequence of the recent political and economic changes in Europe and especially after signing the Bologna Accord by most of the European countries, the higher education sector has attracted a lot of attention. In spite of the unification and standardization measures taken via treaties and agreements, the European map of higher education represents various scenarios. There are countries in which the public universities are the only players in the market (*e.g.* Greece, Finland, etc.), countries where there is a mix between public and private but public is still more reliable and dominant (*e.g.* Spain, France, Germany, etc.), and there are countries where the private sector is emerging and it is becoming prevalent (*e.g.* Poland, Hungary, Latvia, etc.). This diversity represents a sort of natural experiment in order to observe the effects of the market structure on the social performance. As the country contexts are diverse too, the theoretical micro modeling can help to avoid possible biases.

The theoretical results can provide the foundations for empirical testing and afterward can serve as guides to governments in their policies related to higher education. The study of the agents' decisions in the new market conditions and the observation of how those changes affect the welfare of the communities is another reason why this research becomes interesting.

Previous theory argues that in order to cover segments of the whole market that are not covered by the public universities in terms of quality and prices, it becomes interesting and profitable the start-up of new institutions known as private universities.

As Romero and Del Rey (2004) mentioned, the difference between public and private universities is their proper aim: profit-*maximizer* or social welfare-*maximizer*. Several studies assume that a private university is a profit-*maximizer* and a public university is a social welfare-*maximizer*. We adopt as well this assumption, which is very important in establishing our model and in this way we obtain a framework to check for differences with the models developed previously. Another assumption is the use of selective exams to determine university admissions, and the quality of the university depends positively on ability of students, which involves the peer – group effect studied by Rothschild and White (1995).

There have been studies about other scenarios – a competition model of public and private universities from Romero and Del Rey (2004) with a unique equilibrium of the

market and another one studying the effect of borrowing constrains in public and private university' choices by Romero (2005). Both studies mentioned above are good references for our model and keeping them in mind we try to fill a small uncovered area that those papers have not considered.

In the following section we establish a utility function for individuals and a surplus function for monopolies. Following Romero and Del Rey (2004), we assume that both monopolies decide optimally in the following sequence - quality, tuition fees and exams. Using the technique of backward induction we calculate and compare the optimal coordinates or *optimal decision vectors* for both monopolies. As a novelty of this article, we point out the calculation of social welfare levels produced by both monopolies and the comparison between them, in the last section of the paper. Furthermore, in the last section we present the mathematical conditions for which the social welfare produced by public is higher than or equal to that one produced by private and also the inequalities in social performance generated by moving around the boundary condition points.

## 2. The Model

### *2.1. Individuals*

As in the model of Romero (2005)[1], the economy consists of a cline of individuals of measure one. Each individual-*i* is characterized by a different and unobservable ability, $a_i$, and an initial income endowment, $w_i$ uniformly and independently distributed over the interval [0, 1] . An individual-*i* gets utility from his total lifetime income:

$$u_j^i = w_i - f_j + h_i \qquad \{3\}$$

where $f_j$ is the university j's tuition fee, and $h_i$ is the accumulated human capital or total earnings of individual *i*. Human capital is increasing in individual's ability, $a_i$ and in university's educational quality, $Q_j$ and both inputs are complements in the determination of earnings. To simplify the computations, we assume that human capital function has the following form:

[1] The notation used in this article is adopted from the paper of Romero and Del Rey (2004).

$$h_i = a_i Q_j \qquad \{4\}$$

We assume that the human capital that an individual obtains if he does not attend the university is equal to zero, and considering that if he/she does not pay any tuition fee, his utility is equal to his initial endowment, *i.e.*, $u_0^i = w_i$.

### *2.2. Monopolies*

Following the models presented by Romero and Del Rey (2004) and Romero (2005), there are two types of universities that produce educational services of quality $Q_j$, where $j$ = {b, v} stand respectively for public and private. Educational quality may be interpreted as the prestige of the higher education institution[2]. Public and private universities differ in their objectives: while the public university maximizes public surplus, the private institution maximizes profits[3]. Universities $j$ have the same cost function, given by per-student costs, $C(Q_j)$, which are defined as follows:[4]

$$C(Q_j) = Q_j^k, k > 1 \qquad \{5\}$$

The cost function is increasing and convex in quality: $\frac{\partial C(Q_j)}{\partial Q_j} > 0$ and $\frac{\partial^2 C(Q_j)}{\partial^2 Q_j} > 0$.

The explanation for the shape of cost function is that: "if school quality depends positively on teacher quality, we need to increase wages considerably in order to attract better teachers, keeping in mind that the supply of teacher quality is not perfectly elastic."

### *2.3. Allocation Mechanisms*

#### *2.3.1. Exams*

A mechanism to allocate students to universities is the use of admission exams, which aims to select the best students among those who are willing to attend the university. As in

[2] Empirical measures of school quality include pupil/teacher ratios, relative wages of teachers, education expenditures and students' performance in standardized tests.
[3] Public surplus is the difference between the human capital produced by the public university and the costs incurred to provide a certain level of quality.
[4] This specification simplifies calculations and ensures the concavity of the universities' optimization problem.

Romero (2005), the exam consists of a minimum score and students who obtain a score equal or higher are admitted into that university. We assume that the exam technology is able to detect perfectly the student's ability, which means that students who obtain a score higher or equal to the minimum required by the university are those of ability $a_i \geq a_j^E, j = \{b, v\}$.

### *2.3.2. Tuition Fees*

Another mechanism to allocate students to universities is through tuition fees. This mechanism selects students according to their willingness and ability to pay tuition fees. Individuals decide whether to attend university or remain uneducated by means of comparing their utility with and without education. Let $\hat{a_i}$ be the ability of the student who is indifferent between attending school *j* and remaining uneducated, *i.e.*, $u_j^i = u_0^i$:

$$\hat{a}_i = \frac{f_j}{Q_j} \qquad \{6\}$$

Those students of ability $a_i \geq \hat{a}_i$ are willing to attend university *j* while students of ability $a_i \leq \hat{a}_i$ prefer to remain uneducated (see appendix 5).

### *2.4. University Optimal Choices under Monopoly*

Universities as monopolies have to decide optimally in their choices of quality, tuition fees and exams. Following Romero (2005), we assume that in our economy there are perfect capital markets, in which students can borrow any amount of money to finance their education investments. To simplify, the interest rate is constant and equal to zero. The timing of decisions is the following: in the first stage each monopoly chooses educational quality, $Q_j$. In the second stage, the tuition fee, $f_j$, is decided. In the third stage, each institution decides whether to run an exam or accept all applications. Below, we show the monopolies' decision schedule:

**Figure 2.1** Decision schedule

| $t_1$ | $t_2$ | $t_3$ |
|---|---|---|
| $Q_j$ | $f_j$ | Run/Doesn't Run Exam |
| Quality | Tuition Fee | Exam |

*Source:* Own Compilation.

We solve the monopolies' problem by the backward induction technique and we get the *optimal decision vectors*.

### *2.5. University as a Public Monopoly*

The public monopoly aims at maximizing public surplus:

$$U_b = \int_0^1 \int_{a_b}^1 (a_i Q_b - C(Q_b))\, da\, dw \qquad \{7\}$$

*Exams:* In the third stage, the public university decides whether to run an exam or accept all applications, given $f_b$ and $Q_b$.

The optimum level is calculated by taking $\frac{\partial U_b}{\partial a_b} = 0$. We show in this section only the final result (see appendix 6).

$$a_b = [\frac{C(Q_b)}{Q_b}\ if\ f_b \leq C(Q_b); \frac{f_b}{Q_b}\ if\ f_b > C(Q_b)] \qquad \{8\}$$

***Proposition 1:*** *The public monopoly runs an exam if* $f_b \leq C(Q_b)$ *and accepts all applicants otherwise.*

The restriction level is at the point $a_b = \frac{C(Q_b)}{Q_b}$ which corresponds with $f_b \leq C(Q_b)$ otherwise the indifference level is reached $a_b = \frac{f_b}{Q_b}$ accepting up to the agent who is indifferent between remaining uneducated or become educated, meaning all the rest of applicants.

*Fees:* The optimum level of tuition fees is calculated by taking $\frac{\partial U_b}{\partial f_b} = 0$. As we have the optimum $a_b$: $a_b = [\frac{C(Q_b)}{Q_b}\ if\ f_b \leq C(Q_b); \frac{f_b}{Q_b}\ if\ f_b > C(Q_b)]$ according to the backward

induction method we should plug in the $a_b$, in the surplus function in order to get the optimal $f_b$.

Hence, in the second stage we have two cases:

Case 1: $a_b = \frac{C(Q_b)}{Q_b}\ if\ f_b \leq C(Q_b)$ so we should maximize the following surplus function:

$$U_b = \frac{Q_b}{2} - C(Q_b) - \frac{(c^2(Q_b) - 2C^2(Q_b))}{2Q_b^2} \qquad \{9\}$$

As $U_b$ does not depend on $f_b$, in {9} the public monopoly can choose any fee satisfying: $f_b \leq C(Q_b)$.

Case 2: $a_b = \frac{f_b}{Q_b} if\ f_b > C(Q_b)$ and here we should maximize the following surplus function:

$$U_b = \frac{Q_b}{2} - \frac{f_b^2}{2Q_b} - C(Q_b) + f_b \frac{C(Q_b)}{Q_b} \qquad \{10\}$$

As $U_b$ depends on $f_b$, in {10} we can derive $U_b$in terms of $f_b$ and we get the following fee:

$$f_b = C(Q_b) \qquad \{11\}$$

Considering that we have found two different optima for $f_b$ through case 1 and 2 we have to choose the right one, therefore we use the original $U_b$ functions to get the values. The correct $f_b$ value will be that one for which $U_b(f_b)$ is higher. As a result, the optimal tuition fee is: $f_b \leq C(Q_b)$, (see appendix 7).

***Proposition 2:*** *The public monopoly chooses exams and charges anything below or equal to the cost, including a zero tuition fee.*

It appears that the most effective variable to restrict the applicant number in the selection procedure are the exams, considering that high fees are not equally efficient in generating positive margins in public university surplus. The theoretical results are symmetric with what we usually see in the real world.

*Quality:* The optimum level of quality is calculated by taking $\frac{\partial U_b}{\partial Q_b} = 0$. For convenience in calculation we directly derive the original $U_b$ in terms of $Q_b$, and after plugging in the optimal $a_b$ we get the following results:

$$C'(Q_b) = \frac{(1+a_b)}{2} \qquad \{12\}$$

***Proposition 3:*** *The optimal level of public monopoly quality depends positively on the mean ability of the students attending the public university,* $\frac{(1+a_b)}{2}$. (see appendix 8)

We have specified the previous proposition, considering that the functions $Q_b$ and $C'(Q_b)$ are both positive monotonic transformation of each other, so what really matters is the term $\frac{(1+a_b)}{2}$. Having $C'(Q_b) = \frac{(1+a_b)}{2}$, $Q_b$ is just the inverse function of $C'(Q_b)$ , as follows: $Q_b = C'^{-1}(Q_b) = C'^{-1}(\frac{1+a_b}{2})$ .

