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Regulation and marketisation in the Portuguese higher education system*

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Abstract

This paper builds on the ongoing discussion on the regulation and marketisation of the higher education system. Its aim is to study the higher education market (des)equilibrium. Teixeira, Rosa and Amaral (2004) have analysed the presence/absence of market mechanisms in the Portuguese higher education sector. This paper describes supply and demand in the Portuguese system. On the supply side, it looks at indicators such as place distribution and diversity, whereas on the demand side, indicators based on the revealed preferences are computed. It goes a step further in quantifying the (mis)match between the two sides of the market, by suggesting and computing a set of strength and weakness indicators. These indicators are then used in predicting the potential impact of changes in higher education regulations on the market equilibrium and stability.

KEYWORDS: higher education market, demand, supply
JEL CODES: I21, I28.

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1 Introduction

Over the last quarter of the twentieth century, the European higher education sector witnessed an expansion with no precedent. As an example, the number of higher education students has more than doubled between 1980 and 2000 (Eurydice, 2000). Also have the opportunities in higher education expanded and nowadays there is almost always a chance for those who want to proceed their studies (Hoxby, 2004). Despite these improvements, the Lisbon Strategy and an increasing international competition from the US, China and India, have made of the reform of higher education systems a hot topic across Europe. The implementation of the Bologna declaration, which aims at creating a European higher education area, is part of that reform process. The role of the government and markets in renewing the European higher education system has been the subject of several research and policy papers (see, for example, Teixeira, Rosa and Amaral, 2004).

In this paper we look at the extent and impact of public regulation, namely, on the adequacy between the tertiary education supply and demand, by focusing on the imbalances in the undergraduate students market.¹ Data for the Portuguese public higher education system, on which candidates have revealed their preferences and places by programme/institution, is being used to compute some indicators of the (in)adequacy between supply and demand in the higher education market. This is an important step towards a better understanding of its functioning, making of this paper an extension of Teixeira et al. (2004), which discusses the existence of a higher education market in Portugal. The set of indicators we defined and computed makes it possible to identify the strengths and weaknesses of the Portuguese higher education system.

There are several reasons that may justify the state intervention in the higher education market: externalities, information-related problems, monopoly and market power, and income redistribution.² To attenuate the effects of these market failures on social welfare, governments have been using several policy instruments: spill-over effects have justified huge public investments in higher education; information-related problems have motivated the creation of quality control mechanisms; in order to guarantee some degree of competition and diversity, governments have intervened to influence the higher education market structure;

¹We consider that supply is the offer of higher education programmes, measured in terms of places available, and demand is measured using the preferences of the applicants over higher education institutions and programmes. It would also be interesting to analyze the matching between the supply of graduates, the output of the higher education system, and the demand for graduates, that depends on the society organization and on the economy structure. It is important to note that there is no single higher education market, instead there is a multitude of markets; namely: a market for students, for researchers, for lecturers, for scholarships and grants, for graduates, among others (Jongbloed, 2003). In the present study, we concentrate in a specific market: the market for undergraduate students, which will be referred to when speaking of market.

²For a detailed description of these market failures see, for example, Jongbloed (2003, 2004).

student social support have been provided, through grants and scholarships, to ensure access to higher education to an increasing number of students.

Although there is a consensus on the regulating role of the state in higher education systems, some authors ascribe the relative failure of the European higher education system, among other factors, to an excessive public control (see, for example, van der Ploeg and Veuglers, 2006). In many countries, governments have been discussing ways to redefine the role of the state and the implementation of marketisation policies in higher education (Jongbloed, 2003).

Supporters of a more prominent role of markets in the higher education system would argue that more competition between institutions and performance-based funding, through the increase of the agents freedom to adjust to the changes in demand and supply, would result in higher quality and variety of services. In the end, the implementation of marketisation policies would contribute to a better match between supply and demand.

According to Simão, Santos and Costa (2004) the regulation of the Portuguese higher education system aims at guaranteeing the access to a degree to the highest number of students, which should facilitate the integration of workers in the labour market and contribute to the social and economic development of the country. The state, regarding the regulation of the higher education system, should also take into account a cost-benefit analysis (Simão et al., 2004). The extensive regulation of the Portuguese higher education system, affecting both sides of the market, poses important barriers to the freedom of consumers (students) and suppliers (institutions). On the supply side, new institutions, study programmes and places offer are subject to ministerial approval, and higher education providers cannot freely choose the amount to be charged as tuition fee. On the demand side, students do not bear the full cost of the education received, they are poorly informed consumers and the *numerus clausus* is a very strong restriction to the applicants' choices. At the same time that both producers and consumers decide in a constrained environment, the Portuguese higher education system has accompanied the general tendency to an increasing supply that has overcome the demand, resulting in a rising competition for students among higher education providers.

The paper unfolds as follows. The higher education sector in Portugal is the focus of Section 2. Section 3 provides a detailed analysis on the mechanisms at stake in the higher education market in both demand and supply sides. In Section 4, we introduce and compute some indicators on the demand-supply (mis)matching, and discuss explanations that have

been suggested in the literature. We discuss the potential effect of some policies aiming at the marketisation of the higher education sector. Finally, Section 5 concludes and points out possible directions for future research.

2 The Portuguese higher education system: institutions and regulation

The Portuguese higher education system is a binary system, with universities and polytechnics as the main providers. The distinctive feature between universities and polytechnics is the focus on research, as polytechnics are not expected to conduct fundamental research, and should offer vocationally or professionally oriented study programmes.³ The higher education system consists of 27 universities, 40 university schools, 17 polytechnic institutes and 76 polytechnic schools, making a total of 160 units, including both private and public higher education providers. The latter comprises 14 universities, 15 polytechnic institutes, 9 nursery schools and 2 other polytechnic schools.⁴

A large number of institutions, for a small number of participants, is a key feature of the Portuguese higher education network (OECD, 2006). Except for the universities of Coimbra, Lisbon, and Oporto and for the Technical University, most public higher education institutions were created quite recently. In particular, most universities were created in the mid-1970s. Until the mid-1980s the system was characterised by a high regional concentration. From the mid-1980s onwards, polytechnics have guaranteed regional diversification to the higher education system. That is, “public polytechnics had strong regional orientation [...] and were always regarded as the primary instrument for providing higher education to the more remote areas of the country” (MCTES, 2006: 55). In the 1990s, the number of students enrolled in the tertiary education has doubled, reaching 400,000 in 2000. The great expansion of the higher education system in the last decades resulted in a reduction of the relative weight of public universities in total enrolments: in 2004/05 it represented 45% of total enrolments, against 78% of total enrolments in the school year 1983/84.

Most higher education institutions offer study programmes in several fields of study, which the Ministry of Science, Technology and Higher Education (*MCTES, Ministério da Ciência, da Tecnologia e do Ensino Superior*) classified, in 2006, for application purposes, in ten areas: Agriculture, Architecture, Natural Sciences, Law and Social Sciences, Economics,

³Note, however, that in some cases there is some indefinición, as, for instance, some universities offer polytechnic-type study programmes.

⁴As well as the Open University and military institutions.

Sports and Arts, Education, Humanities, Health, and Technology.

Following the signature of the Bologna declaration, higher education study programmes have to be restructured and organized into three cycles.⁵ The first cycle consists of a three- to four-year programme, and it is called *licenciatura*.⁶ Since undergraduate studies used to last four years in most cases, higher education institutions have to make a downsizing effort. They were given the option to adapt to the Bologna rules in 2006/07, or to postpone it to any of the next two school years. About 43% of the programmes have been adjusted to conform to the Bologna rules in 2006/07. The second cycle corresponds to the master and takes three to four semesters,⁷ being followed by the doctorate, which corresponds to the third cycle. According to OECD (2006), the implementation of the Bologna process is an opportunity to renew the study programme offer in Portugal and, therefore, should be seen as an instrument for its rationalization.

The MCTES has been in charge of the higher education sector, by regulating it through various mechanisms. Accreditation and quality assessment are among the instruments available to regulate the public higher education system. However, according to the University Autonomy Act of 1988, the approval of new study programmes and degrees is just a bureaucratic procedure, i.e., universities have almost total freedom to initiate or terminate study programmes. These decisions do not depend on an evaluation or accreditation process: only formal inconsistency concerning the duration or the total number of credits can conduct to refusing universities' new degrees. Public polytechnics' study programmes need a formal approval by the MCTES, based on technical and scientific report.⁸ Private institution study programmes must follow a much more demanding approval process. The approval process can take up to four years and needs a technical and academic report by an external expert committee (ENQA, 2006).

The great expansion of the higher education system in the 1990s, namely the increasing number of private higher education institutions, generated a consensus on the need of establishing a national quality assurance system that would provide a more efficient regulation of the system. The Higher Education Evaluation Act 38/94 defined the framework for the evaluation of higher education in Portugal, which resulted in the creation, in 1998, of

⁵The framework legislation for the implementation of the Bologna process in Portugal was published in March 2006 (DL 74/2006 of 24 March).

⁶Some exceptions apply; namely, some engineering study programmes have been restructured to offer a joint first and second cycle degree, the so-called integrated master.

⁷However, the Portuguese Comprehensive Law on the Education System admits that a master degree can be awarded after only two semesters, under special authorization.

⁸New study programmes in private institutions are subject to very strict requirements, and institutions must be officially recognised in order to award degrees.

the national evaluation agency, CNAVES (*Conselho Nacional de Avaliação do Ensino Superior*). Although it contributed to develop a culture of self-evaluation, CNAVES evaluations did not produce any consequences in terms of suspending a study programme or decreasing funds for a specific institution (ENQA, 2006). The Portuguese MCTES is now leading the assessment process of the higher education system in order to reorganise and rationalise it (MCTES, 2006); and definite steps towards quality assessment of higher education institutions are being taken.⁹ In 2005, the MCTES announced the extinction of CNAVES and the creation of a new accreditation agency is planned for 2007. The agency will be in charge of the programme evaluation, which can therefore work as a barrier to entry, as well as an improvement on market information.

