From Public to Private: How Public Capacity Constraints Fuel Private University Enrollment *

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September 29, 2025

Abstract

In the last decade, an increasing number of students across several European countries — such as Spain, France, Italy, Germany and Finland — have opted for private universities over public ones, despite the higher costs associated with private education. This trend raises questions about the role of capacity constraints at public universities, where students are selected based on entrance scores until full capacity is reached. Such constraints often force students to either settle for less preferred majors or turn to more expensive private institutions. This paper examines the extent to which public capacity constraints have promoted the growth of private universities. A partial equilibrium model is introduced where heterogeneous individuals (in terms of ability and initial wealth) choose between public and private universities across ten distinct fields of study, resulting in a total of twenty different educational options. Using data from Spain, our findings reveal that 28% of private university enrollments can be attributed to public capacity constraints. The analysis also indicates that private students who considered public universities as a first option lower the average admission scores at private universities and also the average student wealth levels. Furthermore, the study quantifies several factors that might have contributed to the rise of private Spanish universities from 2015 to 2020, with tighter public capacity constraints and increased population wealth being the most influential.

*We are grateful to our supervisors, Giacomo Calzolari, Russell Cooper and Alexander Ludwig, for their feedback and guidance. We also thank the Sistema Integrado de Información Universitaria (SIIU) for granting access to the microdatabase essential to our analysis. The travel required to obtain this dataset was supported by EUI mission funds, for which we are thankful. This paper has further benefited from the insightful comments of participants at the SAEe 2024 conference and various EUI working groups. In particular, we would like to thank Alexander Monge-Naranjo, Siyu Shi and Ernesto Villanueva.

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1 Introduction

Since 1995, there has been a notable shift in the enrollment patterns of Spanish undergraduate students, with an increasing number opting for private universities over public ones (Figure 1). In the 90's, 3% of the students attended a private college; nowadays, this number is the 21% of the students. Given that private universities are approximately ten times more expensive than their public counterparts, this substantial increase in private university enrollment is particularly surprising.

However, the increase in private university enrollment has been heterogeneous across different fields of study. In this paper, we propose an explanation for this phenomenon which also contributes to the rise of private universities: the capacity constraints in certain fields of study at public universities. Public universities in Spain have limitations on the number of students they can admit and select students based on their scores from the university entrance exam. Figure 2 shows that degrees with higher cut-off scores are associated with a larger enrollment size in private universities compared to public ones. This suggests that the excess demand in certain fields of study is driving the development and expansion of private universities.

The study of the increasing enrollment in private universities is a significant topic as it is not an isolated phenomenon. According to data from the OECD, countries in Europe, such as France, Germany and Italy, have also experienced an increase in the enrollment share in private universities (Figure 3).

This paper focuses on the years 2015-2020, as this time span provides the necessary data to estimate the model. During these years, there has been a 33% increase in undergraduate enrollment in private universities. This increase in demand for private university education has been accompanied by an expansion in supply, as evidenced by a 30% increase in the number of professors at private universities between 2015 and 2020.

To explain the recent increase in private university enrollment, the study examines public capacity constraints by field of study as a key factor driving this trend. Additionally, we explore how capacity constraints affect the composition of both public and private universities. This is of interest since public and private universities typically differ in the composition of their student bodies. As shown in Table 1, students with lower entrance exam scores and parents with higher occupational statuses are more likely to choose private universities.

This paper introduces a partial equilibrium model where heterogeneous individuals differ in terms of ability and initial wealth. They choose between public and private universities across ten distinct fields of study, resulting in a total of twenty different educational options. Individuals cannot attend a specific field of study in a public university if their score is below a field-specific cut-off. This cut-off is endogenously generated within the model: it ensures the demand for public university places does not exceed capacity constraints. Using data from Spain, our findings reveal that 28% of private university enrollments can be attributed to public capacity constraints. The analysis also indicates that private university students who were rejected from public universities lower the average admission scores at private universities. Furthermore, the study quantifies the contributions of various factors to the rise of private Spanish universities from 2015 to 2020. Beyond the capacity constraints of public universities, these factors include university prices, student composition and population size, education quality and parental income levels.

The paper is structured as follows. Section 2 reviews the related literature on this topic. Section 3 presents, solves and analyzes the model. Section 4 describes the data used to calibrate the model. Section 5 calibrates the model and Section 6 explains the obtained results. Finally, Section 7 concludes and establishes the lines of future work.

2 Related literature

Several theories explain why students choose private universities over public ones. These include signaling a higher status (Cuesta (2019)), the more diversified and specialized offerings of private universities (Teixeira et al. (2012))

and the superior capacity of private universities to invest in higher ability students (Epple, R. Romano, et al. (2017)) or research (De Fraja and Iossa (2002)). This paper focuses on public capacity constraints as a significant factor driving the growth of private universities. When a field of study in a public university becomes unavailable to some students due to a lack of spots, private universities may serve as an alternative for pursuing the desired field. In Spain, there is already evidence that this channel contributes to the growth of private universities, as documented by Herrero and Campillo (2006).

The main contribution of this paper is to highlight how public capacity constraints in different fields of study can drive the growth of private universities. This paper contributes to the literature on public capacity constraints, which is more commonly discussed in the context of health services (W. Chen, Zhang, and X. Chen (2020)), the literature on the choice between public and private education (Epple, R. Romano, et al. (2017)) and the literature on major selection (Conzelmann et al. (2023); Arcidiacono, Hotz, and Kang (2012)).

In the model, individuals make discrete choices between types of universities and fields of study, with extreme value preference shocks for each educational choice, similar to those in Dvorkin and Monge-Naranjo (2019). The sorting and selection of students by abilities in public university higher education choices follow the approach of papers like Capelle (2019) and Epple, R. Romano, et al. (2017).

3 The choice of the type of University

This section describes a partial equilibrium model with educational discrete choices and taste shocks. It characterizes the solution of the model and examines how the results vary with changes in parameters.