Recall that $Q_b$ should be within the segment [0;1] as defined by the initial assumptions of our model.

The result {12} illustrates the fact that students are not only consumers of higher education, but also inputs in its production, as described by Rothschild and White (1995).

### *2.6. University as a Private Monopoly*

The private monopoly aims at maximizing private surplus:

$$U_v = \int_0^1 \int_{a_v}^1 (f_v - C(Q_v))\ da\ dw \qquad \{13\}$$

In the third stage, the private institution chooses the critical level of ability $a_v$ that maximizes $U_v$ subject to $a_v$: $\frac{\partial U_v}{\partial a_v} = 0$.

***Proposition 4:*** *The private university decides to accept all applications and* $a_v = \frac{f_v}{Q_v}$ $if\ f_v \geq C(Q_v)$ *and shuts down if* $f_v \leq C(Q_v)$. (see appendix 9)

$$a_v = [\frac{f_v}{Q_v}\ if\ f_v \geq C(Q_v);\ Shuts\ down\ if\ f_v \leq C(Q_v)] \quad \{14\}$$

If the tuition fee of private university is higher than its cost to offer a specific quality, students up to the indifference level are accepted, otherwise university shuts down because of not providing the financial resources to carry on with its activity.

*Tuition Fees:* The optimum level of tuition fees is calculated by taking: $\frac{\partial U_v}{\partial f_v} = 0$. The final result solving this optimization problem is the following:

$$f_v = \frac{(Q_v + C(Q_v))}{2}\ where\ 0\ \leq Q_v \leq 1 \qquad \{15\}$$

(see appendix 10).

The optimal fee for private university is defined by the average value of the specific quality offered by it and the corresponding value of cost quality.

*Quality:* The optimum level of quality is calculated by taking $\frac{\partial U_v}{\partial f_v} = 0$. For convenience in calculation, we directly derive the original $U_v$ in terms of $Q_v$ and after plugging in the optimal $a_v$ and $f_v$ we get the following result:

$$C'(Q_v) = \frac{(1+a_v)}{2} \qquad \{16\}$$

***Proposition 5:*** *The optimal level of private monopoly quality depends positively on the mean ability of the students attending the private university,* $\frac{(1+a_v)}{2}$. (see appendix 11)

We would like to add that propositions (1-5) correspond with the results obtained by Romero (2005) in the study about the role of borrowing constrains in public and private universities.

Like in previous section, we do not obtain an isolated $Q_v$, so it can be defined as an inverse function of $C'(Q_v)$, such as $Q_v = C'^{-1}(Q_v) = C'^{-1}(\frac{1+a_v}{2})$ , and considering that $Q_v$ and $C'(Q_v)$ are monotonic transformation functions of each other what really matters is the

term $\frac{(1+a_v)}{2}$, which is the mean ability of students attending private university – a meaningful result proving that the optimal quality for a specific private university is defined only by the ability of its students. More explicitly, the first thing that a private should do in its quality decision making is to have a look at the ability of its proper set of pupils and define the quality which will be provided.

## 3. Comparative Statics

The following table resumes the optimal choices for public and private monopoly, so we can easily compare the results.

**Table 2.1** Optimal decision vectors for two monopolies and its difference

| **Monopoly/ Variable** | **Quality $Q_j$** | **Tuition Fee $f_j$** | **Ability $a_i$** |
|---|---|---|---|
| **Public** | $C'(Q_b) = \frac{1+a_b}{2}$ | $f_b \leq C(Q_b)$ | $a_b = [\frac{C(Q_b)}{Q_b} if\ f_b \leq C(Q_b);\ \frac{f_b}{Q_b} if\ f_b > C(Q_b)]$ |
| **Private** | $C'(Q_v) = \frac{1+a_v}{2}$ | $f_v = \frac{Q_v + C(Q_v)}{2}$ | $a_v = [\frac{f_v}{Q_v} if\ f_v \geq C(Q_v); 1\ if\ f_v < C(Q_v)]$ |
| **Difference** | $Q_b = Q_v$ | $f_b < f_v$ | $a_b \leq a_v$ |

*Source:* Own Compilation.

***Proposition 6:*** *In the presence of perfect capital markets, public and private universities provide the same quality under monopoly, although the public ones charge less and they are less selective.*

Following Garcia-Gallego and Georgantzis (2009) we can obtain now the respective social welfare levels produced by each monopolies:

$$SW_b = \frac{(1+a_b)}{2} - C(Q_b) - \frac{C(Q_b)}{Q_b} \qquad \{17\}$$

$$SW_v = \frac{(1+a_v)}{2} - \frac{(Q_v - C(Q_v)}{2} - \frac{f_v}{Q_v} \qquad \{18\}$$

Obviously, $SW_b \geq SW_v$ in this way a public monopoly theoretically produces higher social welfare for a community than a private one.

**Proposition 7:** *In the presence of perfect capital markets, social welfare produced by university as public monopoly is weakly higher than the social welfare produced by university as private monopoly.*

Proposition (6) corresponds with the results obtained by Romero (2005). On the other hand, the proposition (7) is a novelty of our study and takes advantages of the results (1-6) to produce a synthesis for the whole paper which supports our initial aim.

## 4. Mathematical Boundary Conditions for Social Welfare

At this stage, we can observe what boundary conditions must hold, such as: $SW_b \geq SW_v$ to be maintained. First, we insert the linear equations into a system as below:

$$\begin{cases} SW_b = \frac{(1+a_b)}{2} - C(Q_b) - \frac{C(Q_b)}{Q_b} \\ SW_v = \frac{(1+a_v)}{2} - \frac{(Q_v + C(Q_v)}{2} - \frac{f_v}{Q_v} \\ SW_b \geq SW_v \end{cases} \quad \{19\}$$

Thus, we solve out this system by the decision variables and we find out under which conditions the strict positivity makes sense. Also we check what happens in terms of social welfare inequality when we move from the fixed point of the boundary condition to any point.

Here we have some of them, taking into account the condition: $SW_b \geq SW_v$. Solving the system in terms of decision variable, $a_b$ we obtain the boundary condition[5]:

$$\overline{a_b} = a_v + 2C(Q_b) - C(Q_v) + \frac{2C(Q_b)}{Q_b} - \frac{2f_v}{Q_v} - Q_v \quad \{20\}$$

In order that social welfare in the public monopoly to be higher or equal to the private one, ability of students accepted by public university, $\overline{a_b}$ , must be equal to ability of students accepted by private plus a term which is increasing in cost of quality provided by public and decreasing in quality, cost of quality and tuition fee/unit provided by private.

[5] The system of linear equations in this section is solved using the software Wolfram Mathematica 6.

We can be interested in what happens with social performance of both systems in case that $a_b$ changes from $\overline{a_b}$. Let's notate the right term of the equation {20} as $\mu$. Hence we will have: $\overline{a_b} = a_v + \mu$. Having in mind that $a_v$ should be considered as fixed (controlled by the counterparts), in order that $a_b > \overline{a_b}$, we can only play with variables of the term μ which are controlled by ourselves, in this case it is public monopoly.

Therefore, we should increase the cost of quality provided and the new $\mu_1$ will be higher than the old μ. Mathematically, this can be written: $a_b > \overline{a_b} \implies \mu_1 > \mu \Rightarrow C(Q_b)_1 > C(Q_b) \Rightarrow SW_b < SW_v$. We find out that for any $a_b > \overline{a_b}$, the boundary condition does not hold any more implying that the social welfare produced by public becomes lower than that one produced by the private monopoly. Analyzing in the same way if $a_b < \overline{a_b}$ we get that $a_b < \overline{a_b} \implies \mu_1 < \mu \Rightarrow C(Q_b)_1 < C(Q_b) \Rightarrow SW_b > SW_v$, so social welfare produced by public becomes higher than that one produced by private monopoly.

Solving the system in terms of decision variable $a_v$, we obtain the following boundary condition:

$$\overline{a_v} = a_v + C(Q_v) - \frac{2C(Q_v)(1+Q_b)}{Q_b} + \frac{2f_v}{Q_v} + Q_v \qquad \{21\}$$

In order to satisfy the system {19}, the social welfare in public monopoly to be higher or equal to the private one, ability of students accepted by private university $\overline{a_v}$ must be equal to ability of students accepted by public, plus a term which is increasing in quality, cost of quality and tuition fee/unit of quality provided by private, and decreasing in cost of quality provided by public one. It is interesting to know what happens with social welfare when $a_v$ changes from $\overline{a_v}$. As in the previous case let's notate the right term of boundary condition {21} with μ**,** then it will become $\overline{a_v} = a_b + \mu$, as $a_b$ is controlled by the counterpart the only way to affect $a_v$ is by increasing/decreasing the variables affecting $a_v$ in the boundary condition {21}, that is the right term μ. In order to increase μ we have to increase quality $Q_v$ or cost of quality $C(Q_v)$ or tuition fee $f_v$. Any of these increases applied in the equation {18}, decreases the social welfare produced by private monopoly. Mathematically: $a_v > \overline{a_v} \implies \mu_1 > \mu \implies Q_{v1} > Q_v \vee C(Q_v)_1 > C(Q_v) \vee f_{v1} > f_v \implies SW_b > SW_v$.

Analyzing in the same way for $a_v < \overline{a_v}$ , we get: $a_v < \overline{a_v} \Longrightarrow \mu_1 < \mu \Longrightarrow Q_{v1} < Q_v \vee C(Q_v)_1 < C(Q_v) \vee f_{v1} < f_v \Longrightarrow SW_b < SW_v$.

Solving the system {19} in terms of $C(Q_b)$ we obtain the following boundary condition:

$$\bar{C}(Q_b) = \frac{Q_b(2f_v + Q_v(a_b - a_v + C(Q_v) + Q_v)}{2((1+Q_b)Q_v} \qquad \{22\}$$

In order to satisfy the system {19}, the social welfare in public monopoly to be higher or equal to the private one, the cost of quality provided by public is equal to an expression that is increasing in ability distance, counterpart tuition fee and cost. What happens with the equilibrium of the system if cost of quality incurred by public is somewhat higher or lower than $\bar{C}(Q_b)$, can be understood by analyzing the boundary condition {22}. Here, we observe that for a $C(Q_b)$ higher than $\bar{C}(Q_b)$ we have to increase the $a_b$ considering that the other monopoly will maintain fixed its decision variables. In such a case we obtain the social welfare produced by public will become higher than that one produced by private monopoly. Mathematically expressed: $C(Q_b) > \bar{C}(Q_b) \Rightarrow a_{b1} > a_b \Rightarrow SW_b > SW_v$. With the same procedure we obtain: $C(Q_b) < \bar{C}(Q_b) \Rightarrow a_{b1} < a_b \Rightarrow SW_b < SW_v$.