Another instrument used by the MCTES to regulate the higher education system is the *numerus clausus*, which defines the maximum number of students for each study programme in both public and private sectors. *Numerus clausus* works as a restriction on the supply side of the system, affecting the size and composition of the tertiary education sector. Those restrictions have been settled “without a formal national higher education planning framework”, notwithstanding, it has been used as a political instrument to affect the regional distribution of students (OECD, 2006: 26).

The MCTES regulates the access to the higher education system through admission policies as well. Currently, access to public higher education works through a national competition based on students’ revealed preferences and their grade point average, which is a weighted average of their marks in upper secondary education and in national examinations.¹⁰ In practice, each study programme has to define a compulsory examination in one or two disciplines, and the weight given to each grade and exam, within the limits established by the Ministry itself. Students, on their side, have to rank up to six pairs study programme/institution, from the most (the first one) to the least preferred (the last one) alternative. A nationwide tournament involving all candidates and places follows. Admission policies are crucial for the number of candidates and students’ enrolment in higher education, as changes in access conditions may result in great changes in the number of candidates. For example, in 1989, the end of a minimum mark requirement in national examinations coincided with an increase of 20,000 candidates (more than 60%). The reintroduction of national

⁹Different institutions have been in charge of producing reports on the Portuguese higher education system: (i) a self-proposed evaluation report of several higher education institutions by the European University Association (EUA), the OECD (2006) report, that aims at an overall evaluation of the Portuguese higher education system, and the European Association for Quality Assurance in Higher Education report (ENQA, 2006) which provides an analysis of the system of quality assurance and sets the directions for the new accreditation agency.

¹⁰In the private sector there is a decentralized application system.

examinations, in 1996, and minimum marks (95/200), in 2004, coincided with a reduction of candidates and enrolments, which were reinforced by demographic trends (MCTES, 2006).

Public funding of higher education institutions is guaranteed through several channels: a funding formula, based on which direct funding of institutions is defined; contracts for specific activities; the funding of social support services, mainly student grants, meals and accommodation; and research funds. The funding formula, which is the basis for the annual budget of public universities and polytechnics, takes into consideration, among other factors, the teacher/student ratio and the non-teaching staff/teacher ratio. Although it accounts for the qualifications of the teaching staff and the fields of study, the funding formula depends mainly on the number of enrolled students. Whether this is an adequate performance measure or not is a controversial issue. The Ministry argues, however, that in the current context of excess capacity, where institutions compete for students, the student enrolment is also a performance indicator (MCTES, 2006). Given the weight of students' enrolment in the funding formula, the recent decline in overall enrolments in tertiary education poses a problem to the financial sustainability of higher education institutions. Institutions with lower occupation rates will be the most affected by financial constraints.¹¹ In 2006, the Government applied a new formula for determining the direct funding of public higher education institutions, which aimed at introducing quality and performance criteria, namely, the qualification of the teaching staff and the graduation rate (MCTES, 2006). In recent years, the Government has defined research activities as strategic, and therefore, in 2005 and 2006, the science and technology funds increased by 17% and 60%, respectively, whereas education funds remained the same.

The human capital theory is at the centre of the analysis of the Economics of Higher Education. The basic hypothesis states that students invest in their education in the present, and therefore they bear the education-related costs and forego earnings, which will be rewarded in the future by means of higher wages. Apart from living expenses, which take an important share of student budgets, they have to pay tuition fees. In 1997, there was a substantial increase in the tuition price, followed by another one in 2003, which resulted in a significant improvement of higher education institutions' budgets. In 2006, the revenue from tuition fees represented nearly 17% of the total revenue of public higher education institutions, which is close to the OECD average of 19% (OECD, 2006: 81).

When deciding on whether to attend higher education, students think in terms of affordability, i.e., the extent to which there are enough means available to cover education-related

¹¹So far, these constraints have been minored by the inclusion of 'cohesion factors' that limit year to year budget variations.

costs. Student social support, namely, grants and accommodation, is crucial for ensuring the same higher education opportunities to all students and for preventing low-income students from not continuing their studies. Student funding affects the demand for higher education, since the bank loan system availability is limited and for reduced amounts only. Approximately 24% of the enrolled students benefit from a grant. This percentage is similar to the one in Spain, but it is much smaller than those in northern European countries. Accommodation is provided to only 4% of the students in higher education (MCTES, 2006: 56-57).

To conclude, the ongoing assessment of the Portuguese higher education system takes place in a time when the imbalance between demand and supply becomes more and more visible. After a period of extraordinary growth of the number of candidates and registered students in the tertiary education system, since 2003/04 total enrolments have decreased (OCES, 2007b: 15). Simultaneously, the increasing graduate unemployment rate and the need to prepare the labour market for a knowledge-based society has brought to public discussion the issue of the public funds distribution across fields of study. Furthermore, the government regulates the higher education system by controlling access conditions, favouring accreditation and quality assessment of study programmes and institutions, and funding both institutions and students. These regulation mechanisms translate into rigidity in the system and have, therefore, resulted in a sluggish adjustment to changes in demand, which we will characterize in the next section.

3 The higher education market for undergraduate students

This section quantifies higher education supply and demand. As explained above, the allocation of candidates to institutions and study programmes is the result of a nationwide tournament and it is based on their stated preferences. The analysis is then based on a data set consisting of those revealed preferences. We will focus on the public sector, as it is governed by a more homogeneous set of rules and benefits from a centralized application process. Furthermore, the data are publicly available in a website created for that purpose by the MCTES.¹² The data available include information on institution/programme pairs, from 2003/04 to 2006/07; namely: number of applicants placing each pair among their preferences, total number of times a given pair is the first option, the mean of the grade point average of students who applied for each study programme and who were admitted to it.

¹²The information is available at: www.acessoensinosuperior.pt.

3.1 Supply side

Several measures can be used to look at the supply side of the higher education market. In particular, the distribution of study programmes and places, as well as programme diversity, are used to portray the higher education supply in Portugal.

Table 1: Distribution of study programmes by area of study, 2003-2006

Area	2003/04		2004/05		2005/06		2006/07	
	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.
Agriculture	73	0.07	69	0.07	69	0.07	64	0.06
Architecture	58	0.06	63	0.06	73	0.07	72	0.07
Natural sciences	87	0.09	92	0.09	87	0.08	80	0.08
Law and social sciences	107	0.11	129	0.12	145	0.14	162	0.16
Economics	113	0.11	117	0.11	119	0.11	109	0.11
Sports and arts	25	0.02	29	0.03	33	0.03	32	0.03
Education	123	0.12	101	0.1	90	0.09	70	0.07
Humanities	99	0.1	102	0.1	98	0.09	76	0.08
Health	99	0.1	107	0.1	111	0.11	112	0.11
Technology	224	0.22	231	0.22	232	0.22	214	0.22
Total	1008		1040		1057		991	

The total number of study programmes has shown a quite stable distribution over time, but it hides variation across fields of study (see Table 1). In fact, the increasing number of study programmes in Architecture, Law and Social Sciences, and Sports and Arts, has been compensated by a decrease in the number of studies in areas such as Agriculture and Education. Regardless of the school year, Technology study programmes take the biggest share in the higher education offer, whereas the lowest share goes to Sports and Arts. Technology, Law and Social Sciences, Economics and Management, and Health represented all together about 60% of the Portuguese public higher education supply in 2006.

There is also a spatial dimension concerning the study programme offer. Looking at Table 2 some spatial patterns emerge. Firstly, most of the placement offer is concentrated in Lisbon as well as in the North and Centre regions. The South (Alentejo and Algarve), together with the islands (Madeira and Azores), take only a small share of the overall offer of the public higher education sector. Secondly, this picture is basically the same across areas of study, except for study programme offer in the field of Agriculture, which shows up as important in Alentejo, contrasting with a smaller share in more urbanized areas, such as Lisbon.

Table 2: Distribution of study programmes by region (NUTS2) and area of study, 2006

NUT2	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total
Alentejo	11	7	7	18	8	8	9	6	8	12	94
Algarve	3	4	4	8	7	1	4	4	8	7	50
Centre	13	23	23	56	35	10	18	20	29	66	293
Lisbon	8	19	19	30	27	6	8	22	27	53	219
North	27	16	23	38	28	6	26	22	34	70	290
Azores	2	1	2	8	2		2	1	4	5	27
Madeira		2	2	4	2	1	3	1	2	1	18
Total	64	72	80	162	109	32	70	76	112	214	991

Note: The study areas in the table are the following: agriculture (agric), architecture (arch), natural sciences (natsc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).

Despite providing a first picture of the higher education market, the distribution of the study programme supply does not fully characterize the supply side. Another important issue, also related to access policies, is that of capacity. The capacity of the Portuguese higher education system is decided on a yearly basis by the MCTES, which approves the distribution of places across studies proposed by each higher education institution.

Table 3: Distribution of places by institution and area of study, 2006

Institution	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total	Diversity
ESuperiores				60	185				1003	50	1298	
PI Beja	115	30	25	165	50	25	55		70	91	626	0.872
PI Bragança	198	40		195	250	60	205	25	220	530	1723	0.834
PI Castelo Branco	42	100		224	130		80	25	150	224	975	0.826
PI Cávado		81		25	135					85	326	0.547
PI Coimbra	180	70	30	295	300	30	95	20	180	520	1720	0.836
PI Guarda	30	25		234	160	35	70	30	110	105	799	0.838
PI Leiria	60	160	90	460	215	85	95	35	120	316	1636	0.886
PI Lisbon		55	35	202	333		166		385	720	1896	0.706
PI Oporto		40	45	315	500		154	65	410	865	2394	0.731
PI Portalegre	80	69		209	72		55	72	77	96	730	0.860
PI Santarém	50	20		135	170	154	90		90	85	794	0.846
PI Setúbal	25	25		142	302	20	78	16	109	482	1199	0.716
PI Tomar	35	172		35	210			35		242	729	0.653
PI Viana do Castelo	99	70		60	66	30	105		66	210	706	0.839
PI Viseu	223	60		302	200		185	30	120	265	1385	0.835
Total Polytechnic	1137	1017	225	3058	3278	439	1433	353	3110	4886	18936	0.860
ISCTE		35		334	361			35		126	891	0.549
Technical U	260	343	110	343	498	154			70	1355	3133	0.736
U Algarve	90	120	145	315	315	30	135	105	225	275	1755	0.932
U Aveiro	45	85	272	167	365	30	75	167	158	627	1991	0.857
U Azores	22	25	40	178	70		40	20	45	85	525	0.841
U Beira Interior		170	145	165	110	100	21	70	190	240	1211	0.900
U Coimbra	40	60	285	870	275	95	120	269	449	604	3067	0.859
U Évora	80	110	167	165	90	50	60	80	76	95	973	0.969
U Lisbon		260	685	920		40	90	741	653	245	3634	0.785

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... table 3 continued

Institution	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total	Diversity
U Madeira		30	50	114	55	20	60	25	73	120	547	0.887
U Minho		100	272	427	172		111	230	194	718	2224	0.813
U Nova	85	55	205	375	465	20		295	200	755	2455	0.812
U Oporto	120	313	485	530	330	110	55	365	730	900	3938	0.900
UTAD	143	25	187	338	85	95	100	45	72	210	1300	0.906
Total University	885	1731	3048	5241	3191	744	867	2447	3135	6355	27644	0.911
Total	2022	2748	3273	8299	6469	1183	2300	2800	6245	11241	46580	0.910

Notes: 1. The number of places is computed as the maximum number of vacancies among the values announced for the two phases

2. The study areas in columns are the following: agriculture (agric), architecture (arch), natural sciences (natsc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).