3.1 Model description

This model involves three agents: individuals, public universities and private universities. Individuals have already decided to attend university but must still choose between public and private universities ($u \in \{PU, PR\}$) and among ten different fields of study ($j \in \{1, ...10\}$), resulting in 20 different options. Each major has a different price in public and private universities ($p_{u,j}$). Based on the data, we assume that private universities are more expensive than public ones in all the majors ($p_{PR,h} > p_{PU,j}$ for every h and j). Public universities have a quality normalized to 1 and require a minimum score, $\bar{a}_j$, to access each field of study. This cut-off score is endogenous and it will be determined using a the public capacity constraint. The capacity for each major at public universities (C_j) is fixed and exogenous, whereas the capacity at private universities is not limited. To access private universities, individuals just have to pay a tuition fee $p_{PR,j}$, which is higher than at public institutions, and will benefit from a quality level q. Considering that public quality is normalized to 1, the private quality q represents the quality differential between the two types of institutions. Note that the strategic decisions of private and public universities are not considered in this model.

Individuals are characterized by their initial wealth and ability, belonging to the type (y, a). Each individual type is randomly drawn from the frequency distribution of initial wealth and ability of university students, $\mu(y, a)$[1]. Individuals live in two periods, first as students and then as workers. They choose the type of university u an major j based on several factors: university prices $p_{u,j}$, major wages w_j, university quality q_u, the public cut-off scores $\bar{a}_j$, their own heterogeneous characteristics (y, a) and an individual preference shock $\epsilon_{u,j}$.

Their total consumption over both periods is determined by this decision. In the first period, consumption equals the initial wealth minus the university price; in the second period, it is the product of the individual's ability, the wage of the chosen field, and the university's quality. All individuals have ten field-specific cut-off constraints: if

[1]Since this is a frequency distribution, it encapsulates the information of the total number of university students, such that $\sum_{(y,a)} \mu(y, a) =$ Total university demand

their ability a is smaller than the cut-off $\bar{a}_j$, individuals won't be able to choose that field of study in the public university.

Given the prices $p_{u,j}$, university qualities q_u and public cut-off scores $\bar{a}_j$, the individual with type (y, a) solves the following optimization problem:

$$\mathcal{U}(y,a) = \max_{u,j} \{\log(U(y - p_{u,j}, aw_j q_u)) + \epsilon_{u,j}\}$$
$$\text{s.t. } a \geq \bar{a}_j \text{ when } u = PU$$

where $U(\cdot,\cdot)$ is a utility function that increasing and concave in both arguments. We will parametrize this function in the next subsection. Note that individuals have no mechanisms for savings from one period to another (hand-to-mouth). Besides, it is assumed that all individuals can afford even the most expensive universities, ensuring that the first argument of $U(\cdot,\cdot)$ is always positive. If the private university offers better quality than the public one, the educational decision becomes a trade-off between price and quality. Conversely, if the private university's quality is inferior to that of the public university, most students would opt for the public option.

We assume that the preference shock is an extreme value one, where $exp(\epsilon_{u,j})$ are independent random variables distributed Fréchet with a scale of 1 and curvature α. Due to the properties of extreme value shocks, we can derive a direct solution to this problem. Specifically, the probability of an individual of type (y, a) choosing public or private university and major j is given by:

$$P(PU, j|y, a) = \frac{\mathbf{1}\{a \geq \bar{a}_j\} U(y - p_{PU,j}, aw_j)^\alpha}{\sum_j \mathbf{1}\{a \geq \bar{a}_j\} U(y - p_{PU,j}, aw_j)^\alpha + U(y - p_{PR,j}, aw_j q)^\alpha}$$
$$P(PR, j|y, a) = \frac{U(y - p_{PR,j}, aw_j q)^\alpha}{\sum_j \mathbf{1}\{a \geq \bar{a}_j\} U(y - p_{PU,j}, aw_j)^\alpha + U(y - p_{PR,j}, aw_j q)^\alpha}$$

In this formulation, the curvature of the preference shock, α, can be interpreted as the relative importance of the shock with respect to the consumption utility $U(\cdot,\cdot)$. To address the situation where the full capacity in one public major is reached and private universities in the same major might act as better substitutes than other available educational options, we introduce the parameter γ in the probabilities:

$$P(PU, j|y, a) = \frac{\mathbf{1}\{a \geq \bar{a}_j\} U(y - p_{PU,j}, aw_j)^\alpha}{\sum_j \mathbf{1}\{a \geq \bar{a}_j\} U(y - p_{PU,j}, aw_j)^\alpha + (1 + \gamma \mathbf{1}\{a \geq \bar{a}_j\}) U(y - p_{PR,j}, aw_j q)^\alpha} \tag{1}$$
$$P(PR, j|y, a) = \frac{(1 + \gamma \mathbf{1}\{a \geq \bar{a}_j\}) U(y - p_{PR,j}, aw_j q)^\alpha}{\sum_j \mathbf{1}\{a \geq \bar{a}_j\} U(y - p_{PU,j}, aw_j)^\alpha + (1 + \gamma \mathbf{1}\{a \geq \bar{a}_j\}) U(y - p_{PR,j}, aw_j q)^\alpha} \tag{2}$$

Here, γ modulates the degree to which public and private universities in the same majors are considered substitutes. The larger γ is, the stronger the substitution effect when public capacities are filled.

Once this problem is solved, we can calculate the demand of each type of university and major as $D_{u,j} = \sum_{(y,a)} P(u, j|y, a)\mu(y, a)$. Public universities have a fixed capacity for each major, C_j, ensuring that the public capacity constraint holds:

$$D_{PU,j} = \sum_{(y,a)} P(PU, j|y, a)\mu(y, a) \leq C_j$$

If the total demand exceeds the capacity, the cut-off score $\bar{a}$ will increase to exclude students with lower abilities, balancing demand with capacity. If demand falls below capacity, vacancies will remain at the public university. Consequently, $\bar{a}$ will be set to $\min a$, allowing all students access to that major, regardless of their ability.