Solving the system {19} in terms of $C(Q_v)$ we get the following boundary condition:

$$\bar{C}(Q_v) = a_v - a_b + 2C(Q_b) + \frac{2C(Q_b)}{Q_b} - \frac{2f_v}{Q_v} - Q_v \qquad \{23\}$$

In order to satisfy the system {19}, the social welfare in public monopoly to be higher or equal to the private one, the cost of quality provided by the private is equal to an expression that is increasing in ability distance and public cost of qualities but decreasing in tuition fee/quality unit.

Analyzing the boundary conditions we get the following chain results:

$C(Q_v) > \bar{C}(Q_v) \Longrightarrow a_{v1} > a_v \vee f_{v1} < f_v \Longrightarrow SW_b < SW_v$;

$C(Q_v) < \bar{C}(Q_v) \Longrightarrow a_{v1} < a_v \vee f_{v1} > f_v \Longrightarrow SW_b > SW_v$.

For values higher than $\bar{C}(Q_v)$, social welfare produced by public monopoly becomes lower than that one produced by private, and the contrary happens for values lower than $\bar{C}(Q_v)$.

Finally solving the system {19} in terms of $f_v$ we obtain the following boundary condition:

$$\bar{f_v} = \frac{-Q_v(-2C(Q_v)(1+Q_b)+ Q_b(a_b-a_v+C(Q_v)+ Q_v)}{2Q_v} \qquad \{24\}$$

In order to satisfy the system {19}, the social welfare in public monopoly to be higher or equal to the private one, tuition fee asked by the last one is equal to an expression that is increasing in ability distance but decreasing in its proper quality and cost of quality. For movements around the fixed value $\bar{f_v}$ we can conclude the following: $f_v > \bar{f_v} \Longrightarrow a_{v1} > a_v \Longrightarrow SW_b < SW_v$; $f_v < \bar{f_v} \Longrightarrow a_{v1} < a_v \vee Q_{v1} > Q_v \Longrightarrow SW_b > SW_v$.

As we observed in the analysis done in this section, the boundary conditions represent fixed points where equality between two isolated systems is achieved in terms of social performance.

Analyzing these points, we observe that for example, abilities of both systems are positively related but qualities and cost of qualities including tuition fee are negatively across opposite systems. Furthermore, for the boundaries of the cost of qualities, we conclude that these are positively related to ability within the same system but in cost and quality with the opposite system and negatively related to the ability of the opposite system.

Moving around these boundary condition points, it produces changes in the social performance of two systems transforming the equality into the inequality, which does not follow a strictly general rule to be stressed.

## 5. Results and Discussion

As a result of this study, we conclude that with perfect capital markets the quality provided by private or public university under monopoly conditions is the same, public fees are lower than private fees and the public is less selective than the private one, which correspond with the results of Romero (2005).

As a summary of all the results – and as a novelty of this article, we show that social welfare produced by public is higher than or equal to that produced by private. In order to make equal social welfare produced by public and that one produced by private, abilities of

both systems are positively related to each other but with qualities and cost of qualities including tuition fee are negatively in between opposite systems. Furthermore, for the boundaries of the cost of qualities, we conclude that these are positively related to ability within the same system but in cost and quality between the opposite systems, however, they are negatively related to the ability of the opposite system.

Moving around the boundary condition points produces changes in social performance of two systems transforming the equality into inequality, which does not follow a strictly general rule to be stressed. The most reliable argument to support this model is the fact that it is easily understandable, mathematically simple providing straightforward results, which may give a clear vision for undertaking specific regulatory policy related to higher education in micro scale. However, the drawbacks are present and they are inevitable as usually happens in economics. The point is that our assumptions do not always hold and this may appear to be a problem. Also, the continuity in our variables, and the pure or extreme division among profit *maximizer* and social welfare *maximizer* do not always hold. Hence, we are aware of the university institutions which can have mixed objectives or any objective that can be in any point between the two extremes. Therefore, it remains a lot of work to be done, not only theoretical but also empirical in order to improve this model and our understanding of the university sector.

# CHAPTER 3

## A COMPARISON OF THE COURNOT AND STACKELBERG COMPETITION IN A MIXED DUOPOLY OF THE HIGHER EDUCATION MARKET

## 1. Introduction

Mixed duopoly is a market state in which public and private firms coexist. Alongside the recent development in the world economy, the globalization and the privatization policies adopted by many governments, the studies of mixed duopolies have attracted a lot of attention.

According to Varian (1992), duopoly or the so called oligopoly is the study of market interaction with a small number of firms. Thus, by deduction we can say that the mixed duopoly is the study of market interaction between a small number of firms which can be either public or private.

We may indicate that mixed markets are common in many industries such as: television broadcasting (*e.g.* Italy, Spain, Germany, Albania, etc.), banking (*e.g.* France, Spain, Portugal), airlines (*e.g.* India), postal service (*e.g.* Spain, Norway), and also in the higher education industry, where this situation is probably more widespread (*e.g.* Spain, Portugal, France, Germany, Italy, etc.). So that nowadays, we find mixed duopolies in almost all industries across the countries.

We can explain the above situation with the fact that the privatization process of public firms in many countries has given rise to analyses that are focused more on its economic justification rather than on its ideological or political considerations, as Gil (2008) described.

In mixed markets of some countries, price controls and quality standards for products are imposed. Doing so, regulators protect consumers of products and services that are considered of higher importance such as health, education, security, etc. We adopt this condition in our model assuming that tuition fee and quality are exogenous and universities compete only in student's ability, in order to capture the biggest market segment.

There are various studies about mixed duopolies, either with or without product differentiation.

Matsumura and Matsushima (2003) investigated the sequential choice of location in a mixed duopoly, where a welfare-maximizing public firm competes against a profit-maximizing private firm. It is interesting that they introduced the price regulation effect.

Gil (2008) analyzed the horizontal product differentiation in a mixed duopoly and how Stackelberg leadership affects equilibrium and social welfare. However, studies of mixed duopolies with special focus on higher education are very scarce.

Romero and Del Rey (2004) analyzed the competition between public and private universities through a sequential decision for optimal quality, prices and exams. They compared the mixed duopoly results with the public monopoly benchmark, continuing with the comparative statics about social welfare.

Furthermore, Epple and Romano (1998) took further steps developing a theoretical and computational model with tax financed, tuition fee public schools and competitive tuition financed private schools. In their model, students differ by ability and income. The most notable result of their paper is that tuition vouchers increase the relative size of private sector, the extent of student sorting, and benefit high ability students relative to low ability students.

Considering that the studies in this relevant field are limited and there are no theoretical studies that compare two possible situations, like the Cournot competition with Stackelberg, we have the chance to contribute to the existing literature with the present article. Our focus will be on the higher education industry, in a mixed-market situation where a public and a private university charge the same tuition fee and provide the same level of quality[1]. The universities will compete in student's ability, a variable which is estimated through exams and represents the "quantity" in terms of classical Cournot model. Institutions of higher education will accept those students who will obtain a grade equal or higher than the minimum required by each institution. Thus, the market coverage will depend on the decision about the minimum ability level assigned by each institution. The minimum grade is fixed in order to maximize the given preferences represented by the utility function of each university.

The rest of the article is organized as follows: Section 2 outlines the preferences of individuals and monopolies represented by universities. Section 3 describes the general design of games. In Section 4, we show the Cournot scenario, solving the game and demonstrating the equilibrium. In Section 5, we solve the Stackelberg scenario and we demonstrate the equilibrium. In Section 6, we compare the two scenarios and we interpret the results in terms of social welfare. Section 7 contains results and discussion.

[1] We can assume that these variables move in a range which is not relevant in terms of demand function although this is not quite realistic. In case of tuition fees, the government schema of scholarships may wipe out the effect of value differences across institutions. In addition, the tuition fee/quality ratio is assumed to be fairly constant.

## 2. The Model

### *2.1. Individuals*

In this model, we have few economic agents included in the decision making process. We assume that government stands outside, observing which type of competition is better for social welfare. Hence, it does not interact, as it is supposed that the role it plays is to establish policies and the legal framework that better regulates the market. There are two main players in the market: individuals, and institutions of higher education, which can be either public or private. Like in the model of Romero (2005), the economy consists of a continuum of individuals of measure one.

Individuals obtain utility, according to the following linear function:

$$u_i^j = w_i - f_j + h_i \qquad \text{where } j = \{b, v\} \qquad \{25\}$$

where $i$-denoted variables are individual characteristics and $j$-denoted variables are institutional characteristics. The $u_i^j$ represents the utility of individual-$i$ attending the higher institution- $j$. The $w_i$ is the individual initial endowment – the sum of money she/he possesses in the very beginning. The $f_j$ is the tuition fee charged by universities. Finally, $h_i$ is the accumulated human capital by the individual –$i$.

Human capital is defined by the following function:

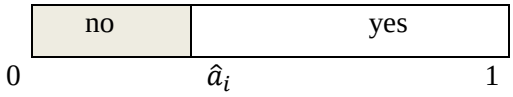
$$h_i = a_i Q_j \qquad \{26\}$$

concurrently it depends on two variables: the student individual ability and the quality offered by the institution she/he attends.

Each variable in the model is continuous and uniformly distributed over the closed interval [0;1].

We assume the ability of the individual being randomly distributed over a segment starting at 0 and ending at 1.

**Figure 3.1** Indifference level




Let $\hat{a}_i$ be the ability of the student who is indifferent between attending university *j* and remaining uneducated, *i.e.*, $u_j^i = u_0^i$:

$$u_j^i = u_0^i \Longrightarrow w_i - f_j + h_i = w_i \Rightarrow h_i = f_j \Rightarrow a_i Q_j = f_j$$

$$\hat{a}_i = \frac{f_j}{Q_j} \qquad \{27\}$$

Those students of ability $a_i \geq \hat{a}_i$ are willing to attend university-*j*, while students of ability $a_i \leq \hat{a}_i$ prefer to remain uneducated.

### *2.2. The Mixed Duopoly*

There are only two institutional players in the market, the public university and the private university that compete with each other in order to fulfill in the best way their own preferences. Their utility functions represent their preferences, in case of public, maximization of consumer surplus is aimed, and in case of private, maximization of profits is aimed. Mathematically, their preferences are represented as follows:

$$\text{Public:} \quad U_b = \int_0^1 \int_{a_b}^1 (a_i Q_b - C(Q_b))\, da\, dw \qquad \{28\}$$

$$\text{Private:} \quad U_v = \int_0^1 \int_{a_v}^1 (f_v - C(Q_v))\, da\, dw \qquad \{29\}$$

These functions describe well the proper aim of each institution, in case of public, it is a continuous sum (double integral) of human capital created, minus the cost incurred to provide a certain level of quality. And in case of private, it is a continuous sum (double integral) of tuition fees minus the cost incurred to provide a certain level of quality. Bearing in mind that preferences also depend on ability level as the sum is generated by the continuum of the individuals admitted by each institution.

