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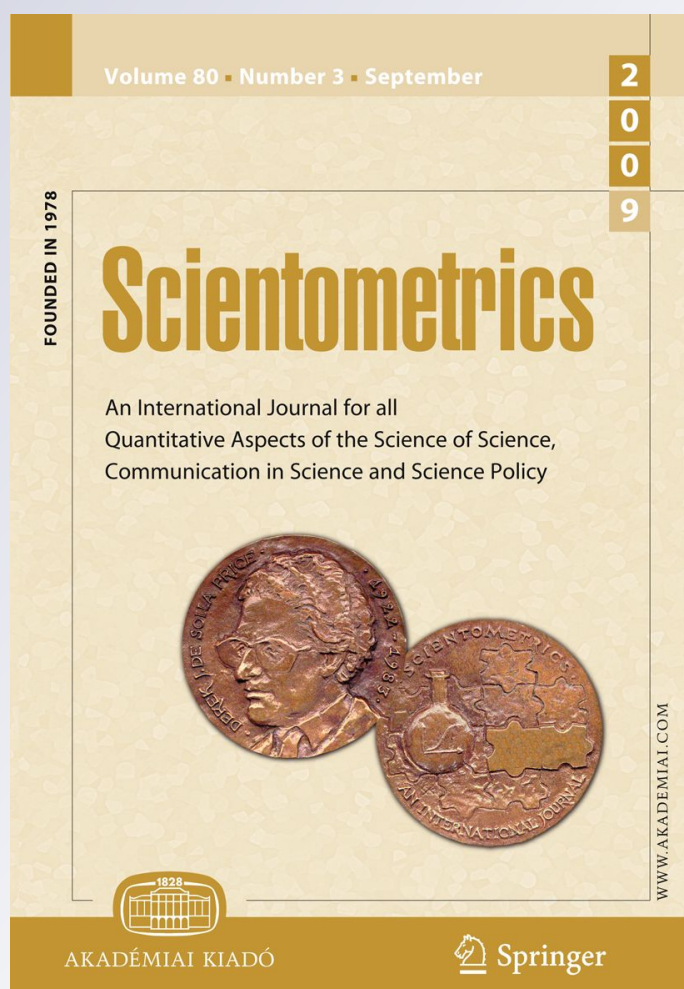
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# Modeling the enrollment demand of masters programs for the Spanish public university system

Mónica Benito · Rosario Romera

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**Abstract** Recent studies have suggested that a causal link exists between the reputation of the institution and the subsequent demand indicators. However, it is unclear how these effects vary across institutional characteristics or whether these effects persist when considering other factors that affects demand outcomes. On the other hand, student demand studies have almost always focused on the demand side of the equilibrium but not the supply side, although both demand and supply equations relate quantity to price. Although the supply is clearly a driver of demand, there are other variables that significantly influence the demand rates. Spanish public university system shows particular features not considered in the mentioned studies. This paper has two objectives. The first one is to modelize the demand for Masters Programs in the Spanish public university system. We propose a panel methodology to estimate the behavior of the demand of Masters Programs based on the data provided by the seventeen Spanish Autonomous Communities. Disaggregated analysis are presented for domestic demand and international demand. We conclude that the offer is a powerful attractor of demand for domestic and international students, and therefore actions of supply reduction should be carefully applied and always according to strategic university policy criteria. The second aim of the article is to analyze the Masters Programs in the Spanish public university system and to provide a benchmark of the current situation of supply (number of programs) and demand (enrollment) at regional level (Spanish Autonomous Communities) and in relation to European scenarios.

**KeyWords** Benchmark · Demand models · Higher education · Masters programs · Panel data

## Introduction

Spanish tertiary education has changed in remarkable ways in the last three decades. Since 1976 the *democratization* of the tertiary education sector leads to a rapid growth in demand

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and in quality assurance which provides the conditions for a successful integration into the European Higher Education Area. Educational qualifications are still the best insurance against unemployment, which clearly increases the lower the level of education attained. This characteristic was noted in almost every Member State in 2010, as the average unemployment rate in the EU-27 for those having attained at most a lower secondary education was 14.2%, much higher than the rate of unemployment for those that had obtained a tertiary education qualification (4.9%).