3.2 Analysis of the public education equilibrium

In this subsection, we explore how equilibrium is influenced by factors such as the ability and wealth levels and its distribution, university prices, university quality and the cut-off grade.

To simplify the analysis, we consider only two educational options: public and private universities. We normalize wages to 1, set the price of public universities to 0 and denote the price of private universities as p. The education choice problem is formulated as:

$$\max\{\underbrace{\log(U(y,a)) + \epsilon_{PU}}_{\text{Public U.}}, \underbrace{\log(U(y-p,aq)) + \epsilon_{PR}}_{\text{Private U.}}\}$$
$$\text{s.t. } a \geq \bar{a} \text{ when choosing public}$$

Thus, the probability that a type (y,a) student attends a public or private university is given by:

$$P(PU|y,a) = \frac{\mathbf{1}\{a \geq \bar{a}\}U(y,a)^{\alpha}}{\mathbf{1}\{a \geq \bar{a}\}U(y,a)^{\alpha} + U(y-p,aq)^{\alpha}}$$
$$P(PR|y,a) = \frac{\mu(y,a)}{\sum_{(y,a)}\mu(y,a)} - P(PU|y,a)$$

We specify the consumption utility function as $U(A,B) = \sqrt{A} + \beta\sqrt{B}$ where β denotes the time discount factor and the utility function is separable and concave in both arguments[2].

The demand of university types can vary with a change in the initial wealth and abilities distribution. This distribution may be modified by a variation in the total population size, in the relative size of the different types (y,a) or in levels (y,a). An increase in the total population that attend university would generate more demand and, generally, tighter capacity constraints. For understanding the other two cases, we analyze the effects on demand with increases of initial wealth or ability.

The probability of choosing each type of university depends on the comparative consumption utility of attending a public university $U(y,a)$ versus a private one $U(y-p,aq)$. An increase in initial wealth boosts both utilities, but because the utility function is separable, this increase translates into a proportionally larger increase in the utility of attending a private university:

$$\frac{\mathrm{d}U(y,a)}{\mathrm{d}y} = u_1'(y) < u_1'(y-p) = \frac{\mathrm{d}U(y-p,aq)}{\mathrm{d}y}$$

Consequently, higher initial wealth induce more students to attend private universities.

Regarding an increase of ability a, if the quality of the private university exceeds the public one ($q > 1$) then

$$\frac{\mathrm{d}U(y,a)}{\mathrm{d}a} = \frac{1}{2}a^{-1/2} < q\frac{1}{2}(aq)^{-1/2} = \frac{\mathrm{d}U(y-p,aq)}{\mathrm{d}a}$$

Thus an increase in ability lead to a higher demand for the higher quality institution.

The variation in demand for public universities also depends on the price of the private universities, the relative quality of the private universities, the cut-off grade. It is easy to see that when the price in private universities increases, the demand for public universities does so; whereas the demand decreases when the quality of the private university increases. An increase in the cut-off score creates a new equilibrium in demand up to the level dictated by the cut-off. Figure 4 illustrates how a specific rise in the cut-off score aligns public demand with both public

[2]Note that the IES here is 2

capacity and exogenous quality (q^*)[3].

4 Data

This section describes the data used for calibrating the previous educational choice model. We distinguish between two types of data: macrodata and microdata, both of which are available for the years 2015 and 2020.

4.1 Macrodata

The macrodata of the paper include university prices by type of university, the capacity of the public university and post-graduation wages, all of them by fields of study. All this data will be fed directly into the model. The data are publicly available on the web page of the Ministerio de Universidades, except for the prices at private universities. These were collected from L-earn.es, capturing the prices for about 60% of private universities for the academic year 2022-2023, segmented by field of study. Additionally, data from Encuesta de financiación y gastos de la enseñanza privada (INE) indicate that student expenditures at private universities increased by 7.2% from 2014 to 2020. Based on this, we assume that the data for 2020 for each field of study in private universities reflects the prices collected from the first web page and to obtain the prices for 2015, we adjust this to account for a uniform increase of 7.2% from 2015 to 2020 across all majors.

According to our university pricing data (Table 2), tuition at private universities is approximately ten times higher than at public universities across all fields. Moreover, tuition changes are likely to negatively impact private university enrollments, as private institutions have increased their prices while public universities have reduced theirs across all majors.

Table 3 presents the capacity of public universities in terms of the number of spots offered in each field. The change in every major is very heterogenous, with 4 sectors being reduced and 6 augmented. These public capacities are not directly comparable with the public enrollment used in the paper, since this offer just include some of the degrees, as it is provided in the data. Therefore, to compute the supply in the code, we have made an adjustment (private enrollment is weighted by $public\_enrollment\_offerDatabase/public\_enrollment\_fullDatabase$ to compute the supply).

We assume that, when making educational choices, students consider the wages of graduates from four years prior in the two years preceding the analysis. These wages are documented in Table 4, indicating that wages for decision-making in 2020 were higher than those in 2015, with significant increases observed in specific fields such as Health Sciences and Sciences.

4.2 Microdata

This subsection explains the microdata used to calculate the joint distribution of initial wealth and ability types, $\mu(a, y)$, and the probability of choosing each educational option for each type. These calculations will be used in the next section to calibrate our educational choice model.

The microdata set includes the following individual variables: the choice of university type and major, the entrance exam score (GPA) and parental occupations. Both GPA and parental occupation are of great interest because they will identify the individual type (y, a) in the model, as it will be explained in section 5. This dataset is not publicly available and was obtained from Ministerio de Universidades, who granted us access following a formal

[3]Note that the demand for private universities is effectively determined once the public university demand is known, as:

$$\text{Demand of private university} = \text{Total university demand} - \text{Demand of public university}$$

request. Parental occupations are linked with parental income using data from the survey cited in Encuesta annual de estructura salarial (INE) and employment percentages from the first semester as cited in Encuesta de la población activa (INE).