There is free access to the capital markets and no borrowing constrains are encountered. The latter state is represented with the zero lower bound in the integrals of the above functions.

In this way, we have a mixed duopoly – a situation of two entities with different preferences and both compete for satisfying their utilities in the best feasible manner.

Universities-*j* have the same cost function, given by an exponential relationship with qualities:

$$C(Q_j) = Q_j^k, k > 1 \qquad \{30\}$$

The cost function is increasing and convex in quality: $\frac{\partial C(Q_j)}{\partial Q_j} > 0$ and $\frac{\partial^2 C(Q_j)}{\partial^2 Q_j} > 0$.

The properties of the cost function are explained with the fact that the supply of teaching quality (highly professional academics) is not elastic enough, thus we need to increase wages drastically in order to attract them. Taking into consideration that regulators set it at certain level in the interval [0;1], the cost would be also fixed at a point inside the interval [0;1].

## 3. Design of the Games

We want to analyze the mixed duopoly *equilibria* $(a_b^e, a_v^e)$ across the following scenarios:

1. One-shot simultaneous game or Cournot with perfect information;
2. Sequential game or Stackelberg leadership model, where one of the institutions has the advantage to move first and it is followed by the other. It is also designed with perfect information.

The strategic variable will be students' ability. Thus, institutions will compete only in ability level. Other variables, such as quality and tuition fee are considered exogenous or fixed by government regulation.

In the Cournot game, players choose their actions not knowing other firms' actions (Osborne, 2004). Similarly, we have the same good (service) produced and we have two players, who in our case instead of firms they are universities. There is a difference in the

preferences of the duopoly entities, they are not homogeneous as in the classical model but it exist some sort of heterogeneity as showed in the section above and it is related to the fact that private universities are profit oriented and the public ones are human capital oriented. We believe that this difference from the classical model will not affect the validity of our results. Instead of being down-sloping in prices, the demand function is uniformly distributed like the strategic variable – ability. The latter assertion is also supported by the fact that tuition fees (prices) and qualities are exogenous. These assumptions will make our solving procedure more straightforward. Thus, directly we may compute the best response functions, and then resolve the system composed by them.

Alternatively, in the sequential move game known as Stackelberg's duopoly game, we have a slightly different situation. We still have two players or universities, and now the public (private) knows about the action of the private (public) arranging its decision according to the signal given by its "leader". Preferences are the same as in Cournot, with a small heterogeneity between players as aforementioned and the demand function is uniformly distributed.

According to the literature, Stackelberg is an extensive game with finite horizon, so we may use backward induction to obtain the sub-game perfect equilibrium.

Having the equilibriums of the both games, we can figure out what happens with *equilibria* either within or across scenarios. In addition, we can see which scenario generates better results for social welfare, other thing being equal.

## 4. The Cournot Scenario

In the simultaneous movement game, we have to find the Nash equilibrium or a vector $(a_b^E;\ a_v^E)$, such as the following system holds: $\{\frac{\partial U_b}{\partial a_b} = 0; \frac{\partial U_v}{\partial a_v} = 0\}$. Similarly to the classical model, first, we derive the respective best response functions, denoted $BRF_b$ and $BRF_v$ as follows: $BRF_b = -a_b Q_b + C(Q_b) = 0$ and $BRF_v = -f_v + C(Q_v) = 0$. Solving the system composed by the best response functions, we get the *equilibria* ability level for public, which is going to be: $a_b^E = \frac{C(Q_b)+f_v-C(Q_v)}{Q_b}$ (see appendix 12).

Considering that we do not obtain the $a_v^E$ from the system solution, we should employ a different approach to find the private ability level which maximizes its preference.

Maximizing rationally its preference, the private would choose the level of ability, which is more on the left side (lower) rather than on the right side (higher) in accordance with the following inequality:

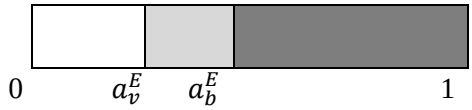
$$\lim_{a_v \to 0} \int_0^1 \int_{a_v}^1 (f_v - C(Q_v))\ da\ dw \gg \lim_{a_v \to 1} \int_0^1 \int_{a_v}^1 (f_v - C(Q_v))\ da\ dw \qquad \{31\}$$

Its validity holds considering that the double integral in its expanded form appears as: $U_v = \big(f_v - C(Q_v)\big)(1 - a_v)$, (see appendix 1). And in order $U_v$ to be maximized, $a_v$ should take the lowest possible value, taking into account that the term $(f_v - C(Q_v))$ should be considered as constant. As we recognize, the lowest possible operational value is the indifference level:

$$a_v^E = \frac{f_v}{Q_v} = \frac{f}{Q} \qquad \{32\}$$

which means that the private will not run exams accepting all applications. Graphically, the market coverage for public and private universities can be represented as below:

**Figure 3.2** Cournot equilibrium




***Proposition 1:*** *In the simultaneous move case, the public university is more selective in student ability than the private.*

We ensure the validity of the proposition, considering that the term: $f_v - C(Q_v) \geq 0$, otherwise the private would not operate in the market. In addition, as $a_b^E$ is different from the indifference level, it should be on its right side, if not the public would not operate either. Thus, $a_b^E > a_v^E$, as depicted above.

## 5. The Stackelberg Scenario

Stackelberg duopoly game is a type of extensive game. Here, one of the firms, in our case universities, moves first. We assume that the private university takes the leadership of the ability level, consequently, it decides first about its selection level. Then the public one observes the leader's decision and takes the best possible action incorporating the information from the private.

Referring to Osborne (2004), in order to solve a game with finite horizon, we use the method of backward induction. First of all, we solve the maximization problem for public and later for private (leader) incorporating the best response function of public.

Public university will choose an optimal level of $a_b^*$, which maximizes its preferences: $\frac{\partial U_b}{\partial a_b} = 0$. Performing the necessary calculations, we find out that: $a_b^* = \frac{C(Q_b)}{Q_b}$ (see appendix 2). Subsequently, the private will have to choose its optimal $a_v^*$. The value will fall in the restricted segment $(a_v; \frac{C(Q_b)}{Q_b})$ instead of the full segment $(a_v; 1)$. Consequently, the private will have to maximize the following preference function:

$$U_v = \int_0^1 \int_{a_v}^{\frac{C(Q_b)}{Q_b}} (f_v - C(Q_v))\ da\ dw \qquad \{33\}$$

The final result of the first order condition is the following: $\frac{\partial U_b}{\partial a_v} = -\left(f_v - C(Q_v)\right) = 0$ (see appendix 13).

From the latter expression, we cannot get an $a_v^*$ value. For this reason, in order to maximize the market coverage, private will choose an ability equal to indifference level:

$$a_v^* = a_v^E = \frac{f_v}{Q_v} = \frac{f}{Q} \qquad \{34\}$$

Similarly to Cournot case, private will not run exams, it will simply accept all applications.

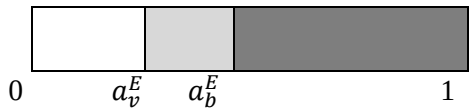
As the best response functions are scalars for both entities, the sub-game perfect equilibrium is the intersection of a horizontal line with a vertical line, that means that both vectors are equal: $(a_b^*; a_v^*) = (a_b^E; a_v^E) = (\frac{C(Q_b)}{Q_b}; \frac{f}{Q})$.

In the inverse case, where public is leader and private follower, we get the same equilibrium vector. This means that Stackelberg *equilibria* are fully symmetric (see appendix 14).

The equilibrium level of ability is more on the right side for public university being more selective, on the other hand the private accepts all application covering the left part of the market.

Graphically, we will have a distribution as follows:

**Figure 3.3** Stackelberg equilibrium




***Proposition 2:*** *In the sequential movement case, the public university is more selective in student ability than the private.*

These results are the opposite of that obtained by the comparison of two distinctive monopolies by Romero (2005).

## 6. Comparative Statics and Social Welfare

In this study, we are particularly interested to find out which policy or regulated form of competition generates more benefits to the social welfare of a community, where the institutions of higher education operate. In order to observe the contribution of each competition framework in social welfare, we have to analyze the following table constructed from the results we obtained and the calculation of *equilibria* within and across scenarios.

**Table 3.1** Equilibrium differences

| ***Equilibria*** | $a_b^E$ | $a_v^E$ |
|---|---|---|
| **Cournot Scenario** | $\frac{C(Q_b) + f_v - C(Q_v)}{Q_b}$ | $\frac{f_v}{Q_v}$ |
| **Stackelberg Scenario** | $\frac{C(Q_b)}{Q_b}$ | $\frac{f_v}{Q_v}$ |
| **Change** | ↘ | $\phi$ |

*Source:* Own Compilation.

As we can observe, moving from the Cournot scenario to the Stackelberg one, equilibrium level of ability decreases in case of public but it does not change in case of private.

***Proposition 3:*** *In the Cournot competition, the public university is more selective than in Stackelberg competition, on the other hand, the private is equally selective across scenarios.*

At this stage, we would like to see what happens with the social welfare. In order to make the analysis easier, let's define social welfare with the following function:

$$SW_D = Q - \int_{a^E}^{1} f\,da + \int_{a^E}^{1} h_i\,da = Q - F + Q \int_{a^E}^{1} a_i = Q\left(1 + \int_{a^E}^{1} da\right) - F \qquad \{35\}$$

It is given that qualities and tuition fees are exogenous, and ability level is continuous and uniformly distributed over the interval [0;1]. Thus, all variables except of student's ability in the above function are scalars. The vector – ability $a^E$ takes the lowest possible value equal to indifference level: $\frac{f}{Q}$, as market is fully covered. Therefore, social welfare produced by duopoly under both scenarios is the same.

***Proposition 4:*** *Total social welfare produced under both scenarios is the same.*

This result is a very interesting hint for regulators, ensuring them that policies about competition inside these frameworks, do not improve or deteriorate social welfare.

## 7. Results and Discussion

We have shown a theoretical duopoly model, where a private university competes with a public university in order to assure the biggest market coverage. We were interested in checking what happens with the *equilibria* within the game and across the games, moving from the Cournot competition scenario to the Stackelberg one.

First of all, within the game we saw that public is more selective than private. This is interpreted with the fact of heterogeneity in preferences, where public is more concerned about human capital creation rather than profit maximization. Hence, better applicants are admitted in order to produce more human capital.

On the other hand, across scenarios, market is completely and equally covered. Furthermore, social welfare produced is also equal. We observed some variations in the first coordinate of the *equilibria* vector. More precisely, public university in Cournot competition is more selective than in Stackelberg competition. This could be due to the uncertainty in Cournot, and in order to avoid remaining out of the market, public chooses to safely move more to the right becoming more selective.