3. ESuperiores is the short for *Escolas Superiores*, which include nine nursing schools, a nautic school and a hotel management school. Because all these schools have a very specialized offer, we opted for collapsing the vacancies.

4. The diversity index is computed as in equation (1), for each higher education institution. It does not apply to the set of schools under the name ESuperiores. Note that nursing schools offer study programs on health only, implying that the diversity index takes the value 0 for most institutions in that set.

5. U stands for University and PI stands for Polytechnic Institute.

Table 3 shows the distribution of places by institution and field of study, in 2006. Several important results are evident in this table. Firstly, the university takes almost 60% of the total capacity, measured as the number of places. That is, there is place for almost 28000 new students to attend university, whereas about 19000 may go to a polytechnic. Secondly, the institutions with the biggest capacity belong to the university sector. For example, the capacity of 5 out of 14 universities is above that of the biggest Polytechnic Institute. Furthermore, the biggest (and also the oldest) four universities (Universities of Coimbra, Lisbon and Oporto, and the Technical University) take 13772 places, that is, about 29.5% of the total places available in the public higher education subsystem. Thirdly, such capacity is not evenly distributed across institutions within higher education sector. Looking at the polytechnic sector places, big institutions like the one in Oporto, coexist with small ones (e.g., IP Cávado&Ave). Also in the university sector, the University of Oporto, the biggest institution, is almost 8 times bigger than the smallest one (University of Azores).

Table 4: Distribution of places by region (NUTS2) and area of study, 2006

NUT2	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total	Diversity
Alentejo	325	229	192	674	382	229	260	152	313	367	3123	0.961
Algarve	90	120	145	315	315	30	135	105	225	275	1755	0.932
Centre	432	867	822	2585	1765	375	671	651	1677	2878	12723	0.906
Lisbon	370	773	1035	2376	2144	234	334	1087	1735	3733	13821	0.877
North	783	704	989	2057	1738	295	800	760	2082	3783	13991	0.903

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... table 4 continued

NUT2	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total	Diversity
Azores	22	25	40	178	70		40	20	140	85	620	0.836
Madeira		30	50	114	55	20	60	25	73	120	547	0.887
Total	2022	2748	3273	8299	6469	1183	2300	2800	6245	11241	46580	0.910

Note: The study areas in the table are the following: agriculture (agric), architecture (arch), natural sciences (natsc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).

The spatial distribution of capacity, shown in Table 4, comes as no surprise; it largely resembles the spatial distribution of the number of study programmes. Interesting enough is the fact that the North, Centre and Lisbon, all together take 40535 places, that is, about 87% of the total places offer. It is important to note that this has a correspondence in terms of population density, as in 2005, these regions accounted for 84% of the total population.¹³

According to Huisman, Kaiser and Vossensteyn (2000), diversity is among the instruments available to governments aiming at shaping the demand for higher education. For instance, increasing diversity enlarges the range of choices offered to students, and consequently it will make higher education accessible to more people and will allow a better fit between supply and demand. The potential relation between diversity and participation is further explored in the next section. For the analysis that follows we look at programme diversity. The total number of places by institution and field of study is used to compute a Shannon-Wiener diversity index of each institutional study offer¹⁴

$$Diversity_s = - \sum_{m=1}^M p_m \log p_m, \quad (1)$$

where $M = 10$ is the number of areas of study offered by Portuguese public higher education institutions; and p_m is the proportion of study programme type m in a given institution measured by total number of places.¹⁵

Programme diversity index values, by higher education institution, by subsystem, and for the entire higher education system, are shown in the last column of Table 3. The overall diversity is quite high (0.908).¹⁶ When comparing subsystems, the university subsystem reveals a higher diversity than the polytechnic subsystem. This does not come as a surprise;

¹³Computations are based on information available at the Instituto Nacional de Estatística website: www.ine.pt.

¹⁴This index is used in Brose (2003), who took it from Magurran, in his work dated from 1988 on ecological diversity measurement.

¹⁵For areas which are not present in a given university, $p_m \log p_m = 0$. This follows from the L'Hôpital rule, according to which $\lim_{p_m \rightarrow 0} p_m \log p_m = 1/(1/p_m) = p_m = 0$.

¹⁶Maximum diversity is achieved whenever places are equally distributed across all areas of study. Because 10 areas are being considered, the maximum value for the diversity index is 1.

it follows from the starting up conditions imposed by the Portuguese legislation.¹⁷ The universities of Algarve and Évora (Alentejo) are among those at the top of institutions offering the most diverse set of studies. It might be the case that since they are located in quite remote areas, with no competition from close-by universities, they strategically opt for offering study programmes in all fields of study, with a small number of places, in order to supply local students' demand. The ISCTE¹⁸, University of Lisbon and the Technical University, all located in Lisbon, present the lowest diversity. In fact, Lisbon counts with four universities, which might allow for some degree of specialization, with no risk of losing students to other regions.

If diversity is computed using equation (1), but the proportion p_m is computed based on the number of study programmes, results on diversity do not differ very much from those above (see Table 15, in Appendix A). The major difference is that diversity is even higher, both in the whole system, and within each subsystem.

3.2 Demand side

Since the mid 1990s, demand for higher education has been affected by several factors, namely: changes in demography and the reintroduction of national exams and minimum marks as entrance conditions (MCTES, 2006; OECD, 2006). All these issues have shaped student preferences. On top of that, peer effects are very likely to happen and individuals are very likely to influence their colleagues and friends through their revealed preferences (Sá, 2006). These reasons justify that the analysis of the demand in the undergraduate student market is based on students' revealed preferences.

Two facets of the demand for higher education are analysed. First of all, we will study the consistency of students' preferences. As explained in Section 2, each candidate's choice set has up to six choices, ranked from the most to the least preferred option. This means that the choice sets might vary significantly across students. The choice set of some students are only composed of university institutions, while others are only of polytechnics; a mixture of both being also possible. The same may also occur in the study programme choice. For example, for some students all alternative studies in their choice set belong to the same area of study, whereas in other students' choice set two or more fields of study are present. In order to analyse how consistent student choice sets are, a choice set is defined as consistent

¹⁷The creation of a new university requires a minimum of 8 study programmes in at least three different areas of study, whereas a polytechnic can be created with just two study programmes, which may belong to the same area of study (Simão et al., 2004).

¹⁸ISCTE is a specialised school, where most studies are concentrated in two fields: Law and Social Sciences, and Economics.

when it includes only identical choices.¹⁹ Choice consistency can be analysed under four different perspectives: (i) the type of higher education institution; (ii) the higher education institution itself; (iii) the study programme; and (iv) the region.

Table 5: Proportion of students with consistent choice sets regarding the higher education institution type, 2003-2006

Type of institution	2003/04	2004/05	2005/06	2006/07	Total
Non-University	0.332	0.333	0.265	0.251	0.296
University	0.477	0.486	0.486	0.458	0.476

Note: Proportions in this table are computed as the number of individuals with only that type of institution in the choice set to the total number of individuals who have at least one institution of that type in the choice set.

Regarding the type of higher education institutions' choice, it is interesting to note that the proportion of students whose choice set only contains university options is higher than that of students with only polytechnics in their choice set (see Table 5). It is evident that the proportion of students with just universities in their choice sets is more stable than that of students with a polytechnic choice set over the period under analysis. The biggest decrease in the proportion of students with a polytechnic choice set occurred between 2004/05 and 2005/06, when it decreased about 6 percentage points.²⁰

Table 6: Proportion of students with consistent choice sets regarding the higher education institution, 2003-2006

Institution	2003/04	2004/05	2005/06	2006/07	Total
PI Beja	0.082	0.087	0.073	0.049	0.074
PI Bragança	0.073	0.067	0.048	0.046	0.059
PI Castelo Branco	0.040	0.042	0.029	0.033	0.036
PI Cávado&Ave	0.156	0.116	0.083	0.048	0.094
PI Coimbra	0.064	0.055	0.039	0.045	0.051
PI Guarda	0.032	0.034	0.020	0.020	0.027
PI Leiria	0.087	0.084	0.073	0.078	0.081
PI Lisbon	0.093	0.100	0.077	0.072	0.085
PI Oporto	0.141	0.151	0.110	0.112	0.128
PI Portalegre	0.046	0.041	0.038	0.031	0.04
PI Santarém	0.065	0.063	0.043	0.046	0.055
PI Setúbal	0.158	0.147	0.089	0.080	0.122
PI Tomar	0.079	0.087	0.050	0.028	0.065
PI Viana do Castelo	0.066	0.077	0.040	0.045	0.058
PI Viseu	0.088	0.077	0.062	0.070	0.075
ISCTE	0.048	0.041	0.055	0.040	0.046
Technical U	0.084	0.086	0.09	0.072	0.083
U Algarve	0.178	0.172	0.159	0.144	0.162

Continued on next page...