Table 5 shows the comparison of the microdata and the macrodata in enrollment. From 2015 to 2020, private university enrollment increased by 4.2 percentage points in the macrodata. However, due to data clearing[4], the percentages in the aggregate data and our available microdata are not exactly the same. In Table 6, we can see the share of students in private universities for each field of study. Despite the data clearing, most fields are well adjusted, with the exception of Education and Health Services where the private university share is underrepresented in the microdata.

Having the distributions of the GPA and the parental occupation in the data, allows to compute the frequency distribution of the model for each type $\mu(y, a)$. Due to data clearing in the microdata, in our code, we compute the frequency distribution of types $(\mu(y, a))$ as the distribution in percentage terms of the microdata times the total enrollment in the macrodata.

The GPA is the entrance grade required to enter any Spanish university. Individuals have the right to apply to a university if they achieve the GPA requirement (get more than a 5 over 10). The GPA is composed of 60% from high school grades and 40% from the selectivity exams. While students' high school grades are evaluated by their high school teachers, the selectivity exams are graded anonymously. The GPA ranges from 5 to 10, with 6 GPA levels considered in the data, each corresponding to the closest integer in the GPA scale. Table 7 shows the distribution of the GPA levels by year and university type. From this table, we observe that test scores in public universities tend to be higher than in private ones. Additionally, there has been an increase in the distribution of grades over time.

The individual parental occupation shows the level at which the occupation of the individual's parents is classified. The levels are: both parents with low occupations or without occupation, one parent with a medium occupation, both parents with medium occupations, one parent with a high occupation, and both parents with high occupations. The distribution of these parental occupations is shown in Table 8, where we can see that higher parental occupations are much more common in private universities than in public ones. Additionally, we observe that parents of students in universities have higher occupations over time.

To link the parental occupations with parental income, we connect the occupation type with the occupation categories (Ministerio de Universidades). The occupations are then linked to income data (Encuesta annual de estructura salarial (INE)) and their percentages in the population (Encuesta de la población activa (INE)). Using this information and considering the unemployment rates for individuals aged 35-55 (Encuesta de la población activa (INE)), we have induced the income for each parental occupation category, as shown in Table 9, assigning each parent the induced probabilities to belong to each group. We can see that this income has increased over time for each category.

It is of extreme importance the availability of the aggregate choices of each type (y, a) for each of the fields of study. This allows us to calibrate the model parameters by minimizing the distance between the demand generated by the model and these conditional moments. To get a flavour about how the educational choices are in the data, Table 1 shows the probability that a student with a certain score and parental occupation would choose a private university in 2020. In general, we see that students with higher entrance scores have a greater probability of attending public universities, while students with higher parental income have higher probabilities of attending private universities.

5 Calibration

In this section, we explain how we adjusted the initial wealth and ability levels based on the data, introducing two additional parameters to the model. Then, we describe how the model's parameters are calibrated using the

[4]This data includes only students under 30 years old and not all cohorts are included.

conditional probabilities of educational choices for each type. For the other exogenous variables, namely university prices, post-graduation wages, public capacity, and the frequency distribution of different types, we directly use the actual data.

As stated in the previous section, there are six GPA levels: 5-5.5, 5.5-6.5, 6.5-7.5, 7.5-8.5, 8.5-9.5, 9.5-10. Since these levels are equidistant, we link them to an extra ability level that is also equidistant: $0.75, 0.85, 0.95, 1.05, 1.15, 1.25$ in this order. We assume that an individual's ability in the model is defined as $a =$ GPA extra level$+s_a$. The parameter s_a indicates the importance of differences in abilities for future income in the model ($aq_u w_j =$ (GPA extra level $+$ $s_a)q_u w_j$). A larger s_a means that these differences are less significant for future income[5].

As shown in the previous section, the five parental occupation categories reflect five different parental income levels. We assume that initial wealth in the model is defined as $y =$ Parental income level $\times\, s_y$. The parameter s_y reflects the importance of parental income with respect to university prices, since consumption in the first period is $y - p_{u,j} =$ Parental income level $\times\, s_y - p_{u,j}$.

Now, we are in a position to estimate all the parameters in the model, denoted as $\Theta = (\beta, \alpha, q, \gamma, s_a, s_y)$. To do this, we minimize the squared distance between the conditional moments from the data (M_d) and the demand of each type generated by the model ($M_s(\Theta) = P(u, j|y, a)\mu(y, a)$), which depends on our parameters Θ as shown in equations (1) and (2). Thus, the minimization problem is:

$$\min_{\boldsymbol{\Theta}} (\mathbf{M}_d - \mathbf{M}_s(\boldsymbol{\Theta}))(\mathbf{M}_d - \mathbf{M}_s(\boldsymbol{\Theta}))'.$$

As a result, we will obtain the estimated parameters, $\hat{\Theta}$, and the endogenously generated $\bar{a}_j$ for each field of study.

The algorithm is as follows:

1. Fix a grid for the parameters Θ.
2. Fix one set of parameters Θ_i.
3. Start with the maximum ability type a'.
4. Compute the probabilities in (1) and (2) using a', every initial wealth type y and the parameters Θ_i.
5. Multiply these probabilities with the distribution of each type $\mu(y, a')$, getting the demand of each educational option for each type: $D_{u,j}(y, a') = P(u, j|y, a')\mu(y, a')$.
6. Compute the demand of students in the public university for each major j: $D_{PU,j}(\geq a') = \sum_{a \geq a'} D_{u,j}(y, a)$.
7. Compare the demand $D_{PU,j}(\geq a')$ with the capacity of the public university in that major C_j.
8. If the demand of the public university exceeds the capacity in major j', fix $\bar{a}_{j'} = a'$ and adjust the probability of attending that major in the public university so that these students meet the capacity perfectly[6].
9. If you are not done with all the ability types, select the next ability type $a' = a'_{-1}$ and come back to step 4.
10. Compute the loss generated by the squared difference of the demand from the model, $M_s(\Theta) = D_{u,j}(y, a))$ and the data moments, M_d.
11. If you are not done with the full grid of parameters, select the next set of parameters Θ_{i+1} and continue in step 3.
12. Get the parameters $\hat{\Theta}$ that compute the smallest loss obtained in step 10.