We believe that with this model we give some useful hints to regulators for policies that will be undertaken on the subject of higher education market and its regulation. On the other hand, we are also aware of the shortcomings of the article. The simplification of variables to the unity magnitude and the continuity property do not always hold. Also, the pure division of preferences in extreme heterogeneity is not very realistic. However, we believe this is a first step to an extended model that also can be testable and adjustable with empirical data.

# CHAPTER 4

**SUMMARY AND CONCLUSIONS**

## 1. Main Findings

We believe that with the present enquiry, we have contributed to the literature of Economics of Education by bringing multifold insights into the micro and the macro scale. The study does a brief literature review about the topic of provision and regulation pointing out the main elements that stand in front of the regulator at the moment of framing the policies about higher education. In general, the study recognizes the following aspects:

(1) The importance of higher education in the creation of the stock of human and social capital.

(2) The existence of private and social returns to education as estimated by Mincer (1958) and later by Psacharoupolos (2009).

(3) The existence of informational problems from both, supply and demand side at the moment of taking decisions about investment in human capital. These problems are present in: regulated and deregulated systems (see Chapter 1).

(4) The variety of provision and regulation systems due to the country-context: history, society, demography and economy.

(5) In spite of the wide consensus about the importance of higher education in the creation of human and social capital, this is not sufficient. There are cases that certain type of provision may endanger social cohesion and inclusion. Hence, the classical economic approach of endeavoring to reach the production-possibility frontier should be employed.

In Chapter 1, we study the economic regulation and provision of higher education and we approach the problem theoretically and empirically reaching the following conclusions:

In our theoretical review, we underlined the opinions given by distinguished economists such as Smith, Mill, Marshall and Friedman who are known for their high influence on the economic thought.

Smith pointed out competition, efficiency, and effectiveness as main determinants of a good regulation in the education sector. In the other side, Marshall saw education as a collective good similar to roads, gaslight, etc., so according to him, it must not be in private ownership. In addition, he indicated that an educated individual has more real wealth in the broadest sense than someone who is not.

According to Mill, education should promote the variety of talents and tastes and this variety should be considered as an advantage rather than a disadvantage. Friedman went further, offering solutions that would promote competition and equal treatment of higher education institutions. He indicated the voucher system as a tool, which permits to finance the individuals and not the institutions basing on the ownership criteria. Furthermore, Friedman drew a sharp line between vocational and general training pointing out that the grounds of provision and regulation should not be the same for both.

After a real-world case review, we concluded with a classification of the following regulation models: Emerging (*e.g.* Eastern-Europe), In-deregulation (*e.g.* US), Deregulated (*e.g.* Japan), Regulated with private orientation (*e.g.* UK) and Highly-regulated (*e.g.* Western-Europe). Our classification takes into account the main variables which contribute in clearing higher education markets and the strategies employed by the regulator to pursue certain objectives (see Baldwin and Cave, 1999). Market harnessing strategies are frequently used in the following models: Deregulated, In-deregulation and Regulated systems with private orientation. On the contrary, Highly-regulated models are achieved through command and control strategies. In the other side, Emerging models try to accommodate their selves along the transition route. They attempt to stick strategies which better fit to their circumstances and avoid common failures such as: capture, legalism and high enforcement costs.

Regarding the empirical analysis, we find that at the level of significance $\alpha = 0{,}05$ the entry rate is affected negatively by the private market coverage and positively by the private spending. No-significant effect of the structural variables over graduation rate and student-professor rate was observed. The findings suggest that the optimal economic regulation should spot provision solutions with both: high public participation and high private spending (*e.g.* UK, US, etc.). This cannot be easy due to the fact that in most of the cases, the normal correlation between public participation and private spending is negative. We believe that in countries like US, UK, Australia, etc., the high level of private spending is mainly generated by the strong links university-business, and through the easy conversion of academic results into economic outcomes (*e.g.* patents, contracts, spin-offs, etc.) as Conti and Gaule (2011) indicated.

Related to the Chapter 2: Public versus Private Monopoly in the Higher Education Market; we reach the following conclusions:

Firstly, we find that with perfect capital markets the quality provided by the private and the public universities under monopoly conditions is the same, public fees are lower than private fees and the public is less selective than the private one, which correspond with the results of Romero (2005).

Secondly, as a novelty of the chapter, we show that social welfare produced by public is higher than or equal to that produced by private.

Thirdly, in order to make equal social welfare produced by public and that one produced by private, abilities of both systems are positively related to each other but with qualities and cost of qualities including tuition fee are negatively in between opposite systems. Furthermore, for the boundaries of the cost of qualities, we conclude that these are positively related to ability within the same system, but in cost and quality between opposite systems, however they are negatively related to ability of opposite system.

Fourthly, moving around the boundary condition points produces changes in social performance of the two systems transforming the equality into the inequality, which does not follow a strictly general rule to be stressed.

And finally, related to the Chapter 3: A Comparison of the Cournot and Stackelberg Competition in a Mixed Duopoly of the Higher Education Market; we show a theoretical duopoly model where a private university competes with a public university in order to assure the biggest market coverage. We were interested in checking what happens with the *equilibria* within the game and across games, moving from a Cournot competition scenario to a Stackelberg one.

First of all, within the game we see that public is more selective than private, which is the opposite of that obtained by Romero (2005). This is due to the design of the games and the fact of heterogeneity in the preferences, where public is more concerned about human capital creation rather than profit maximization. Hence, better applicants are admitted in order to produce more human capital.

On the other hand, across scenarios, the market is completely and equally covered. Furthermore, the social welfare produced is also equal. We have discovered some variations in the first coordinate of the *equilibria* vector. More precisely, public university in Cournot competition is more selective than in Stackelberg competition. This could be caused by the uncertainty in Cournot, and in order to avoid remaining out of the market, public chooses to safely move more to the right becoming more selective.

## 2. Limitations and Possible Improvements

In this dissertation, in spite of offering useful insights about the micro and the macro provision and regulation in the higher education sector, we recognize various limitations which should be taken into account for any possible future extension.

Referring to the Chapter 1, we are aware of the limited number of economics schools included in the section that deals with the views of the influential economists. Moreover, the descriptive analysis of the variety of system does not take into account other relevant higher education systems (*e.g.* South America, Africa, Russia, Balkans, etc.). Furthermore, the empirical analysis is limited on the number of explanatory variables and the number of observations. And finally, the performance variables do not throw much light on social cohesion and inclusion as important factors in the estimation of social welfare.

In the other side, the micro analysis: Chapter 2 and Chapter 3, has some limitations related to the assumptions.

The cost symmetry, the assumed simplicity in human capital creation, continuity and distribution of variables within the closed interval [0;1] have to be reconsidered for future extensions.

However in general, the development of complementary scenarios in micro scale creates wider fundaments for major improvements in both directions: macro and micro. These improvements may involve the following issues:

1) Macro modeling, which would avoid problems related to the existence of the markets: heterogeneity, fragmentation, etc., as pointed out by Becker (2009).
2) A deeper implementation of the concept of human and social capital creation (*e.g.* peer-group effect, bridging capital, bonding capital, etc.) that would fit more with the recent internationalization and globalization developments.
3) In modeling preferences of other types of higher education institutions (*e.g.* not-for-profit, non-profit, etc.) would explain more about the US system of provision and regulation.
4) Further research on the distribution of the main variables (*e.g.* costs, qualities, tuition fees, abilities, etc.), which define the preferences and equilibrium in higher education markets and adoption of outcomes in micro and macro modeling.

In the other side, related to Chapter 1, we should try to decompose the performance variables *(e.g.* entry rate, graduation rate and student-professor) according to different socio-economic gradients in order to check for possible significant effects. This would indicate which structural variables affect more social cohesion and inclusion.

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# APPENDICES

## Appendix 1: Dataset of Structure and Performance Variables across some countries

| | *Structure Variables* | | | | | *Performance Variables* | | |
|---|---|---|---|---|---|---|---|---|
| *Country* | **Pu_Spe/ GDP[1]** | **Pr_Spe/ GDP[1]** | **TotSpe/ GDP[7]** | **Pr_Spe/ Tot_S[8]** | **Pr_Enr/ Tot_En[2]** | **Entry Rate[3]** | **Gradu Rate[4]** | **Stud/Prof Rate[5]** |
| **Australia** | 0,7 | 0,8 | **1,5** | **0,5** | 5,0 | 94 | 48,5 | m |
| **Austria** | 1,2 | 0,1 | **1,3** | **0,1** | 15,9 | 54 | 29,3 | 15,6 |
| **Belgium** | 1,3 | 0,1 | **1,4** | **0,1** | 56,5 | 31 | m | 19,5 |
| **Canada** | 1,5 | 1,0 | **1,5** | **0,7** | 0,0 | m | 36,6 | m |
| **Chile** | m | m | **2,2** | **m** | 92,8[6] | 47 | m | m |
| **Czech Republic** | 0,9 | 0,2 | **1,2** | **0,2** | 13,5 | 59 | 38,4 | 19,6 |
| **Denmark** | 1,6 | 0,1 | **1,7** | **0,0** | 1,8 | 55 | 47,3 | m |
| **Estonia** | 1,1 | 0,2 | **1,3** | **0,1** | 53,2[6] | 42 | m | m |
| **Finland** | 1,6 | 0,1 | **1,7** | **0,0** | 10,7 | 69 | 44 | 14,9 |
| **Germany** | 1,0 | 0,2 | **1,2** | **0,1** | 9,8 | 40 | 28,5 | 11,9 |
| **Hungary** | 0,9 | m | **m** | **m** | 15,8 | 53 | 30,1 | 16,3 |
| **Iceland** | 1,2 | 0,1 | **1,3** | **0,1** | 21,1 | 77 | 51 | 10,2 |
| **Ireland** | 1,2 | 0,2 | **1,4** | **0,2** | 4,7 | 51 | 47,1 | 14,3 |
| **Israel** | 0,9 | 0,7 | **1,6** | **0,4** | 13,1[6] | 60 | 37,4 | m |
| **Italy** | 0,8 | 0,2 | **1,0** | **0,2** | 7,0 | 50 | 32,6 | 18,3 |
| **Japan** | 0,5 | 1,0 | **1,5** | **0,7** | 79,2 | 49 | 40,4 | 10,1 |
| **Korea** | 0,6 | 1,9 | **2,6** | **0,8** | 80,2 | 71 | m | m |
| **Mexico** | 0,9 | 0,4 | **1,2** | **0,3** | 33,3 | 35 | 19,4 | 14,6 |
| **Netherlands** | 1,1 | 0,4 | **1,5** | **0,3** | 0,0 | 63 | 41,8 | 14,4 |
| **New Zealand** | 1,1 | 0,5 | **1,6** | **0,3** | 12,1 | 78 | 49,6 | 17,2 |
| **Norway** | 1,6 | 0,1 | **1,7** | **0,0** | 14,0 | 77 | 40,7 | 9,2 |
| **Poland** | 1,0 | 0,4 | **1,5** | **0,3** | 33,2 | 85 | 50,2 | 16,1 |
| **Portugal** | 0,9 | 0,5 | **1,3** | **0,4** | 24,6 | 84 | 40 | 14,1 |
| **Slovak Republic** | 0,7 | 0,2 | **0,9** | **0,2** | 11,0 | 69 | 61,4 | 15,6 |
| **Slovenia** | 1,0 | 0,2 | **1,2** | **0,2** | 27,6[6] | 61 | 26,8 | 20,4 |
| **Spain** | 1,0 | 0,2 | **1,2** | **0,2** | 14,1 | 46 | 27,4 | 10,9 |
| **Sweden** | 1,4 | 0,2 | **1,6** | **0,1** | 8,6 | 68 | 36,2 | 8,8 |
| **Switzerland** | 1,3 | m | **m** | **m** | 17,4 | 41 | 30,5 | m |
| **Turkey** | m | m | **m** | **m** | 6,0 | 40 | 20,9 | 17,8 |
| **United Kingdom** | 0,6 | 0,6 | **1,2** | **0,5** | 0,0 | 61 | 47,8 | 16,5 |
| **United States** | 1,0 | 1,7 | **2,7** | **0,6** | 26,1 | 70 | 37,8 | 15,3 |
| **Argentina** | 0,9 | 0,2 | **1,2** | **0,2** | 53,5[6] | 47 | m | 15,7 |
| **China** | m | m | **m** | **m** | 28,3[6] | 17 | m | m |
| **Indonesia** | 0,3 | m | **m** | **m** | 95,5[6] | 22 | m | 22,7 |
| **Russian Federation** | 0,9 | 0,5 | **1,5** | **0,4** | 38,2[6] | 72 | m | 12,7 |