¹⁹Consistency, however, should not be taken for the usual meaning it carries in Microeconomic theory.

²⁰An individual has a polytechnic choice set if his choice set only contains polytechnic schools.

... table 6 continued

Institution	2003/04	2004/05	2005/06	2006/07	Total
U Aveiro	0.068	0.071	0.068	0.059	0.066
U Azores	0.186	0.131	0.099	0.126	0.131
U Beira Interior	0.031	0.035	0.021	0.021	0.027
U Coimbra	0.067	0.064	0.057	0.057	0.061
U Évora	0.045	0.043	0.037	0.040	0.041
U Lisbon	0.069	0.067	0.068	0.05	0.063
U Madeira	0.350	0.290	0.301	0.294	0.303
U Minho	0.085	0.084	0.090	0.086	0.086
U Nova	0.032	0.037	0.033	0.034	0.034
U Oporto	0.105	0.111	0.106	0.104	0.106
UTAD	0.046	0.051	0.035	0.043	0.044

Notes: 1. Proportions in this table are computed as the total number of students with only that institution in the choice set to the total number of students that have placed that institution among their choices, at least once. Most of other schools in the polytechnic sector, namely nursing schools offer only one study programme, which does not allow for the computation of the consistency rate.

2. U stands for University and PI stands for Polytechnic Institute.

Such rates of consistency are not evenly distributed across higher education institutions. The effect of the geographic isolation of some higher education institutions is clear in Table 6. Universities like those in Madeira, Algarve and Azores, which are geographically isolated, show the highest consistency rates, for the overall period between 2003 and 2007 (30.3%, 16.2% and 14%, respectively). It is important to note, however, that the proportion of students that exclusively opt for the University of Azores has decreased from 2003/04 to 2004/05. The four universities located in Lisbon show quite low consistent rates: 3.4% for the University Nova of Lisbon, 4.6% for the ISCTE, 6.3% for the University of Lisbon, and 8.3% for the Technical University. However, when consistency regarding the region is analysed (see Table 7), Lisbon takes the biggest share of students that consistently choose to study in that region (about 43%). It implies that a considerable number of students have a strong preference for studying in Lisbon, which is obviously justified given its diversity regarding the study programme supply. Madeira ranks second in top regions in terms of choice consistency. In this case, it is possibly because distance constraints apply to those living in the island, which confirms the well-known negative impact of distance on student higher education choice (see, for instance, Sá, Florax and Rietveld, 2004, for the case of Dutch students).

Table 7: Proportion of students with consistent choice sets regarding the region, 2003-2006

Institution	2003/04	2004/05	2005/06	2006/07	Total
Alentejo	0.092	0.091	0.076	0.074	0.084
Algarve	0.178	0.172	0.159	0.144	0.162
Centre	0.190	0.183	0.175	0.169	0.179
Lisbon	0.439	0.436	0.424	0.412	0.428
North	0.306	0.306	0.298	0.279	0.297
Azores	0.193	0.141	0.113	0.129	0.141
Madeira	0.350	0.290	0.301	0.294	0.303

Note: Proportions in this table are computed as the total number of students, whose choice set contains institutions all belonging to a given region, to the total of students who place at least one institution in that region among their choices.

Table 8 shows indicators for study programme consistency, that is, how systematic the choice sets are across areas of study. The highest consistent-choice rates are achieved in Architecture, Health, and Technology, whereas the lowest goes for Natural Sciences Studies. It is important to note, however, that students are constrained in their choices by the options they made in secondary education. First of all, students attending upper secondary education have to choose a track and an area of study. Regular education includes two main tracks, of which the *Cursos Científico-Humanísticos* is geared for further studies.²¹ Students in that track have to choose one out of five alternative areas of study: Science and Technology, Social and Human Sciences, Social and Economic Sciences, Languages and Literatures, and Visual Arts. All areas count with a set of courses in common, and a specific component. By default, students from all areas can apply to all higher education study programmes. Depending on the exams required to attend a given programme, it might imply, however, additional work to apply to some studies.²²

Table 8: Proportion of students with consistent choice sets regarding the area of study, 2003-2006

Area of study	2003/04	2004/05	2005/06	2006/07	Total
Agriculture	0.105	0.102	0.091	0.080	0.095
Architecture	0.458	0.493	0.510	0.594	0.512
Natural Sciences	0.080	0.082	0.098	0.091	0.088
Law and Social Sciences	0.244	0.249	0.273	0.260	0.256
Economics	0.305	0.343	0.324	0.311	0.320
Sports and Arts	0.165	0.221	0.189	0.265	0.211
Education	0.184	0.175	0.159	0.135	0.166

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²¹The other track is the *Estudos Tecnológicos*, which prepares students for direct entry into the labour market. Although students following this track can also apply to higher education, this is not a very common choice.

²²For instance, students attending Social and Human Sciences in secondary education do not study mathematics, which will make it harder for those students to study by themselves for the maths exam required, for instance, for most studies in Economics.

... table 8 continued

Area of study	2003/04	2004/05	2005/06	2006/07	Total
Humanities	0.127	0.142	0.145	0.135	0.136
Health	0.489	0.522	0.546	0.468	0.506
Technology	0.400	0.432	0.412	0.356	0.400

Note: Proportions in this table are computed as the total number of students, whose choice set contains institutions all belonging to a given area of study, to the total of students who place at least one institution in that region among their choices.

The second issue to be analysed on the demand side is that of students' preferences regarding institutions. The demand faced by each institution can be analysed either by means of the number of students, who have chosen it as their first choice, or counting the number of students, who have included it in their choice set, no matter its rank. Because the latter does not include only first-choices, but also second-best alternatives, it appears to better measure the demand size.²³

Table 9: Distribution of total hits by institution and area of study, 2006

Institution	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total
Esuperiores				454	1499				8489	50	10492
PI Beja	378	85	132	638	175	55	227		611	200	2501
PI Bragança	733	78		668	517	142	740	62	2394	1090	6424
PI Castelo Branco	270	631		874	625		346	103	1658	868	5375
PI Cávado&Ave		417		399	1007					202	2025
PI Coimbra	1151	599	127	1580	1391	109	645	223	1600	2942	10367
PI Guarda	121	143		966	711	213	448	132	1350	225	4309
PI Leiria	285	825	469	3049	946	313	293	39	1483	1122	8824
PI Lisboa		294	172	4020	2024		774		3382	2524	13190
PI Portalegre	323	198		1015	133		164	191	1052	169	3245
PI Oporto		45	161	3559	2822		327	88	5006	4017	16025
PI Santarém	205	117		917	579	952	360		1155	244	4529
PI Setúbal	46	71		841	1176	39	631	3	1493	1306	5606
PI Tomar	163	622		138	495			33		422	1873
PI Viana do Castelo	555	353		394	315	173	330		433	710	3263
PI Viseu	750	179		1569	675		642	60	1257	707	5839
Total Polytechnic	4980	4657	1061	21081	15090	1996	5927	934	31363	16798	103887
ISCTE		514		2432	2796			180		985	6907
Technical U	872	3420	734	2746	3025	497			1721	4826	17841
U Algarve	327	544	669	1660	1390	80	399	280	2307	726	8382
U Aveiro	192	585	2128	2220	2694	36	590	799	2199	4579	16022
U Azores	70	62	137	808	175		38	47	735	153	2225
U Beira Interior		993	813	1209	547	551	16	121	3479	336	8065
U Coimbra	163	245	1803	6216	1776	982	581	818	3730	2019	18333
U Évora	478	655	451	1163	577	254	538	150	875	274	5415
U Lisbon		1865	2132	3136		218	240	1610	3865	1337	14403
U Madeira		52	51	997	283	40	155	51	696	113	2438
U Minho		427	706	2513	1228		786	917	1951	3616	12144
U Nova	257	141	1488	2684	2512	65		1104	2875	3225	14351

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²³Table 16, referring to first-option distribution, is shown in Appendix A.

... table 9 continued

Institution	agric	arch	natssc	lawsoc	eco	sparts	educ	hum	health	tec	Total
U Oporto	784	1468	3395	3433	986	587	672	2003	5418	4171	22917
UTAD	636	148	1751	1971	288	599	244	109	717	627	7090
Total University	3779	11119	16258	33188	18277	3909	4259	8189	30568	26987	156533

Note: 1. Hits are the total number of choice sets including a study programme in a field of study and a given higher education institution.

2. The study areas in the table are the following: agriculture (agric), architecture (arch), natural sciences (natssc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).

3. U stands for University and PI stands for Polytechnic Institute.

Table 9 shows the distribution of the total number of hits, by higher education institution and field of study, in 2006.²⁴ Total demand for university education is higher than total demand for polytechnic education. In both subsystems, the institutions in Oporto are on top of the demand. As expected, universities located in remote areas, such as those in the islands of Madeira and Azores, as well as Évora, face a lower demand.

This section portrays the Portuguese higher education system, by describing its functioning and providing some supply and demand measures. The next obvious question is: Does supply meet demand? This is the main issue to be discussed in the next section, where we go on with the analysis by assessing the supply-demand (mis)match in the Portuguese higher education market.

4 The mechanisms at work in the higher education market

4.1 Does supply meet demand?

The analysis of supply and demand, separately, as presented in the previous section, contributes for a better understanding of the two sides of the Portuguese higher education market. However, it is important to keep in mind that higher education constitutes a special type of market, where consumers (students) are also inputs in the production function. Furthermore, public funding of higher education institutions makes it possible to charge prices that do not reflect the actual education costs, and therefore do not guarantee the equilibrium between demand and supply.

All these issues call for the analysis of the (mis)match between demand and supply in the Portuguese higher education sector.²⁵ Our aim is then to study the higher education

²⁴When talking about hits, we are referring to the number of choice sets that include studies in a given field and in a given higher education institution.