[5] A larger s_a would also result in higher total future income, but this would be offset by an increase in β.

[6] In this way, the students that want to attend the restricted educational option with lower ability than a' can't go, with higher ability than a' would be able to attend always and, if they have ability a', they would be assigned with probability $P^{adj}(PU, j'|a')$. Besides, the adjusted probability in each initial wealth type will be distributed according to the previous weights in the probabilities.

6 Results

This section exposes the results obtained from the calibration of the model. According to Table 10, the model overestimates the amount of students that go to private universities, stating that the increase has been 6pp. of the total enrollment instead of the 3.6pp. increase that gives the the microdata, thus, more work in the calibration will have to be performed in the future to better adjust the private increase.

For 2020, the estimated parameters using the calibration of the conditional moments are in Table 11. β being bigger than 1 manifest that the future consumption is more important for the individuals than the immediate one. Intuitively, this happens because the first consumption period is the university period (which last around four years) meanwhile the second period is the consumption for the rest of the working life, so total future consumption weights more than the immediate consumption in the university period. $\alpha = 6$ indicates that consumption utility is quite important relative to the preference individual shock. γ is 0, which means that private universities aren't better substitutes of the public universities for the same field of study than the rest of available educational options. Finally, s_a and s_y are estimated so that the ability levels and the initial income with respect to price are well adjusted. Giving that s_a is positive, giving less importance to the ability differentials and s_y is 1 so that the difference between current initial endowment and prices is well captured. The quality of the private university q is smaller than 1, which means that the private university is of lower quality than the public one.

The model predicts a cut-off score for every field of study and the percentage of students with that cut-off as a grade that would be able to attend that field of study in public university[7]. Table 12 shows the cut-off scores predicted by the model for each field of study and how tight they are for that ability level. According to the model, 7 of 10 fields of study in the public university would be at full capacity with a positive cut-off score[8]. The capacity constraints of the public university increase the enrollment in the private university. Shutting down the public capacity constraints, we can see that they are responsible for 28% of the enrollment in each private field of study. On the other hand, public capacity constraints make 15% of the public students to stay in public universities in a 2nd preferred option or onwards.

Regarding the composition of the students, Table 13 shows that the model accurately predicts the abilities and initial income of private and public university students. Consistent with the data, public university students have higher abilities (0.98) compared to private university students (0.94). This difference is mainly driven by private students who were rejected from public universities (0.87)[9]. On the other hand, private university students have higher initial endowments than public students. Those who choose private universities due to public rejections are poorer than those who chose private as their first option. This is likely because they initially preferred public universities for their lower cost. For public universities, the positive correlation between abilities and initial wealth provides a plausible explanation.

To determine the factors behind the increase in Spanish university enrollment from 2015 to 2020, we estimate the model using the same calibration obtained for 2020 while allowing the quality of education to vary. The results indicate that the quality of private universities remained constant from 2015 to 2020 (0.4). The generated cut-offs are similar by field of study but less strict than in 2020. We can now perform a decomposition exercise to attribute the 4.2% increase in private university enrollment between 2015 and 2020 to different factors. Figure 5 shows that the majority of the increase is due to tighter cut-offs (60%) and higher initial wealth levels (54%). This indicates that capacity constraints and the increase in students' initial wealth are the main drivers of the increase in private university enrollment during this period. A smaller portion of the increase is due to changes in cohort

[7] These students will be assigned randomly to that public field of study, so they would get in if they are lucky enough, otherwise they will be reallocated.

[8] However, this is mostly driven by the offer of the sectors, we think that with a calibration of the returns of the education in each field of study, the real cut-off would be better captured.

[9] In the model, there is no formal rejection. A student is considered "rejected" by the public system if, in a model without public capacity constraints (no cut-offs), they would choose a public university but, in the model with constraints, they opt for a private one.

size and composition (23%), while private university quality does not contribute at all since it remained unchanged. Conversely, two factors contribute negatively to the increase: post-graduation wages (-10%) and university prices (-27%)[10].

Why has it been the change? The cohort size of enrollment is bigger (since the population size of the cohort is bigger) and the composition has changed such that higher grades and wealthier students are more common (Table 14). Also, for each of the types, now it became more common to go to private university, specially for lower scores and also lower parental occupations (Table 15). This can be explained with the higher levels of wealth in the total population and the public capacity constraint (the two factors that contribute the most according to our exercise).

7 Conclusions and future work

This paper finds that capacity constraints in public universities significantly drive the increase in private university enrollment. Without these constraints, 28% of students currently in private universities would attend public institutions. The constraints affect student composition, resulting in private universities having students with lower abilities and less wealth. The findings indicate that private universities are growing mainly due to public capacity constraints and rising population wealth levels.