*Sources:* Own Compilation based on OECD (2011) and PROPHE (2010).

*Notes:*
[1]Public and Private Expenditure over GDP: Expenditure on educational institutions as a percentage of GDP, by source of fund and level of education (2008), Table B2.3: (http://dx.doi.org/10.1787/888932463802)
[2]StatExtracts Dataset: Students enrolled by type of institution (http://stats.oecd.org/#). Values are obtained by calculating the private enrollments over the total enrollments for the year 2008.
[3]Entry rates into tertiary education and age distribution of new entrants (2009), Table C2.1: Total of Tertiary Type-A (http://dx.doi.org/10.1787/888932464429)
[4]Graduation rates at tertiary level (2009), Table A3.1: Total of Tertiary Type-A (http://dx.doi.org/10.1787/888932462434)
[5]Ratio of students to teaching staff in educational institutions (2009), Table D2.2: All Tertiary Education (http://dx.doi.org/10.1787/888932465189)
[6]Prophe (2010): Country Data Summary: (http://www.albany.edu/dept/eaps/prophe/data/international.html)
[7]Obtained by summing up the values of the fist and the second column.
[8]Obtained by dividing the values of the second and the third column.
m – stands for missing value.
All values are in percentage.

## Appendix 2: Descriptive Statistics for Performance Variables based on high/low level of Structural Variables

| | | **Performance Variables** | | |
|---|---|---|---|---|
| | | **Entry Rate** | **Graduation Rate** | **Student-Professor Rate** |
| **Structure Variables** | **Private Enrollments /Total Enrollments** | $\mu_1$= 61,8; $\mu_2$= 48,3<br>$s_1$=14,7; $s_2$=20,8<br>$n_1$=22; $n_2$=12 | $\mu_1$= 39,8; $\mu_2$= 36,2<br>$s_1$=9,9; $s_2$=10,5<br>$n_1$=18; $n_2$=9 | $\mu_1$= 14,5; $\mu_2$= 16,1<br>$s_1$=3,3; $s_2$=3,8<br>$n_1$=16; $n_2$=10 |
| | **Private Spending/GDP** | $\mu_1$= 56,2; $\mu_2$= 71,0<br>$s_1$=15,0; $s_2$=13,5<br>$n_1$=19; $n_2$=9 | $\mu_1$= 38,9; $\mu_2$= 42,3<br>$s_1$=11,1; $s_2$=5,4<br>$n_1$=16; $n_2$=8 | $\mu_1$= 14,7; $\mu_2$= 14,3<br>$s_1$=3,6; $s_2$=2,6<br>$n_1$=17; $n_2$=6 |
| | **Public Spending/GDP** | $\mu_1$= 59,4; $\mu_2$= 58,8<br>$s_1$=18,1; $s_2$=15,7<br>$n_1$=19; $n_2$=12 | $\mu_1$=38,7; $\mu_2$=40,3<br>$s_1$=10,7; $s_2$=7,7<br>$n_1$=17; $n_2$=9 | $\mu_1$= 15,7; $\mu_2$= 13,8<br>$s_1$=3,4; $s_2$=3,7<br>$n_1$=16; $n_2$=9 |
| | **Total Spending/GDP** | $\mu_1$= 58,5; $\mu_2$= 66,1<br>$s_1$=17,4; $s_2$=10,2<br>$n_1$=20; $n_2$=9 | $\mu_1$= 37,5; $\mu_2$= 42,5<br>$s_1$=12,3; $s_2$=5,2<br>$n_1$=12; $n_2$=12 | $\mu_1$= 15,5; $\mu_2$= 13,2<br>$s_1$=3,2; $s_2$=3,1<br>$n_1$=14; $n_2$=9 |
| | **Private Spending/Total Spending** | $\mu_1$= 57,9; $\mu_2$= 70,1<br>$s_1$=15,3; $s_2$=14,1<br>$n_1$=20; $n_2$=9 | $\mu_1$= 39,5; $\mu_2$= 41,2<br>$s_1$=11,1; $s_2$=4,9<br>$n_1$=17; $n_2$=7 | $\mu_1$= 14,64; $\mu_2$= 14,5<br>$s_1$=4,0; $s_2$=2,2<br>$n_1$=14; $n_2$=9 |

*Source:* Own Compilation: Values calculated from the dataset in appendix 1.
*Note:* $\mu_1$, $s_1$, $n_1$, refer to the mean, the variance and the number of observations of the performance variables for which the structural variable is equal or higher than its average level. In addition, $\mu_2$, $s_2$, $n_2$, refer to the mean, the variance and the number of observations of the performance variables for which the structural variable is higher to its average level.

## Appendix 3: Normality Tests for the Performance Variables

| Entry Rate | Graduation Rate | Student-Professor Rate |
|---|---|---|
| Lilliefors test = 0.0818691, with p-value ~= 0.81<br>Jarque-Bera test = 0.344897, with p-value 0.841601<br><br>p-values > α, where α=0,01 or 0,05<br>$H_0$: accepted | Lilliefors test = 0.0978109, with p-value ~= 0.72<br>Jarque-Bera test = 0.235345, with p-value 0.888987<br><br>p-values > α, where α=0,01 or 0,05<br>$H_0$: accepted | Lilliefors test = 0.118961, with p-value ~= 0.44<br>Jarque-Bera test = 0.22736, with p-value 0.892543<br><br>p-values > α, where α=0,01 or 0,05<br>$H_0$: accepted |

*Source:* Own Compilation.
*Note:* The data for which are derived the test comprise the three last columns of the dataset in the appendix 1. Tests are estimated with the open-source software Gretl (http://gretl.sourceforge.net/index.html).

## Appendix 4: Tests for the Homogeneity of Variances

| | | Performance Variables | | |
|---|---|---|---|---|
| | | **Entry Rate** | **Graduation Rate** | **Student-Professor Rate** |
| **Structure Variables** | **Private Enrollments /Total Enrollments** | $n_1$ = 22, $Var_1$ = 216.7<br>$n_2$ = 12, $Var_2$ = 434.2<br>Test statistic:<br>F(11, 21) = 2.00369<br>Two-tailed p-value = 0.1646 | $n_1$ = 18, $Var_1$ = 97<br>$n_2$ = 9, $Var_2$ = 111.2<br>Test statistic:<br>F(8, 17) = 1.14639<br>Two-tailed p-value = 0.7673 | $n_1$ = 16, $Var_1$ = 11.2<br>$n_2$ = 10, $Var_2$ = 14.2<br>Test statistic:<br>F(9, 15) = 1.26786<br>Two-tailed p-value = 0.6576 |
| | **Private Spending/GDP** | $n_1$= 19, $Var_1$= 224.5<br>$n_2$ = 9, $Var_2$ = 181.8<br>Test statistic:<br>F(18, 8) = 1.23487<br>Two-tailed p-value = 0.7939 | $n_1$= 16, $Var_1$ = 124.2<br>$n_2$= 8, $Var_2$= 29.7<br>Test statistic:<br>F(15, 7) = 4.18182<br>Two-tailed p-value = 0.06345 | $n_1$= 17, $Var_1$= 12.8<br>$n_2$ = 6, $Var_2$ = 6.9<br>Test statistic:<br>F(16, 5) = 1.85507<br>Two-tailed p-value = 0.5119 |
| | **Public Spending/GDP** | $n_1$= 19, $Var_1$ = 327.9<br>$n_2$= 12, $Var_2$= 246.2<br>Test statistic:<br>F(18, 11) = 1.33184<br>Two-tailed p-value = 0.6387 | $n_1$= 17, $Var_1$ = 113.7<br>$n_2$= 9, $Var_2$ = 58.9<br>Test statistic:<br>F(16, 8) = 1.93039<br>Two-tailed p-value = 0.3481 | $n_1$ = 16, $Var_1$ = 11.7<br>$n_2$ = 9, $Var_2$ = 13.5<br>Test statistic:<br>F(8, 15) = 1.15385<br>Two-tailed p-value = 0.771 |
| | **Total Spending/GDP** | $n_1$= 20, $Var_1$= 301.6<br>$n_2$ = 9, $Var_2$ = 104.6<br>Test statistic:<br>F(19, 8) = 2.88337<br>Two-tailed p-value = 0.1286 | *$n_1$= 12, $Var_1$ = 152.3*<br>*$n_2$ = 12, $Var_2$ = 27.4*<br>*Test statistic:*<br>*F(11, 11) = 5.55839*<br>*Two-tailed p-value = 0.00836* | $n_1$= 14, $Var_1$ = 10.2<br>$n_2$ = 9, $Var_2$ = 9.8<br>Test statistic:<br>F(13, 8) = 1.04082<br>Two-tailed p-value = 0.9918 |
| | **Private Spending/Total Spending** | $n_1$ = 20, $Var_1$ = 235.2<br>$n_2$ = 9, $Var_2$ = 119.8<br>Test statistic:<br>F(19, 8) = 1.96327<br>Two-tailed p-value = 0.3309 | $n_1$ = 17, $Var_1$ = 123.1<br>$n_2$= 7, $Var_2$= 24.3<br>Test statistic:<br>F(16, 6) = 5.06584<br>Two-tailed p-value = 0.05442 | $n_1$= 14, $Var_1$ = 15.6<br>$n_2$ = 9, $Var_2$ = 4.7<br>Test statistic:<br>F(13, 8) = 3.31915<br>Two-tailed p-value = 0.09514 |

*Source*: Own Compilation.
*Note:* Variances are estimated by taking the square of standard deviation in appendix 1. F-test is the ratio between the highest and the lowest variance. P-values are generated by Gretl ((http://gretl.sourceforge.net/index.html).