²⁵Using a different set of variables, Cabral (2006) identifies and provides some measures of the imbalances in the Portuguese higher education system. He looks at the evolution of the system in the 90s and gives some evidence of the mismatch between the evolution of supply and demand. He stresses the deepening of the imbalances in the higher education system that resulted from its great expansion and, he argues, its increasing inefficiency.

market (des)equilibrium. In this section, several indicators to measure the degree of adjustment between demand and supply are considered. Teixeira et al. (2004) have analysed the presence/absence of market mechanisms in the Portuguese higher education sector. This paper goes a step further in quantifying the higher education market (des)equilibrium, by suggesting and computing a set of indicators, which provide the starting point for a ranking-based analysis. Institutional rankings are central to overcome the absence of information on quality in the Portuguese higher education system, which is a basic requirement for a real higher education market.

The occupation rate in the higher education system, that is, the proportion of available places that are filled, provides a first picture of the matching between supply and demand, namely it allows for quantifying the excess supply in the system. Numbers for the whole system show excess supply and a decreasing occupation rate. In 2003/04, 95.4% of places were filled, but the rate has decreased to 87.5% and to 82.1% in 2004/05 and 2005/06, respectively, and recovered to 88.0% in 2006/07.²⁶ Occupation rate, however, hides variation across institutions and fields of study. Looking at Table 10, some salient conclusions emerge. First of all, the polytechnic subsystem shows a lower occupation rate than the university subsystem, with a difference of six percentage points between them. Namely, six polytechnic institutions show an occupation rate below 80%, while the University of Évora is the only university below that rate. The highest occupation rate within the polytechnic sector is the one achieved by the Polytechnic Institute of Oporto (98.1%), immediately followed by that of Leiria (97.2%). In the university subsystem, the occupation rate of five institutions is above 90%, three of which have full occupation: ISCTE, and the universities of Aveiro and Oporto have an occupation rate of about 99% or higher.

Table 10: Distribution of occupation rate by institution and area of study, 2006

Institution	agric	arch	natsec	lawsoc	eco	sparts	educ	hum	health	tec	Total
PI Beja	0.626	0.533	0.960	0.830	0.880	0.720	1.036		1.057	0.385	0.762
PI Bragança	0.652	0.550		0.836	0.428	0.500	0.776	0.640	1.077	0.364	0.613
PI Castelo Branco	0.833	1.020		0.710	0.800		0.875	0.800	1.047	0.638	0.810
PI Cávado&Ave		1.049		1.000	1.007					0.694	0.936
PI Coimbra	0.956	1.086	1.033	1.034	0.883	1.033	0.874	1.050	1.139	0.783	0.928
PI Guarda	0.900	1.040		0.812	0.900	1.029	0.929	0.633	1.064	0.400	0.834
PI Leiria	0.900	1.056	1.078	1.046	1.019	1.024	0.842	0.286	1.100	0.826	0.972
PI Lisbon		1.000	1.114	1.045	0.871		1.018		1.081	0.663	0.874
PI Portalegre	0.763	0.768		0.742	0.306		0.564	0.694	1.026	0.208	0.645
PI Oporto		1.000	1.133	1.029	1.034		0.812	0.538	1.046	0.957	0.981
PI Santarém	1.020	1.000		1.044	0.753	1.071	0.878		1.100	0.753	0.941

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²⁶These figures were computed based on data available at www.acessoensinosuperior.pt.

... table 10 continued

Institution	agric	arch	natssc	lawsoc	eco	sparts	educ	hum	health	tec	Total
PI Setúbal	0.360	1.040		1.028	0.884	0.700	0.885	0.188	1.083	0.529	0.756
PI Tomar	1.029	0.797		1.029	0.614			0.257		0.256	0.561
PI Viana do Castelo	1.061	1.071		1.000	0.833	1.100	0.981		1.030	0.690	0.912
PI Viseu	0.744	1.000		0.947	0.845		0.692	0.633	1.042	0.445	0.773
Total Polytechnic	0.807	0.946	1.076	0.941	0.845	0.943	0.850	0.572	1.055	0.639	0.845
ISCTE		1.029		1.036	1.044			1.029		1.016	1.036
Technical U	0.750	1.035	0.855	0.991	1.018	0.922			1.029	0.846	0.910
U Algarve	0.867	0.758	0.793	0.946	0.940	0.633	0.719	0.790	0.973	0.713	0.850
U Aveiro	1.000	1.012	1.011	1.012	1.027	0.967	1.027	0.880	1.019	0.959	0.987
U Azores	1.045	1.000	0.950	0.944	0.943		0.550	0.450	0.933	0.553	0.838
U Beira Interior		1.059	0.938	1.061	1.064	1.040	0.190	0.314	0.984	0.292	0.822
U Coimbra	0.800	1.033	0.881	1.030	1.022	1.011	0.792	0.595	1.018	0.637	0.885
U Évora	0.513	0.873	0.611	1.030	1.078	1.040	1.033	0.413	1.066	0.389	0.792
U Lisbon		1.015	0.745	1.024		1.000	1.011	0.463	1.020	0.918	0.848
U Madeira		0.767	0.340	1.018	1.036	0.900	0.800	1.040	1.000	0.658	0.835
U Minho		1.020	0.610	1.028	1.052		1.036	0.983	1.021	0.948	0.948
U Nova	0.600	0.709	0.839	0.819	1.019	1.000		0.756	1.000	0.898	0.881
U Oporto	0.917	1.013	0.938	1.028	1.003	1.000	1.127	0.989	1.018	0.986	0.996
UTAD	0.790	1.040	1.102	0.985	1.047	0.937	0.470	0.244	1.028	0.524	0.845
Total University	0.777	0.983	0.832	1.001	1.018	0.966	0.830	0.687	1.012	0.829	0.904
Total	0.794	0.969	0.849	0.979	0.930	0.958	0.843	0.672	1.034	0.747	0.880

Notes: 1. Occupancy rates can be above 1. In some specific situations, institutions may admit more students than the available places. For instance, when there is a group of students with the same characteristics regarding the requirements for a given study, all of them should be admitted, even if it implies the creation of additional places.

2. The study areas in columns are the following: agriculture (agric), architecture (arch), natural sciences (natssc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).

3. The polytechnic subsystem includes *Escolas Superiores* as well, although occupation rates for each of those schools are not shown in the table. However, occupation rates for the whole polytechnic subsystem and for the higher education system were obtained using those schools.

4. U stands for University and PI stands for Polytechnic Institute.

Considering the occupation rate across scientific areas, Health is clearly the field with the highest rate (more than 100%).²⁷ Conversely, both Humanities and Technologies present occupation rates below 75%. Within the Technologies, only five institutions have an occupation of at least 95%: ISCTE, universities of Aveiro, Minho and Oporto; and the Polytechnic Institute of Oporto.

Occupation rate also shows spatial variation. The North is the region where supply and demand are closer, with an occupation rate of 90%, while in Alentejo, clearly there is an excess in the overall supply (see Table 11).

²⁷Note that occupation rates above 100% may follow from the rules in the national contest for allocating students. For instance, students with the same grade point average and fulfilling all the entrance requirements should all be admitted to a given study programme, which may imply that additional places are created in order to accommodate some students.

Table 11: Distribution of occupation rate by NUT2 and area of study, 2006

NUT2	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total
Alentejo	0.692	0.808	0.656	0.895	0.762	1.026	0.881	0.546	1.064	0.425	0.790
Algarve	0.867	0.758	0.793	0.946	0.940	0.633	0.719	0.790	0.973	0.713	0.850
Centro	0.928	0.995	0.961	0.981	0.926	1.021	0.839	0.627	1.043	0.685	0.888
Lisboa	0.689	1.003	0.787	0.990	0.974	0.923	0.985	0.557	1.033	0.783	0.879
Norte	0.796	0.997	0.888	0.997	0.912	0.888	0.813	0.879	1.034	0.799	0.900
Açores	1.045	1.000	0.950	0.944	0.943		0.550	0.450	0.979	0.553	0.863
Madeira		0.767	0.340	1.018	1.036	0.900	0.800	1.040	1.000	0.658	0.835
Total	0.794	0.969	0.849	0.979	0.930	0.958	0.843	0.672	1.034	0.747	0.880

Note: See footnote 1, Table 10.

The analysis of the occupation rate, however, does not indicate how satisfied students allocated to the places are. The fact that students rank over a maximum of six alternative study/institution pairs allows us to know what their (conditional) best choices are. Table 12 shows the proportion of admitted students to the first option by higher education institution, which is a proxy for students' happiness. The proportion for the whole system is about 66%, which hides differences between subsystems, that is, a proportion of about 69% in the university subsystem contrasts with a rate of about 61% in polytechnics. The highest proportion of students admitted in their first option is achieved in the field of Technology for both subsystems. For the other fields of study there is considerable variation across institutions.

Table 12: First option-admitted ratio by institution and area of study, 2006

Institution	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total
ENautica Infante D. Henrique					0.395					0.846	0.510
ES Enfermagem Angra Heroísmo									0.600		0.600
ES Enfermagem Artur Ravara									0.563		0.563
ES Enfermagem Bissaya Barreto									0.530		0.530
ES Enfermagem C. Gulbenkian Lisboa									0.645		0.645
ES Enfermagem Cidade Porto									0.264		0.264
ES Enfermagem D. Ana Guedes									0.440		0.440
ES Enfermagem Dr. Ângelo Fonseca									0.659		0.659
ES Enfermagem Francisco Gentil									0.183		0.183
ES Enfermagem Maria Fernanda Resende									0.686		0.686
ES Enfermagem São João									0.645		0.645
ES Hotelaria Turismo Estoril				0.733	0.667						0.687
PI Beja	0.472	1.000	0.500	0.628	0.909	0.111	0.561		0.351	0.857	0.583
PI Bragança	0.403	0.545		0.613	0.467	0.367	0.560	0.875	0.354	0.539	0.489
PI Castelo Branco	0.486	0.686		0.648	0.635		0.486	0.550	0.516	0.573	0.587
PI Cávado&Ave		0.588		0.800	0.779					0.508	0.675
PI Coimbra	0.413	0.645	0.065	0.600	0.558	0.355	0.711	0.810	0.307	0.794	0.580
PI Guarda	0.407	0.385		0.458	0.604	0.333	0.554	0.684	0.359	0.714	0.492
PI Leiria	0.370	0.550	0.608	0.622	0.813	0.862	0.513	0.500	0.455	0.762	0.647
PI Lisbon		0.818	0.205	0.687	0.652		0.722		0.351	0.786	0.622