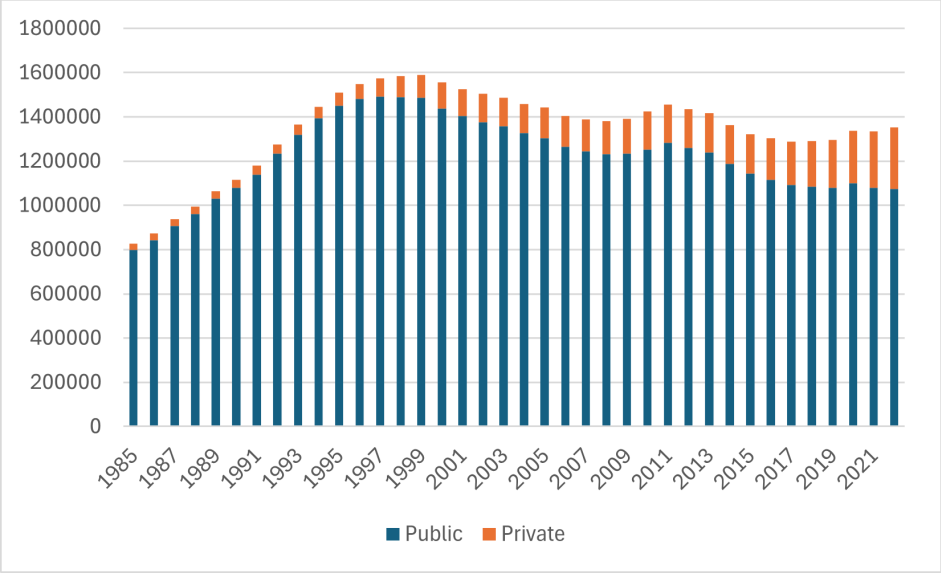
In the future, we would like to explore the consequences of increased private university enrollment driven by public capacity constraints. This will involve examining changes in productivity for both types of institutions and assessing the broader economic impacts (Vu and Vu-Thanh (2022); Lee (2005)), including the implications for public funding of higher education through taxes (Glomm and Ravikumar (1992); Epple and R. E. Romano (1996)). If the demand for fields of study aligns with employment demand, the private universities' ability to quickly adapt to student preferences could fill job vacancies more efficiently, potentially benefiting the economy (Conzelmann et al. (2023)). Additionally, the geographical location of universities is a crucial factor in individual choice (De Fraja and Iossa (2002)), which will be explored in future research. It is also essential to determine if the growth of private universities negatively impacts public ones, particularly in terms of quality (Romero and Rey (2004); Oliveira (2006)). Lastly, to fully understand the economic implications of university privatization, it is necessary to consider the outside option of not attending college and the budget constraints, as these are fundamental to educational choices (Lochner and Monge-Naranjo (2011)). These areas of research are of great interest and will be pursued in future work.

[10] This was predictable because public universities decreased their prices while private ones increased them from 2015 to 2020.

A Appendix

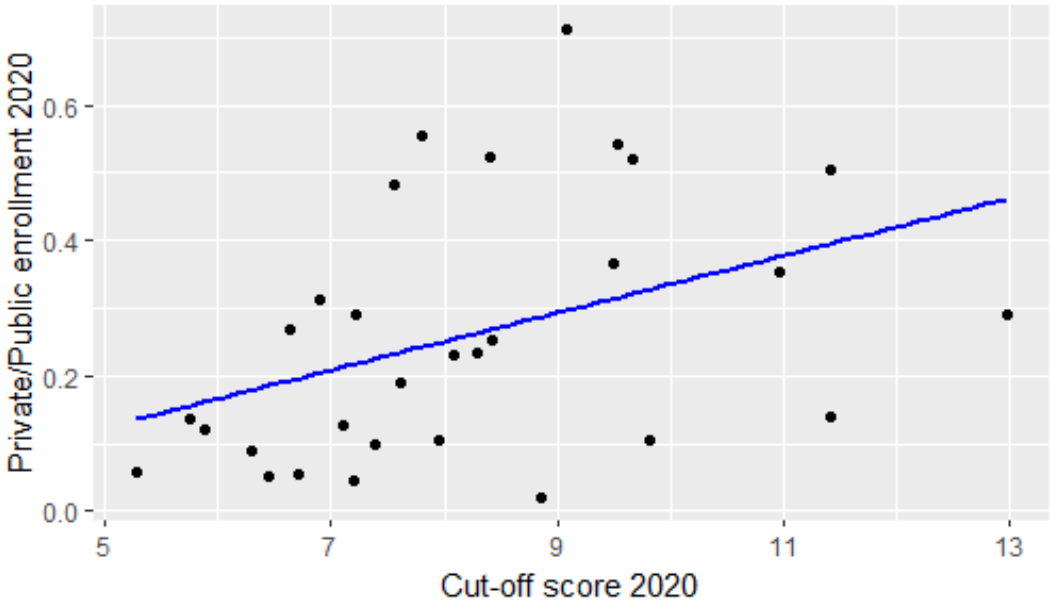
A.1 Figures

Figure 1: Total enrollment in Spain



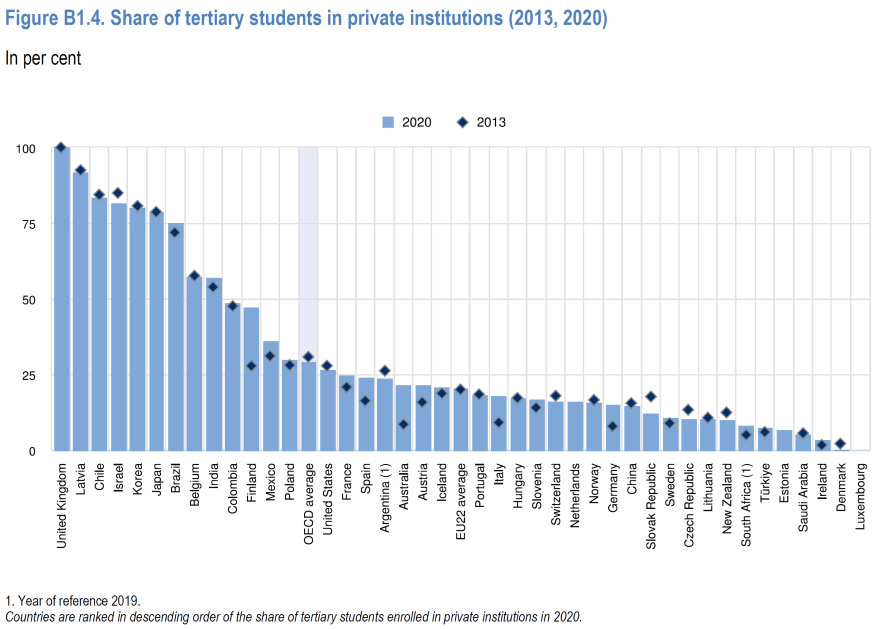
Source: data from Ministerio de Universidades.

Figure 2: Relationship between cut-off and size of private university



Source: Ministerio de Universidades.