**Appendix 5: Calculation of indifference level for agents**

We know the following:
$u_i^j = w_i - f_j + h_i$
$h_i = a_i Q_j$
$u_0^i = w_i$
$C(Q_j) = Q_j^k, k > 1, j = \{b, v\}$
$u_i^j = w_i - f_j + h_i$
$u_0^i = w_i$
Hence, the indifference point: $u_j^i = u_0^i \Longrightarrow w_i - f_j + h_i = w_i$

$$h_i = f_j$$
$$a_i Q_j = f_j$$
$$\hat{a}_i = \frac{f_j}{Q_j}$$

$a_i \geq \hat{a}_i$ are willing to attend university.
$a_i \leq \hat{a}_i$ are willing to remain uneducated.

**Appendix 6: Calculation of optimal ability level for public**

We calculate the optimal $a_b$, getting $\frac{\partial U_b}{\partial a_b} = 0$;
as we have given:

$$U_b = \int_0^1 \int_{a_b}^1 (a_i Q_b - C(Q_b))\, da\, dw$$

we expand this function in order to be easily to derivate in terms of $a_b$:

$$U_b = \int_0^1 \int_{a_b}^1 \left(a_i Q_b - C(Q_b)\right) da\, dw$$
$$= \int_0^1 \left( \int_{a_b}^1 a_i Q_b \right.$$
$$\left. - \int_{a_b}^1 C(Q_b) da \right) dw$$
$$= \int_0^1 \left(Q_b a_i^2 I_{a_b}^1 - C(Q_b) a_i I_{a_b}^1\right) dw$$
$$= \int_0^1 \left( Q_b \frac{(1 - a_b^2))}{2} - C(Q_b)(1 - a_b) \right) dw$$
$$= \left( Q_b \frac{(1 - a_b^2)}{2} - C(Q_b)(1 - a_b) \right) w I_0^1 = Q_b \frac{(1 - a_b^2}{2} - C(Q_b)(1 - a_b)$$

Then, the expanded function is: $U_b = Q_b \frac{(1-a_b^2)}{2} - C(Q_b)(1-a_b)$

$$\frac{\partial U_b}{\partial a_b} = Q_b(-a_b) + C(Q_b) = 0 \Longrightarrow -a_b Q_b + C(Q_b) = 0 \Longrightarrow a_b = \frac{C(Q_b)}{Q_b}$$

Thus, we have the optimum level of: $a_b = \frac{C(Q_b)}{Q_b}$, integrating this information with the agents indifference level, we obtain the following equilibrium:

$$a_b = \frac{C(Q_b)}{Q_b} \wedge a_b = \frac{f_b}{Q_b}$$

As the indifference condition indicates that: $C(Q_b) = a_b Q_b = f_b$.

Finally, $a_b = \frac{C(Q_b)}{Q_b} if\ f_b \leq C(Q_b)$; $\frac{f_b}{Q_b} if\ f_b > C(Q_b)$.

Therefore, we have two different $U_b$ functions:
Case 1

$$a_b = \frac{C(Q_b)}{Q_b} if\ f_b \leq C(Q_b)$$

$$U_b = Q_b \frac{(1 - \frac{C(Q_b)}{Q_b^2})}{2} - C(Q_b)\left(1 - \frac{C(Q_b)}{Q_b}\right) = \frac{Q_b}{2} - \frac{C^2(Q_b)}{2Q_b^2} - C(Q_b) + \frac{C^2(Q_b)}{Q_b}$$
$$= \frac{Q_b}{2} - C(Q_b) - \frac{C^2(Q_b) - 2C^2(Q_b)}{2Q_b^2}$$

Case 2

$$U_b = Q_b \frac{(1 - \frac{f_b^2}{Q_b^2})}{2} - C(Q_b)\left(1 - \frac{f_b}{Q_b^2}\right) = \frac{Q_b}{2} - \frac{f_b^2}{2Q_b^2} - C(Q_b) + f_b \frac{C(Q_b)}{Q_b}$$

Results that can be used for further stages in the sequential optimization problem.

**Appendix 7: Calculation of optimal fee for public**

We calculate the optimal $f_b$, getting $\frac{\partial U_b}{\partial f_b} = 0$. We use case 2 only if this $U_b$ is function of $f_b$.

$$\frac{\partial U_b}{\partial f_b} = -\frac{f_b}{Q_b} + \frac{C(Q_b)}{Q_b} = 0 \Longrightarrow -\frac{1}{Q_b}\left(-f_b + C(Q_b)\right) = 0 \Longrightarrow f_b = C(Q_b)$$

plugging in $f_b = C(Q_b)$ in case 2 we have:

$$U_b = \frac{Q_b}{2} - \frac{f_b^2}{2Q_b^2} - C(Q_b) + f_b \frac{C(Q_b)}{Q_b} = \frac{Q_b}{2} - \frac{C^2(Q_b)}{2Q_b^2} - C(Q_b) + \frac{C^2(Q_b)}{Q_b} \text{ (I)}$$

and case 1 for $f_b \leq C(Q_b)$:

$U_b = = \frac{Q_b}{2} - C(Q_b) - \frac{C^2(Q_b) - 2C^2(Q_b)}{2Q_b^2} = \frac{Q_b}{2} - \frac{C^2(Q_b)}{2Q_b^2} - C(Q_b) + \frac{C^2(Q_b)}{Q_b^2}$ (II)

As $\frac{C^2(Q_b)}{Q_b^2} \leq \frac{C^2(Q_b)}{Q_b} \Longrightarrow U_b^I \leq U_b^{II}$, the optimal decision is $f_b \leq C(Q_b)$.

## Appendix 8: Calculation of optimal quality for public

We calculate the optimal $Q_b$, using $\frac{\partial U_b}{\partial Q_b} = 0$.

As we have calculated in the expanded $U_b$: $U_b = Q_b \frac{(1-a_b^2)}{2} - C(Q_b)(1-a_b)$ we are still working on it:

$$\frac{\partial U_b}{\partial Q_b} = \frac{(1-a_b^2)}{2} - C'(Q_b)(1-a_b) = 0 \Longrightarrow \frac{(1-a_b^2)}{2} = (1-a_b)C'(Q_b)$$

$$\Longrightarrow (1-a_b)\frac{(1+a_b)}{2(1-a_b)} = C'(Q_b) \Longrightarrow C'(Q) = \frac{(1+a_b)}{2}$$

## Appendix 9: Calculation of optimal ability for private

We calculate the optimal $a_v$ through $\frac{\partial U_b}{\partial a_v} = 0$.

Private monopoly function:

$$U_v = \int_0^1 \int_{a_v}^1 (f_v - C(Q_v) da\, dw$$

We expand it in order to make easier the calculations of partial derivatives, obtaining:

$$U_v = \int_0^1 \int_{a_v}^1 (f_v - C(Q_v))\ da\, dw$$

$$= \int_0^1 [\int_{a_v}^1 f_v da$$

$$- \int_{a_v}^1 C(Q_v) da] dw = \int_0^1 \left[f_v a_i I_{a_v}^1 - C(Q_v) a_i I_{a_v}^1\right] dw$$

$$= \int_0^1 [f_v(1-a_v) - C(Q_v)(1-a_v)] dw = ([f_v - C(Q_v)(1-a_v)] w I_0^1$$

$$= (f_v - C(Q_v)(1-a_v)$$

$$U_v = \big(f_v - C(Q_v)\big)(1 - a_v)$$

the optimal $a_v$ will be at that point where $\frac{\partial U_v}{\partial a_v} = 0$, hence the first order condition is: $\frac{\partial U_v}{\partial a_v} = -f_v + C(Q_v) = 0$.

As we can see, it is not possible to get an $a_v$ optimal from the maximizing $U_v$ function, therefore we use the $a_v$ from the individual's side (remind the indifference point):

$a_v = [\frac{f_v}{Q_v}\ if\ f_v \geq C(Q_v);\ Shuts\ down\ if\ f_v \leq C(Q_v)]$.

**Appendix 10: Calculation of optimal fee for private**

We calculate optimal $f_v$, using $\frac{\partial U_v}{\partial f_v} = 0$.

$\frac{\partial U_v}{\partial f_v} = 1 - \frac{f_v}{Q_v} - \frac{1}{Q_v}\big(f_v - C(Q_v)\big) = 1 - \frac{f_v}{Q_v} - \frac{f_v}{Q_v} + \frac{C(Q_v)}{Q_v} = 1 - \frac{2f_v}{Q_v} + \frac{C(Q_v)}{Q_v} = 0.$

hence, the optimal $f_v$ is the following:

$$f_v = \frac{Q_v + C(Q_v)}{2}\ where\ 0 \leq Q_v \leq 1$$

is a maximum because:

$\frac{\partial^2 U_v}{\partial^2 f_v} = -\frac{2}{Q_v} < 0$ is strictly negative.

**Appendix 11: Calculation of optimal quality for private**

We calculate the optimal $Q_v$ , through $\frac{\partial U_v}{\partial Q_v} = 0$
from the appendix (9) we know the extended form of private monopoly function:

$$U_v = \big(f_v - C(Q_v)\big)(1 - a_v)$$

which can be rewritten as follows:

$$U_v = f_v - a_v f_v - C(Q_v) + a_v C(Q_v)$$

reminding that optimal $a_v$ is $a_v = \frac{f_v}{Q_v}$ and from here we get: $f_v = a_v Q_v$ having this result we can replace all $f_v$ terms in the private monopoly function:

$$U_v = a_v Q_v - a_v^2 Q_v - C(Q_v) + a_v C(Q_v)$$

at this stage we get the first order condition in terms of $Q_v$: $\frac{\partial U_v}{\partial Q_v} = 0$.