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... table 12 continued

Institution	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total
PI Oporto		0.900	0.039	0.719	0.841		0.696	1.086	0.408	0.764	0.698
PI Portalegre	0.508	0.547		0.568	0.773		0.387	0.580	0.329	1.000	0.535
PI Santarém	0.843	0.500		0.596	0.766	0.448	0.835		0.364	0.313	0.577
PI Setúbal	0.667	0.615		0.548	0.693	0.357	0.783	1.000	0.610	0.722	0.667
PI Tomar	0.472	0.628		0.583	0.519			0.889		1.000	0.638
PI Viana do Castelo	0.486	0.587		0.700	0.782	0.576	0.583		0.559	0.552	0.585
PI Viseu	0.482	0.733		0.664	0.686		0.594	0.368	0.384	0.873	0.620
Total Polytechnic	0.472	0.634	0.343	0.627	0.697	0.505	0.631	0.718	0.446	0.732	0.608
ISCTE		0.250		0.575	0.666			0.583		0.891	0.644
Technical U	0.641	0.668	0.606	0.465	0.501	0.838			0.542	0.935	0.723
U Algarve	0.295	0.714	0.478	0.671	0.753	0.895	0.680	0.807	0.397	0.893	0.655
U Aveiro	0.489	0.605	0.447	0.586	0.584	1.207	0.675	0.592	0.540	0.767	0.630
U Azores	0.478	0.680	0.684	0.798	0.924		0.955	0.333	0.610	0.851	0.756
U Beira Interior		0.433	0.221	0.469	0.812	0.644	1.000	0.318	0.353	0.786	0.486
U Coimbra	0.563	0.742	0.486	0.759	0.769	0.677	0.284	0.675	0.536	0.821	0.679
U Évora	0.732	0.417	0.441	0.594	0.835	0.462	0.629	0.848	0.420	0.838	0.588
U Lisbon		0.640	0.708	0.723		0.650	0.484	0.746	0.518	0.671	0.660
U Madeira		0.957	0.588	0.672	0.789	0.667	0.604	0.923	0.603	0.962	0.744
U Minho		0.627	0.651	0.738	0.895		0.774	0.606	0.677	0.645	0.691
U Nova	0.706	0.923	0.419	1.000	0.943	0.950		0.740	0.730	0.776	0.811
U Oporto	0.327	0.845	0.510	0.837	1.082	1.045	0.210	0.629	0.655	0.858	0.753
UTAD	0.442	0.500	0.345	0.616	0.910	0.618	0.638	0.545	0.622	0.736	0.581
Total University	0.510	0.656	0.517	0.706	0.768	0.771	0.575	0.676	0.563	0.815	0.687
Total	0.488	0.648	0.502	0.678	0.735	0.673	0.610	0.681	0.504	0.784	0.656

Note: 1. The first option-places ratio is computed as the total number of places taken by students who placed it as first option to the total number of places announced.

2. The study areas in the table are the following: agriculture (agric), architecture (arch), natural sciences (natsc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).

3. U stands for University and PI stands for Polytechnic Institute.

A deeper analysis of the market requires, however, additional measures. Firstly, an indicator of the demand pressure has been computed, r_i , which is the ratio of the number of hits each institution i gets (h_i) to the number of places in that institution (p_i). Its computation is based on students' revealed preferences, and is given by:

$$r_i = \frac{h_i}{p_i}. \quad (2)$$

It is important to note that hits are the total number of times an institution/study is chosen. It can be seen as an indicator of the students' interest in the study programme, and therefore a measure for the potential demand for that study, or its ability to attract new students.

Table 13: Indicators on market (des)equilibrium, 2006

Institution	r_i	\bar{O}_i	\bar{G}_i	s_i	w_i
PI Beja	4.00 (13)	2.10 (9)	128 (13)	0.63 (12)	0.56 (11)
PI Bragança	3.73 (14)	2.37 (15)	129 (12)	0.50 (14)	0.70 (15)

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... table 13 continued

Institution	r_i	\bar{O}_i	\bar{G}_i	s_i	w_i
PI Castelo Branco	5.51 (6)	2.10 (9)	132 (7)	0.90 (9)	0.52 (10)
PI Cávado&Ave	6.21 (3)	1.70 (1)	134 (3)	1.22 (3)	0.37 (2)
PI Coimbra	6.03 (4)	2.11 (12)	132 (7)	0.93 (8)	0.46 (4)
PI Guarda	5.39 (7)	2.33 (13)	128 (13)	0.64 (11)	0.59 (12)
PI Leiria	5.39 (7)	1.92 (4)	134 (3)	1.07 (5)	0.37 (2)
PI Lisbon	6.96 (1)	1.94 (5)	142 (1)	1.45 (2)	0.46 (4)
PI Oporto	6.69 (2)	1.79 (2)	139 (2)	1.54 (1)	0.32 (1)
PI Portalegre	4.45 (11)	2.33 (13)	131 (10)	0.52 (13)	0.66 (14)
PI Santarém	5.70 (5)	2.10 (9)	132 (7)	1.00 (6)	0.46 (4)
PI Setúbal	4.68 (9)	1.85 (3)	133 (5)	1.10 (4)	0.50 (8)
PI Tomar	2.57 (15)	2.07 (8)	128 (13)	0.39 (15)	0.64 (13)
PI Viana do Castelo	4.62 (10)	2.03 (7)	133 (5)	0.95 (7)	0.47 (7)
PI Viseu	4.22 (12)	1.96 (6)	130 (11)	0.76 (10)	0.52 (9)
ISCTE	7.75 (2)	1.67 (4)	141 (9)	1.72 (2)	0.33 (3)
Technical U	5.70 (7)	1.69 (6)	146 (4)	1.26 (7)	0.34 (4)
U Algarve	4.78 (11)	1.93 (11)	135 (14)	1.00 (10)	0.44 (10)
U Aveiro	8.05 (1)	1.86 (9)	141 (9)	1.59 (4)	0.38 (7)
U Azores	3.95 (14)	1.61 (3)	138 (11)	0.96 (12)	0.36 (6)
U Beira Interior	6.66 (3)	2.38 (14)	142 (6)	1.16 (9)	0.60 (14)
U Coimbra	5.98 (4)	1.84 (8)	146 (4)	1.19 (8)	0.40 (9)
U Évora	5.57 (8)	2.11 (12)	138 (11)	0.95 (13)	0.53 (13)
U Lisbon	3.96 (13)	1.88 (10)	147 (2)	0.95 (13)	0.44 (10)
U Madeira	4.46 (12)	1.60 (2)	142 (6)	1.66 (3)	0.38 (7)
U Minho	5.46 (9)	1.67 (4)	142 (6)	1.30 (6)	0.35 (5)
U Nova	5.85 (5)	1.54 (1)	147 (2)	1.44 (5)	0.29 (2)
U Oporto	5.82 (6)	1.72 (7)	154 (1)	1.77 (1)	0.25 (1)
UTAD	5.45 (10)	2.14 (13)	137 (13)	0.97 (11)	0.51 (12)

Note: 1. The occupation rate is also showed for comparison. See the text for an explanation of the indices.

2. For each indicator we present its value, as well as the rank of the institution within each subsystem (in brackets).

3. U stands for University and PI stands for Polytechnic Institute.

The demand pressure index and the rank positions according to it are shown in the first two columns of Table 13. Within the university sector, University of Aveiro and ISCTE are the institutions that better perform regarding the demand pressure, contrasting with the universities of Azores, Lisbon, Madeira and Algarve that belong to the group with the worst performance. This may reflect the remoteness of the universities of Azores, Madeira and Algarve. Polytechnics of Lisbon and Oporto show a high ability to attract students, whereas those of Tomar, Bragança and Beja are of interest to much less students.

Similar indicators can be computed using the set of choices of each candidate. The choice set includes at most six choices, which are ranked according to their preferences, from the most to the least preferred option. In order to measure the degree of preference for a given higher education institution, we compute the average preference rank of the students who have been actually admitted to it, \bar{O}_i . The smaller \bar{O}_i , the better the higher education institution ranks.

Going back to Table 13, University Nova of Lisbon is the most preferred institution among admitted students, with an average preference rank of 1.54. It is closely followed by the universities of Madeira and Azores, located in remote regions (islands). The big average position of inland universities like those of Beira Interior, Évora and UTAD reveal that these are less likely to be in the top list of student choices. Regarding the polytechnic subsystem, the picture is pretty much the same: the Polytechnics of Bragança, Guarda and Portalegre appear to be the least preferred.

From the institutions standpoint, it is obviously important to fill the places available. It allows them to increase their capacity, and qualifies them for more public funding. But the quality of their student body also has a non-negligible role for the position of a higher education institution in the market. High performing students are the best inputs that an institution may look for, as they might start a virtuous cycle of high standards in education and stimulate research.

The stock of human capital at entrance of the pool of admitted students can work as an indicator of student body quality, and can be proxied by the mean of their grade point average. This indicator performance index has been called \bar{G}_i . Although it proxies the quality of the initial stock of human capital, the fact that it depends on study programme requirements is an obvious limitation, which should be taken into account when analysing the data. According to Table 13, University of Oporto is the institution with the best pool of students, as shown by an average entrance grade of 150 points. Again, there are differences between coastal and inland regions, with the former getting a better pool of students than the latter, the fact that inland universities offer much less places. The low population density in inland regions, associated with the fact that most higher education institutions have a rather local catchment area, may explain, at least partly, those differences. In this regard, it should be stressed that public higher education institutions are not entirely free to choose their students. Places and entrance requirements are defined in advance, and institutions have to accept all applicants that fulfil those requirements up to the limit of the *numerus clausus*.