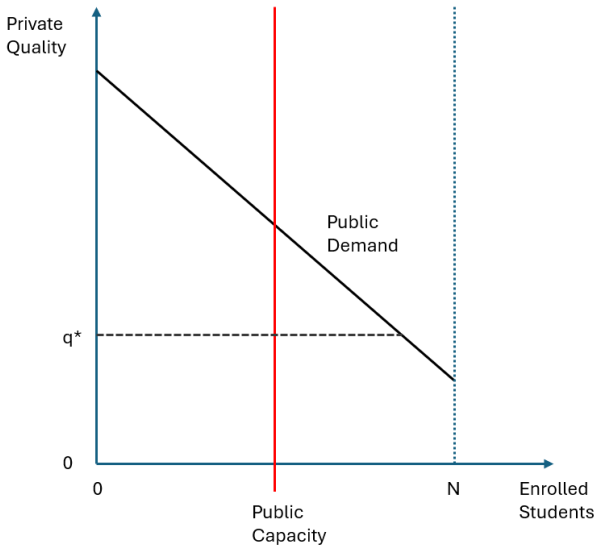
Figure 3: Private enrollment across countries



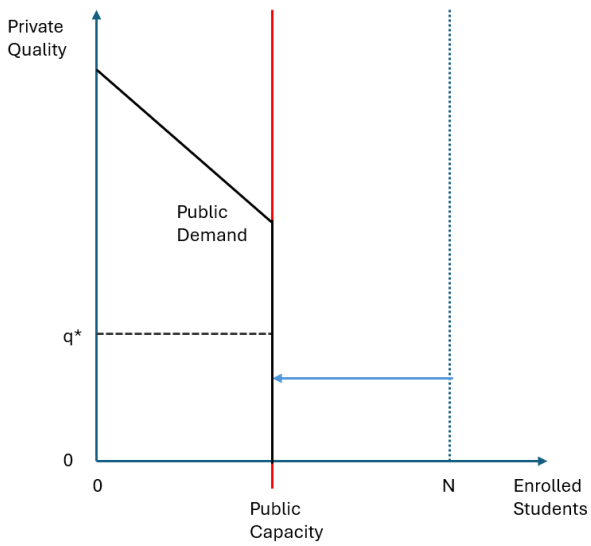
Source: OECD.

Figure 4: Determination of the cut-off ($\bar{a}$)

(a) Exogenous Quality (q^*)

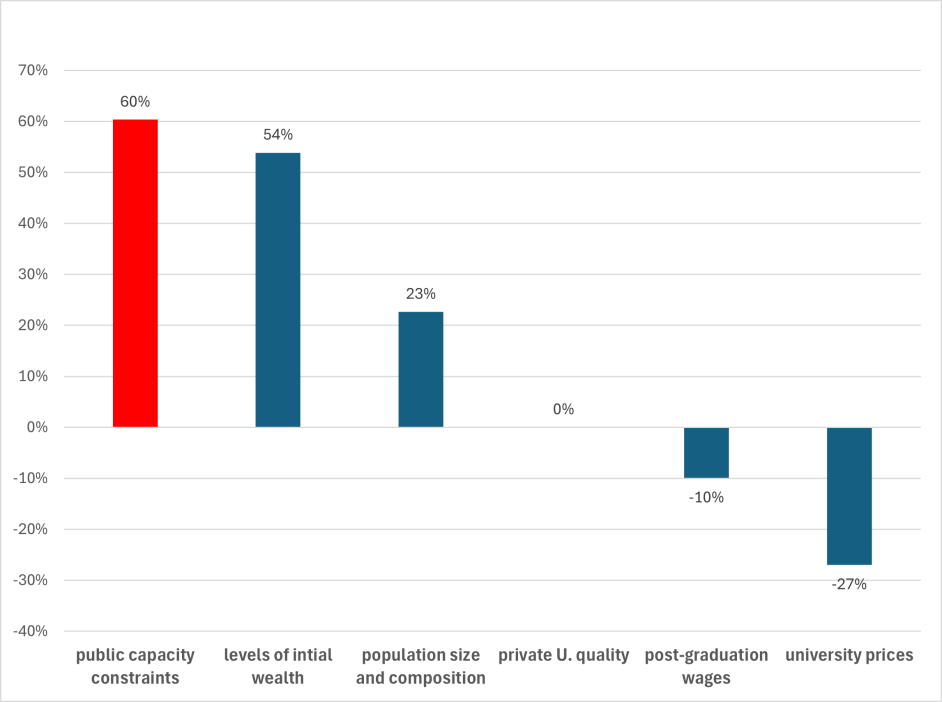


(b) Adjustment of the cut-off



Source: own elaboration.

Figure 5: Factors that contribute to the increase in private universities (2015-2020)



Source: results from the model.

A.2 Tables

Table 1: Percentage of students that attend private university by their characteristics

Score \ P.O.	Both Low	One Medium	Both Medium	One High	Both High	
5-5.5	12	12	16	22	29	(6)
5.5-6.5	8	9	13	18	24	(26)
6.5-7.5	7	6	9	13	19	(27)
7.5-8-5	6	5	8	12	17	(23)
8.5-9.5	5	4	6	9	12	(16)
9.5-10	4	3	5	6	7	(2)
	(18)	(17)	(14)	(28)	(22)	

Note: Values in percentages for the year 2020. Source: microdata from Ministerio de Universidades.

Table 2: Annual Prices

	Field of Study	Public 2015	Public 2020	Private 2015	Private 2020
1	Education	1002	882	14517	15546
2	Arts & Humanities	1080	931	10105	10822
3	Social Sciences	1157	998	13500	14447
4	Business & Law	1014	896	10622	11394
5	Sciences	1361	1138	7465	7989
6	Computing	1423	1188	12213	13093
7	Engineering	1463	1218	12907	13831
8	Agriculture	1399	1150	11600	12425
9	Health Services	1334	1132	12056	12918
10	Services	1084	973	9005	9630

Sources: public prices from macrodata of the Ministerio de Universidades and private prices from L-earn.es and Encuesta de financiación y gastos de la enseñanza privada (INE).