$\frac{\partial U_v}{\partial Q_v} = a_v - a_v^2 - C'(Q_v) + a_v C'(Q_v) = 0.$
which can be rewritten: $\frac{\partial U_v}{\partial Q_v} = a_v(1 - a_v) - C'(Q_v)(1 - a_v) = 0$

combining: $f_v = \frac{Q_v + C(Q_v)}{2}$ and $a_v = \frac{f_v}{Q_v}$ we obtain:

$$a_v = \frac{f_v}{Q_v} = \frac{\frac{Q_v + C(Q_v)}{2}}{Q_v} = \frac{Q_v + C(Q_v)}{2Q_v} = \frac{1}{2} + \frac{C(Q_v)}{2Q_v} \Longrightarrow 2a_v = 1 + \frac{C(Q_v)}{Q_v} \Longrightarrow 2a_v - \frac{C(Q_v)}{Q_v} = 1$$

plugging in this result in $\frac{\partial U_v}{\partial Q_v} = a_v(1 - a_v) - C'(Q_v)(1 - a_v) = 0$

$$\frac{\partial U_v}{\partial Q_v} = a_v \left(2a_v - \frac{C(Q_v)}{Q_v} - a_v\right) - C'(Q_v)(1 - a_v) = a_v \left(a_v - \frac{C(Q_v)}{Q_v}\right) - C'(Q_v)(1 - a_v) = 0$$

now let's isolate $C'(Q_v)$:

$$a_v \left(a_v - \frac{C(Q_v)}{Q_v}\right) - C'(Q_v)(1 - a_v) = 0 \Longrightarrow a_v \left(a_v - \frac{C(Q_v)}{Q_v}\right) = C'(Q_v)(1 - a_v)$$

$$\Longrightarrow C'(Q_v) = a_v \frac{\left(a_v - \frac{C(Q_v)}{Q_v}\right)}{1 - a_v} = \left(\frac{1}{2} + \frac{C(Q_v)}{2Q_v}\right) \frac{\left(\frac{1}{2} + \frac{C(Q_v)}{2Q_v} - \frac{C(Q_v)}{Q_v}\right)}{\left(1 - \frac{1}{2} - \frac{C(Q_v)}{2Q_v}\right)}$$

$$\Longrightarrow C'(Q_v) = \left(\frac{1}{2} + \frac{C(Q_v)}{2Q_v}\right) \frac{\left(\frac{1}{2} - \frac{C(Q_v)}{2Q_v}\right)}{\left(\frac{1}{2} + \frac{C(Q_v)}{2Q_v}\right)} = \frac{1}{2} + \frac{C(Q_v)}{2Q_v}$$

Finally:

$$C'(Q_v) = a_v = \frac{1}{2} + \frac{C(Q_v)}{2Q_v}$$

**Appendix 12: Solution of Simultaneous Game**

We should find a vector $(a_b^E;\ a_v^E)$ which solve the system of the best response functions: $\left\{\frac{\partial U_b}{\partial a_b} = 0; \frac{\partial U_v}{\partial a_v} = 0\right\}$.

First, let´s expand the public preferences expressed in an integral function into an easier derivable form:

$$U_b = \int_0^1 \int_{a_b}^1 (a_i Q_b - C(Q_b))\, da\, dw = \int_0^1 (\int_{a_b}^1 a_i Q_b da - \int_{a_b}^1 C(Q_b) da) dw =$$

$$\int_0^1 \left( Q_b \frac{a_i^2}{2} I_{a_b}^1 - C(Q_b) a_i I_{a_b}^1 \right) dw = \int_0^1 \left( Q_b \frac{(1-a_b^2))}{2} - C(Q_b)(1-a_b) \right) dw =$$

$$\left( Q_b \frac{(1-a_b^2)}{2} - C(Q_b)(1-a_b) \right) w I_0^1 = Q_b \frac{(1-a_b^2}{2} - C(Q_b)(1-a_b)\,.$$

Then, the expanded function is: $U_b = Q_b \frac{(1-a_b^2)}{2} - C(Q_b)(1-a_b)$

Therefore, we can calculate the first order condition:

$$\frac{\partial U_b}{\partial a_b} = Q_b(-a_b) + C(Q_b) = 0 \Longrightarrow -a_b Q_b + C(Q_b) = 0 \Longrightarrow a_b^* = \frac{C(Q_b)}{Q_b}$$

$$\frac{\partial^2 U_b}{\partial^2 a_b} = -Q_b$$

The second order condition is negative, so the function $U_b$ is concave. The best response function for the public is: $a_b = \frac{C(Q_b)}{Q_b}$.

Now, let´s expand the private preferences expressed in an integral function into an easier derivable form:

$$U_v = \int_0^1 \int_{a_v}^1 (f_v - C(Q_v))\ da\, dw = \int_0^1 [\int_{a_v}^1 f_v da - \int_{a_v}^1 C(Q_v) da] dw = \int_0^1 [f_v a_i I_{a_v}^1 -$$

$$C(Q_v) a_i I_{a_v}^1] dw = \int_0^1 [f_v(1-a_v) - C(Q_v)(1-a_v)] dw = ([f_v - C(Q_v)(1-a_v)] w I_0^1 =$$

$$(f_v - C(Q_v))(1-a_v)$$

Then, the expanded function is: $U_v = \big(f_v - C(Q_v)\big)(1-a_v)$

the optimal $a_v$ will be at that point where $\frac{\partial U_v}{\partial a_v} = 0$, hence the first order condition is:

$$\frac{\partial U_v}{\partial a_v} = -f_v + C(Q_v) = 0.$$

The second order condition is negative, hence the function $U_v$ is concave. The best response function for the private is: $-\big(f_v - C(Q_v)\big) = 0$.

Duopoly equilibrium is the intersection of the best response functions $BRF_j$ for $j = \{b, v\}$:

$$\begin{cases} \dfrac{\partial U_b}{\partial a_b} = -a_b Q_b + C(Q_b) = 0 \\ \dfrac{\partial U_v}{\partial a_v} = -f_v + C(Q_v) = 0 \end{cases}$$

$$-a_b Q_b + C(Q_b) = -f_v + C(Q_v) \Longrightarrow C(Q_b) + f_v - C(Q_v) = a_b Q_b$$

$$\Longrightarrow a_b^E = \frac{C(Q_b) + f_v - C(Q_v)}{Q_b}$$

**Appendix 13: Solution of Sequential Game with private leadership**

We should find a vector $(a_b^E;\ a_v^E)$ which solve the system of the best response functions $\left\{\frac{\partial U_b}{\partial a_b} = 0; \frac{\partial U_v}{\partial a_v} = 0\right\}$.

We solve the game with the method of backward induction. First, we find the optimal $a_b$ for the public (follower) which is the same as in the simultaneous game:

$$\frac{\partial U_b}{\partial a_b} = Q_b(-a_b) + C(Q_b) = 0 \Longrightarrow -a_b Q_b + C(Q_b) = 0 \Longrightarrow a_b^* = \frac{C(Q_b)}{Q_b}$$

Afterwards, given the public best response, the private (leader) has to choose an $a_v$ which maximizes the following preferences:

$$U_v = \int_0^1 \int_{a_v}^{\frac{C(Q_b)}{Q_b}} (f_v - C(Q_v))\ da\ dw$$

In order to make the derivation procedure easier for us, we expand the above preferences as follows: $U_v = \int_0^1 \int_{a_v}^{\frac{C(Q_b)}{Q_b}} (f_v - C(Q_v))\ da\ dw = \int_0^1 (f_v a_i - C(Q_v) a_i) I_{a_v}^{\frac{C(Q_b)}{Q_b}}\ dw =$

$\int_0^1 \left( a_i \left(f_v - C(Q_v)\right) I_{a_v}^{\frac{C(Q_b)}{Q_b}} \right) dw\ ) = \int_0^1 \left( \frac{C(Q_b)}{Q_b} \left(f_v - C(Q_v)\right) - a_v \left(f_v - C(Q_v)\right) \right) dw =$

$\left( \left(f_v - C(Q_v)\right) \left(\frac{C(Q_b)}{Q_b} - a_v\right) \right) w I_0^1 = \left(f_v - C(Q_v)\right) \left(\frac{C(Q_b)}{Q_b} - a_v\right)$

Thus, the expanded $U_v$ is: $U_v = \left(f_v - C(Q_v)\right)\left(\frac{C(Q_b)}{Q_b} - a_v\right)$

The first order condition is the following:

$$\frac{\partial U_v}{\partial a_v} = -\left(f_v - C(Q_v)\right) = 0$$

**Appendix 14: Solution of Sequential Game with public leadership**

We should find a vector $(a_b^E;\ a_v^E)$ which solve the system of the best response functions $\left\{\frac{\partial U_b}{\partial a_b} = 0; \frac{\partial U_v}{\partial a_v} = 0\right\}$.

We solve the sequential game with the method of backward induction. First, we find an optimal $a_b$ for the private (follower).

The expanded preference function for private is: $U_v = \left(f_v - C(Q_v)\right)(1 - a_v)$

$\left(f_v - C(Q_v)\right)$ would be considered as constant, thus, to maximize $U_v$ the private should choose the lowest operational value which is: $a_v^* = \frac{f_v}{Q_v}$.

The public should take its decision incorporating the best decision taken by the private (follower).

The public university will maximize the following utility function:

$$U_b = \int_0^1 \int_{a_b}^{\frac{f_v}{Q_v}} (a_i Q_b - C(Q_b)) da dw$$

which can be expanded as follows:

$$U_b = \int_0^1 \int_{a_b}^{\frac{f_v}{Q_v}} \left(a_i Q_b - C(Q_b)\right) da dw = \int_0^1 \left( \int_{a_b}^{\frac{f_v}{Q_v}} a_i Q_b da - \int_{a_b}^{\frac{f_v}{Q_v}} C(Q_b) da \right) dw = \int_0^1 \left(Q_b \frac{a_i^2}{2} I_{a_b}^{\frac{f_v}{Q_v}}\right.$$

$$\left. - C(Q_b) I_{a_b}^{\frac{f_v}{Q_v}}\right) dw = \int_0^1 \left(Q_b \frac{\left(\frac{f_v^2}{Q_v^2} - a_b^2\right)}{2} - C(Q_b)\left(\frac{f_v}{Q_v} - a_b\right)\right) dw$$

$$= \left(Q_b \frac{\left(\frac{f_v^2}{Q_v^2} - a_b^2\right)}{2} - C(Q_b)\left(\frac{f_v}{Q_v} - a_b\right)\right) w\, I_0^1$$

$$= \frac{2f_v^2}{Q_v^2} Q_b - \frac{a_b^2}{2} Q_b - \frac{f_v}{Q_v} C(Q_b) + a_b\, C(Q_b)$$

Thus, the expanded $U_b$ is: $U_b = \frac{2f_v^2}{Q_v^2}Q_b - \frac{a_b^2}{2}Q_b - \frac{f_v}{Q_v}C(Q_b) + a_b\ C(Q_b)$.

The first order condition is the following:

$$\frac{\partial U_b}{\partial a_b} = -a_b Q_b + C(Q_b) = 0$$

Therefore, the optimal $a_b$ for the public having incorporated the information from the private is: $a_b^* = \frac{C(Q_b)}{Q_b}$.

The vector which includes two optimal values is also the sequential *equilibria* of the market: $(\frac{C(Q_b)}{Q_b}; \frac{f_v}{Q_v})$.