Using student revealed preferences, we can go a step further and compute strength and weakness indicators. A major advantage of these indicators, as it will be shown later, is their ability to suggest how the system will adjust in case of changes in market regulations. The strength measure, s_i , is defined as

$$s_i = \frac{f o_i}{p_i}, \quad (3)$$

where fo_i is the total number of students choosing institution i as first option. The strength index can be interpreted as the proportion of places that are certain in the allocation of students to higher education institutions, since the first option reveals students' first-best. Given their constraints, specifically their grades in secondary education and the admission exams, students' decisions are the result of an optimization process, and, as such, are optimal. Under this assumption, first choices can be taken as absolute preferences that will not be changed. Students who have chosen a given study programme/institution as their first choice will complete their registration. If $s_i > 1$, then all places offered are filled for sure. This means that institutions would be able to expand their capacity if they are allowed to increase the number of places and admit more students. The opposite occurs when $s_i < 1$. That is, an institution might not be filling all places, which can be seen as a first indicator of institutional weakness.

From Table 13 it appears that polytechnics perform worse than universities regarding the strength indicator. University of Oporto shows the highest value for the strength measure (1.77). The immediate implication is that without supply constraints, the University of Oporto could increase the number of places by 77% without excess supply. Universities of Lisbon and Évora, on the contrary, are the institutions with the lowest strength value in the university subsystem. The fact that the strength index is below 1 for both implies that the end of the *numerurs clausus* regulation would cause them to loose students. In the Polytechnic subsystem, the institution in Oporto is once more the strongest one, as shown by the value of the index (1.54), while the Polytechnic Institute of Tomar has the smallest value of the overall system (0.49). This exercise makes it possible to get a first picture of the effects of the end of *numerurs clausus*, despite some limitations that should, however, be kept in mind. Namely, *numerurs clausus* are among the constraints that students take into account when applying to higher education, and therefore it cannot be taken as guaranteed that their choice set composition would be the same if that constraint did not apply. Values below 1 for the strength index indicate the weakness of some higher education institutions.

There are, however, better proxies for the degree of weakness faced by a given higher education institution. We compute a weakness index, w_i , defined as

$$w_i = \frac{p_i - FO_i}{p_i}, \quad (4)$$

where FO_i is the total number of first options among the admissions to higher education institution i . The index informs on the proportion of places filled with second-best alternatives, that is, the proportion of students that might be lost to other institutions in case

the distribution of places changes. The index is bounded between 0 and 1. The lower the value, the lower the weakness in case competing courses in other institutions were allowed to increase *numerus clausus*. The weakness indicator measures the degree of students' unhappiness, which might have consequences on their performance, as well as on drop out rates.

Table 13 summarizes the values for the weakness index by higher education institution. It shows that, similarly to what happens in the strength index analysis, the University of Oporto is the institution with the smallest proportion of students that potentially can be lost. In the polytechnic subsystem, the Polytechnic Institute of Bragança is the most fragile institution, which in the free access (no *numerus clausus*) scenario would loose 70% of its potential students (measured by places).

So far, we have discussed the indicators showing how they vary across higher education institutions. But there are other dimensions to be analysed. In particular, there is some variability in those indices according to the field of study. Table 14 shows the above presented indices computed for each field of study.

Table 14: Performance indices per program area in 2006

Area	r_i	\bar{O}_i	\bar{G}_i	s_i	w_i
Agriculture	4.04 (8)	2.29 (9)	132 (5)	0.58 (10)	0.62 (10)
Architecture	5.73 (3)	1.89 (6)	145 (2)	1.24 (3)	0.40 (3)
Natural Sciences	5.20 (5)	2.26 (8)	141 (3)	0.71 (8)	0.59 (9)
Law and Social Sciences	6.95 (2)	1.87 (5)	136 (4)	1.44 (2)	0.38 (2)
Economics	5.47 (4)	1.74 (2)	131 (7)	1.09 (4)	0.37 (1)
Sports and Arts	4.86 (6)	1.95 (7)	131 (7)	1.06 (5)	0.41 (4)
Education	4.03 (9)	1.82 (3)	129 (10)	0.84 (6)	0.50 (6)
Humanities	3.53 (10)	1.82 (3)	132 (5)	0.67 (9)	0.54 (7)
Health	10.58 (1)	2.42 (10)	156 (1)	2.15 (1)	0.55 (8)
Technology	4.12 (7)	1.60 (1)	131 (7)	0.75 (7)	0.49 (5)
Total	5.63	1.92	136.47	1.09	0.48

Notes: See notes 1 and 2, Table 13.

Several interesting conclusions come from results in Table 14. Health studies present by far the highest number of hits per place (r_i), about 10.6, revealing the highest demand pressure in the system. Humanities, on the contrary, present the lowest tension on the demand side (that is, 3.5). When accounting for all choices in admitted students' choice set (\bar{O}_i), we conclude that Technology studies are in the top of the preferences: the average position is approximately 1.6. Interesting enough is the fact that Health occupies the worst position, with an average rank above 2.4. As a result of the difficult access to those studies, prospective students might end up being placed in one of their low ranked preferences. Finally, the

highest average grade among the students accepted for a given study (\bar{G}_i) belongs to Health Studies (156), and the lowest to Education Studies (less than 130). Regarding the strength and weakness indices, Health is the area of studies counting with the highest strength (2.15), whereas the lowest belongs to Agriculture (0.58). Economic Studies counts with the lowest weakness level (0.37). Agriculture-type studies get in turn the highest value for the weakness index (0.62), meaning that about 62% of the places are filled by non-first options.

4.2 Adjustment in the higher education market

The indicators presented and discussed in the previous section make it possible to measure the degree of (dis)equilibrium between demand and supply, for the whole system and across institutions. In this section we use those indicators to discuss the existence of a higher education market in Portugal.

Jongbloed (2003) describes the set of necessary conditions for the existence of a higher education market. On the supply side, higher institutions should be free to enter the market, to specify the product, to use the available resources and to determine prices. On the demand side, students should be free to choose the provider and the study programme, and should benefit from adequate information on prices and quality, and should pay a price that covers education costs. Teixeira et al. (2004) analyze the existence of each and every condition regarding the Portuguese higher education system. These authors identify the three main issues at stake in the higher education system that prevent the creation of a real higher education market: (i) contestability absence; (ii) dissociation between prices and costs; and (iii) information insufficiencies. Teixeira et al. (2004) argue that the most important conditions for a free market are still absent from the Portuguese higher education system. The indicators presented in the previous section seem to corroborate their view.

The existence of low entry barriers is the main feature of those markets; that is, the threat of new entrants forces the existing institutions to behave in a competitive way. The initial investment that new higher education institutions need to make constitutes a barrier to freedom of entry in the market. Despite that, a good number of private institutions were able to enter the market. Nowadays, however, the reduction in the total number of applicants makes mergers between institutions very likely. A good example is the already announced merger between the University of Lisbon and the Polytechnic of Lisbon, which together take 5530 places, representing a 12% market share, in public higher education, in the school year 2006/07. This is quite an interesting example involving two institutions, being each of them quite specialized in terms of study programme offer, which will lead to a big institution with

a more diversified study programme offer. This follows from the complementarities in terms of study offer between the two existing institutions. If we recomputed the diversity index for the University of Lisbon, considering the intended merger, we would find that it increased from 0.785 to 0.863, taking into account computations based on the places available in each field of study.

Public higher education institutions do not behave as firms in several other ways. So far, they have been able to create the study programmes they wanted to, with public funding. Furthermore, due to public funding, wrong decisions, so far, were never penalised with bankruptcies, although the funding formula introduces incentives for the institutions to offer programmes that match the demand. Otherwise, they would be indirectly penalised through a reduction of the government financing which depends on the number of students. That means that if the study programme offer does not match the demand, institutions are obliged to adjust themselves as they will not receive funding for those programmes. However, there is a high rigidity within the institutions themselves that may hinder the adjustment to the changing conditions in the demand side of the market. Most of the rigidity comes from the faculty staff, which takes the biggest share of higher education budgets, whose qualifications are in most cases too specific of a scientific area. Given the difficulty institutions have to adjust by themselves, the government recently decided to stop financing study programmes with less than 20 students admitted. Institutions can continue to offer them, but at their own expenses. Using data for 2006 we conclude that the fully implementation of such a measure would result in a reduction of 234 programmes, representing 6503 places, that is, 24% and 14%, respectively. Polytechnics would be the most affected, losing 3372 places, that is, 18% of the places available in that subsystem.

An important conclusion from the previous section was that of an existing excess of capacity in the system, although it is not evenly distributed across institutions and areas of studies. Excess capacity is the consequence of demographic trends and large investments in the public sector during the 1990s: since in 2002/03 total places exceeded the number of candidates. This situation implies an increasing competition between higher education institutions for students. If the market mechanisms were at work in the higher education system, we would expect programmes facing an insufficient demand to adjust by reducing their tuition fees, or, keeping the price constant; the adjustment would have to be made via quantity, implying the close down of some programmes. The reverse would be expected for programmes facing a higher demand relative to the number of places.

In the public sector, tuition fees, the price students pay for the education they receive, have to be within certain limits that are established by law. Institutions are free to set the price within that interval. It is important to note, however, that even the maximum price charged is far below the real cost of the education provided. On the other hand, in private institutions the price is set such that students pay for the full education costs. This generates unfair competition between institutions from the two sectors, which is on the basis of the private institutions' claiming for the introduction of a voucher system. Furthermore, it has been shown that students get considerable returns from education investments (Cardoso, 2007; Portugal, 2004), suggesting that they should pay a bigger share of their education costs. This is obviously related to students' finance. The almost non-existent loan market for financing education studies might be an obstacle to investment in further education and is, at least partly, the result of information failures in the higher education market, where no credible information on institutional and programme quality really exists. The accreditation agency announced for 2007 can be seen as a first step towards a hierarchy of studies and institutions that would allow for better informed decisions.

Information insufficiencies refer to both education suppliers and consumers. On the one hand, students know very little about institutional and programme quality when applying to higher education. In Portugal there is no tradition regarding quality assessment and ranking of higher education institutions, which are on the basis of a real higher education market. In fact, a real market requires that students become critical consumers, which is only possible if information on quality is made publicly available. Although, when applying to higher education, students do not have all the information about the quality of the programme and about the future return of their investment; they base their decisions on their own information set, and therefore students' choices can be seen as optimal. In that sense, the strength and weakness measures presented could be used as indicators of higher education institutions quality and, therefore, as indicators of the future adjustment in the higher education system.