Table 3: Public capacity

	Field of Study	2015	2020	Change (%)
1	Education	29572	28395	-3.98
2	Arts & Humanities	28760	29008	0.86
3	Social Sciences	22133	23031	4.06
4	Business & Law	50758	49452	-2.57
5	Sciences	18508	18799	1.57
6	Computing	8718	9781	12.20
7	Engineering	41241	39031	-5.35
8	Agriculture	4675	4220	-9.73
9	Health Services	29920	31410	4.98
10	Services	9567	10466	9.39

Source: macrodata from Ministerio de Universidades

Table 4: Wages

	Field of Study	2015	2020	Change (%)
1	Education	25,678	29,563	15
2	Arts & Humanities	22,637	26,245	16
3	Social Sciences	23,560	26,874	14
4	Business & Law	24,977	27,976	12
5	Sciences	21,892	26,144	19
6	Computing	30,000	34,191	14
7	Engineering	28,635	31,096	9
8	Agriculture	23,307	26,618	14
9	Health Services	28,595	33,611	18
10	Services	23,023	25,902	13

Source: macrodata from Ministerio de Universidades

Table 5: Private enrollment over total

	2015	2020	2015-2020
Macrodata	13.5%	17.7%	4.2%
Microdata	10.1%	13.7%	3.6%

Source: microdata and macrodata from Ministerio de Universidades.

Table 6: Private enrollment over total

	Field of Study	Macrodata	Microdata
1	Education	25.24%	17.53%
2	Arts & Humanities	7.75%	9.34%
3	Social Sciences	19.33%	17.27%
4	Business & Law	16.88%	16.38%
5	Sciences	7.02%	4.46%
6	Computing	10.39%	9.57%
7	Engineering	8.17%	6.18%
8	Agriculture	9.11%	11.33%
9	Health Services	27.71%	19.67%
10	Services	19.28%	19.63%

Note: year 2020. Source: microdata and macrodata from Ministerio de Universidades.

Table 7: Distribution of University Enrollment by Test Score

	5-5.5	5.5-6.5	6.5-7.5	7.5-8.5	8.5-9.5	9.5-10
Total 2015	8.1%	30.3%	27.6%	20.6%	12.2%	1.4%
Total 2020	5.9%	26.1%	27.3%	22.6%	15.7%	2.5%
Public 2020	5.4%	25.0%	27.4%	23.1%	16.5%	2.7%
Private 2020	9.1%	32.7%	27.0%	19.4%	10.7%	1.1%

Source: macrodata from Ministerio de Universidades.

Table 8: Distribution of University Enrollment by Parental Occupation

	Both Low	**One Medium**	**Both Medium**	**One High**	**Both High**
Total 2015	21.70%	19.14%	12.40%	27.38%	19.39%
Total 2020	18.49%	17.13%	13.97%	28.19%	22.21%
Public 2020	19.41%	18.08%	14.33%	27.57%	20.62%
Private 2020	12.74%	11.20%	11.74%	32.11%	32.22%

Source: microdata from Ministerio de Universidades.

Table 9: Family Occupation and Income

Parental occupation	**2015**	**2020**
Both parents with high occ.	68,286	73,818
At least one with high occ.	46,749	51,611
Both with medium occ.	36,947	40,183
At least one with medium occ.	30,175	33,991
Both with low or no occ.	23,404	27,800

Sources: Encuesta annual de estructura salarial (INE), Encuesta de la población activa (INE) and Ministerio de Universidades.

Table 10: Microdata and Model Prediction

	2015	**2020**	**2015-2020**
Microdata	10.1%	13.7%	3.6%
Model prediction	11.6%	17.6%	6.0%

Sources: microdata from Ministerio de Universidades and results from the model.

Table 11: Calibrated model parameters for 2020

Parameter	**Description**	**Value**
β	Future consumption weight	1.6
α	Curvature of the preference shock	6.0
q	Quality of private university	0.4
γ	Substitutability of private/public U. in the same major	0.0
s_a	Ability level adjustment	0.4
s_y	Initial wealth adjustment	1.0

Source: results from the model.

Table 12: Cut-off score, probability of attending public university, and percentage of individuals going private due to public capacity constraint

	Field of Study	$\bar{a}$	Probability of Public Study ($\bar{a}$)	Private U. students rejected in 1st choice
1	Education	0.85	0.992	27.87%
2	Arts & Humanities	0.0	-	28.30%
3	Social Sciences	0.85	0.884	27.98%
4	Business & Law	0.0	-	28.25%
5	Sciences	0.85	0.448	28.48%
6	Computing	1.05	0.556	28.10%
7	Engineering	0.0	-	28.05%
8	Agriculture	1.05	0.126	28.14%
9	Health Services	0.85	0.599	28.16%
10	Services	0.95	0.303	28.33%

Source: results from the model.

Table 13: Abilities and initial endowment of the students

	Data	Model	Accepted in 1st choice	Rejected in 1st choice
Abilities-Private	0.94	0.94	0.98	0.87
Abilities-Public	0.98	0.98	1.00	0.90
Initial wealth-Private	52418	50154	51063	47837
Initial wealth-Public	46746	46969	47558	44544

Source: results from the model.

Table 14: Percentage increase of students in each category (2015-2020)

Score \ P.O.	Both Low	One Medium	Both Medium	One High	Both High
5-5.5	-34	-36	-18	-28	-13
5.5-6.5	-23	-22	0	-12	-2
6.5-7.5	-13	-9	13	1	9
7.5-8.5	-6	2	27	11	19
8.5-9.5	8	24	46	31	35
9.5-10	41	83	125	87	86

Note: Values in percentages. Source: microdata from Ministerio de Universidades.

Table 15: Percentage increase of students attend private university by their characteristics (2015-2020)

Score \ P.O.	Both Low	One Medium	Both Medium	One High	Both High
5-5.5	53	60	31	33	23
5.5-6.5	62	53	37	33	29
6.5-7.5	68	72	44	40	28
7.5-8.5	53	60	33	35	23
8.5-9.5	25	32	34	27	28
9.5-10	14	25	0	3	18

Note: Values in percentages. Source: microdata from Ministerio de Universidades.

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