As an example, the strength measure could be used to evaluate the potential effect of deregulating the Portuguese higher education market, namely, the impact of free access to higher education (i.e., no *numerus clausus*), the most rigid element on the supply side. It follows from Table 12 that ISCTE and University of Oporto could raise their places in 72% and 77%, respectively. Institutional rankings based on students' revealed preferences, like the one proposed by Avery, Glickman, Hosby and Metrick (2004), may benefit from indicators as the strength and weakness indices presented in this paper. However, further research is

required in order to make sure that institution rankings are not a distorted picture of reality.

5 Concluding remarks

This paper contributes to the ongoing debate on the regulation and marketisation of higher education. It aims at analysing the Portuguese higher education system by suggesting a set of demand and supply indicators, as well as some measures of the imbalances in that market.

The supply and demand sides of the market have been analysed. University programme diversity is higher than that in the polytechnic subsystem. Universities are more spatially concentrated and offer the majority of places (i.e., about 60%). Total demand for the university subsystem is higher and concentrated in the most populated regions. Applicant preferences' consistency is higher for the university subsystem and for institutions located in regions with no local competition, which seems to corroborate the well-known negative impact of distance on students' choices.

Several measures of the (mis)match between demand and supply have been proposed. Occupation rate shows variation across institutions, fields of study, and regions. That is, the proportion of available places that are filled is higher in the university subsystem, although there is a considerable variation in that rate across institutions and fields of study. Most universities show occupation rates above 80%, whereas six polytechnics are below that level. The highest ratio is found for Health studies with rates above 100%, contrasting with rates below 75% for Humanities and Technology. The Northern region is where the supply and demand are closer, with an occupation rate of 90%, while Alentejo presents excess supply. In order to measure applicants' well-being, we compute the proportion of students admitted in their first option. Once again, that proportion is higher in the university (69%) than in the polytechnic subsystem (61%). Studies in the field of Technology appear to have the best matching (about 78%).

We also propose a set of measures to characterize the type of equilibrium in the market. Demand pressure on study programmes and institutions, measured by the ratio of the total number of hits to the number of places; degree of attractiveness, that is, the average preference rank; and student quality proxied by the mean grade point average of all admitted candidates, are among the indicators in use for the analysis. University of Aveiro and ISCTE show the highest demand pressure. Universities in regions with smaller pools of candidates, such as those in the islands (Madeira and Azores) and the University of Algarve, as well as the University of Lisbon, which shares the location with three other universities, face a

lower demand. The highest average preference rank goes for the University Nova of Lisbon. Inland universities (Beira Interior, Évora and UTAD) are less likely to be in the top of students' preferences, as they are polytechnics located in inland regions (Bragança, Guarda and Portalegre). The University of Oporto receives the best pool of students with an average entrance grade of 150 points. Coastal universities get better students, on average, than those located in inland regions.

Finally, strength and weakness indicators, based on candidates' revealed preferences, have been proposed. Students' choices are the result of an optimization process, and therefore are optimal. Given the fact that first choices are absolute preferences, a picture of the system stability is obtained by assessing the match between them and the corresponding available places. We conclude that, in both subsystems, the institutions located in Oporto get the highest value for the strength index, computed as the proportion of first options to the available places. Universities of Évora and Lisbon are the ones performing the worst according to that indicator. When considering the polytechnic subsystem, the lowest strength is achieved by the Polytechnic of Tomar. The weakness index, the proportion of places filled with second-best alternatives, complements that analysis. The index analysis confirms the best position of the University and the Polytechnic of Oporto, whereas the Polytechnic Institute of Bragança shows up to be the most fragile institution.

These indicators can be used in predicting the impact of changes in higher education regulations on market equilibrium and stability. Institutions with higher values for strength and lower values for weakness indices could enhance their market share if *numerus clausus* did not apply. Such policy would foster the marketisation of the higher education system, by improving the match between demand and supply. However, a dynamic long-run analysis is required, as such measure could also result in a reduction of the number of higher education institutions, and therefore in a higher concentration and lower competition in the system.

The set of indicators proposed in this paper sets the stage for a rank-based analysis of the Portuguese higher education system. Each indicator characterises the system under a different perspective, but they also complement each other in portraying the mechanisms at work in the market. All proposed indicators, however, refer to the application moment. A deeper analysis on institutions performance is then needed, which requires the construction of performance measures accounting for, for example, graduates' labour market outcomes. Such institutions' rankings based on students' revealed preferences and graduates' labour market outcomes, would allow for comparing institutions on a like-for-like basis, and would

contribute to inform student choices, a basic requirement for a real higher education market.

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Appendix A: Additional tables

Table 15: Distribution of the number of study programmes by institution and area of study, 2006

Institution	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total	Diversity
ESuperiores	0	0	0	2	6	0	0	0	11	2	16	
PI Beja	3	1	1	4	1	1	2		2	3	18	0.896
PI Bragança	7	1		4	4	2	7	1	6	10	42	0.863
PI Castelo Branco	2	3		6	4		2	1	5	7	30	0.840
PI Cávado&Ave		2		1	3					2	8	0.574
PI Coimbra	5	2	1	7	4	1	3	1	6	12	42	0.874
PI Guarda	1	1		5	4	1	2	1	3	4	22	0.872
PI Leiria	2	4	2	12	5	2	3	2	2	7	41	0.900
PI Lisbon		1	1	4	3		3		11	7	30	0.722
PI Oporto		1	1	7	7		7	2	12	13	50	0.783
PI Portalegre	3	2		6	2		2	2	2	3	22	0.863
PI Santarém	2	1		4	3	5	3		2	2	22	0.862
PI Setúbal	1	1		3	5	1	4	1	3	8	27	0.839
PI Tomar	1	5		1	6			1		6	20	0.659
PI Viana do Castelo	4	2		2	2	1	3		1	7	22	0.817
PI Viseu	7	2		7	5		5	1	2	6	35	0.839
Total Polytechnic	38	29	6	75	64	14	46	13	68	99	452	0.902
ISCTE		1		5	5			1		3	15	0.615
Technical U	6	8	4	6	4	3			2	18	51	0.805
U Algarve	3	4	4	8	7	1	4	4	8	7	50	0.952
U Aveiro	1	2	9	5	7	1	2	5	5	14	51	0.879
U Azores	2	1	2	8	2		2	1	3	5	26	0.855
U Beira Interior		4	4	4	2	2	1	2	3	5	27	0.914
U Coimbra	1	1	7	13	3	3	2	7	3	11	51	0.871
U Évora	3	3	6	4	2	2	2	4	2	4	32	0.969
U Lisbon		6	10	5		1	1	14	6	5	48	0.798
U Madeira		2	2	4	2	1	3	1	2	1	18	0.908
U Minho		3	6	7	3		3	6	3	13	44	0.838
U Nova	1	2	4	5	4	1		6	1	10	34	0.838
U Oporto	3	5	10	7	2	1	1	10	5	13	57	0.889
UTAD	6	1	6	6	2	2	3	2	1	6	35	0.918
Total University	26	43	74	87	45	18	24	63	44	115	539	0.938
Total	64	72	80	162	109	32	70	76	112	214	991	0.948

Notes: 1. The study areas in the table are the following: agriculture (agric), architecture (arch), natural sciences (natsc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).
2. U stands for University and PI stands for Polytechnic Institute.

Table 16: Distribution of first options by institution and area of study, 2006

Institution	agric	arch	natsc	lawsoc	eco	sparts	educ	hum	health	tec	Total
Esuperiores				190	458				2064	11	2723
PI Beja	34	16	12	110	40	2	37		113	30	394
PI Bragança	64	12		130	50	12	100	14	333	142	857
PI Castelo Branco	34	106		157	72		42	11	345	109	876
PI Cávado&Ave		71		80	206					40	397
PI Coimbra	126	136	3	301	155	14	144	65	217	438	1599
PI Guarda	11	15		89	99	29	44	13	180	30	510

Continued on next page...

... table 16 continued

Institution	agric	arch	natssc	lawsoc	eco	sparts	educ	hum	health	tec	Total
PI Leiria	26	163	97	592	237	89	52	5	277	218	1756
PI Lisbon		190	18	803	471		260		565	446	2753
PI Oporto		39	6	794	776		140	52	1078	790	3675
PI Portalegre	44	32		127	17		12	29	98	20	379
PI Santarém	46	14		154	103	137	82		233	21	790
PI Setúbal	6	17		135	233	5	197	3	459	260	1315
PI Tomar	17	93		25	80			8		62	285
PI Viana do Castelo	91	64		107	85	22	75		127	96	667
PI Viseu	90	47		323	119		87	7	278	103	1054
Total Polytechnic	589	1015	136	4117	3201	310	1272	207	6367	2816	20030
ISCTE		81		569	665			22		192	1529
Technical U	151	751	81	365	448	325			504	1322	3947
U Algarve	25	113	82	331	262	17	104	74	573	177	1758
U Aveiro	26	146	299	439	397	35	131	181	485	1018	3157
U Azores	11	22	36	227	65		21	3	119	40	544
U Beira Interior		136	77	184	107	107	4	7	729	55	1406
U Coimbra	18	69	243	1382	338	184	70	116	832	391	3643
U Évora	168	104	50	211	106	38	86	30	97	31	921
U Lisbon		491	563	879		45	44	260	948	217	3447
U Madeira		26	10	391	121	12	37	38	199	76	910
U Minho		129	146	671	330		218	183	479	737	2893
U Nova	36	36	160	767	788	21		177	957	580	3522
U Oporto	155	754	635	1117	452	421	71	409	1785	1182	6981
UTAD	132	27	183	386	81	157	30	6	175	88	1265
Total University	722	2885	2565	7919	4160	1362	816	1506	7882	6106	35923

Note: 1. The total number of first-options in this table refers to the number of student choice sets which first choice is a study on a given area of study in a given university.

2. The study areas in the table are the following: agriculture (agric), architecture (arch), natural sciences (natssc), law and social sciences (lawsoc), economics (eco), sports and arts (sparts), education (educ), humanities (hum), health (health), and technology (tec).

3. U stands for University and PI stands for Polytechnic Institute.

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