We start giving some hints about the Spanish education adjusted to the requirements of the Bologna Declaration, part of the formation of the European Higher Education Area (see OCDE Reviews of Tertiary Education SPAIN, 2009). Within this framework, university education is to be structured around two educational levels: Undergraduate education (*Grado* cycle) and Postgraduate education (*Máster* and *Doctorado* cycles). The Postgraduate university level comprises advanced, specialist or multidisciplinary training whose aim is academic or professional specialization; it may also provide grounding of research. The successful completion of a *Máster* cycle leads to a Masters Degree with between 60 and 120 ECTS credits. The *Doctorado* cycle provides students with advanced training in research techniques. It may require a Masters Degree or specific courses, and other research training activities. It also includes the preparation of a doctoral thesis based on original research. Successful completion of this cycle leads to the title of Doctor.

Public and private universities can offer programs that lead to official degrees valid throughout Spain or programs that they do not lead official title as part of a professional specialization. Currently the Spanish university system accounts 78 institutions, 50 public and 28 private. Since 2007 (LOU national regulation) universities are given freedom to define the curricula. This represents the end of the “national diplomas”. To be able to provide official postgraduate degrees, the university must have the authorization of the Autonomous Community and study plans that have to be approved by the National Agency for Quality Assessment and Accreditation (ANECA).

In this paper we focus on the official Masters Degrees. Generally speaking graduate student's enrollment in Masters Programs is usually influenced by the reputation of the institution which is perceived as a quality assurance. Harvard, Princeton, Columbia University, Chicago Business School are well-known international institutions, or national institutions like IESE, Instituto de Empresa, etc. The preference for these institutions appears to be independent of the number of programs that constitute the global supply of these elite centers. Nowadays, in the Spanish public postgraduate landscape the use of rankings is not a common practice. It appears that the potential demand for a Masters program is not significantly influenced by the available evidences on the quality itself of the specific program. Moreover, we observe that the potential quality of the program is often related to the image provided by well-established institutions or new emerging institutions. In this sense, the recent experience driven by the Spanish Ministries of Education and Science and Innovation called campus of international excellence (CIE) project, may help clarify this issue. Thus, the total volume of supply of official Masters Programs (graduate) that each center is able to offer reflecting its potential capacity, as proved in Sect. 2, results in a determinant for the official Masters demand in Spain.

Since the official Masters Programs started being offered in 2006–2007, the number of students enrolled in the Spanish Public System has grown from 15,047 students to 66,937 in 2009–2010, which represents an increase of 345%. The total number of available Masters Programs, commonly used as a measure of supply, has also grown significantly. So far 2,429 have been accredited by the official Spanish system. These findings highlight the continuing increase occurred in the supply that has grown from 829 in 2006–2007 to 2,429

during 2010–2011, representing a relative increase of 193%. In a scenario like this, it is obvious to relate the increase in the supply of graduate programs with positive increases in demand. The second part of this article looks deeper into the supply/demand structure for Masters Programs in the Spanish public university system.

National and international studies on demand models suggest that in addition to the offer, there are other variables that may influence the decision of students choosing a particular official Masters Program in some Spanish public university. The correlation between tuition and demand may be explained by different factors, for example, financial aid to students or improvement of the university's ranking. Another possibility could be that applicants and their families might regard tuition as an indicator of institutional quality. From a slightly different perspective, this interpretation is consistent with a monopolistic competition model in which an institution could increase its demand by product differentiation.

Tuition and fees to be charged by Spanish public universities are fixed every year by the Autonomous Community government where the institution is located. It is a common practice in Germany and in other European countries in the European Higher Education Area. This fact is closely related to the concept of "cost-sharing" applied to Higher Education (see Johnstons and Marcucci 2010; Bowman and Bastedo 2009). Moreover, private universities charge tuition following their own policies (see Abbey and Armour-Garb 2010). According to cost of living increases, regional Governments fix every year the range for the public prices of official Masters Programs to be charged by the public universities located in the region. Roughly speaking, public prices for the academic year 2009–2010 and throughout the seventeen Autonomous Communities (AACC) range between 832 and 1,879 Euros. The lowest (highest) prices correspond to lowest (highest) experimental-level programs. Under regional law Spanish public institutions have not the authority to set different tuition rates based on regional residency. Therefore, there are not differences between tuition and fees for resident and non-resident students. This policy will change in the immediate future to make more profitable for the institution the enrollment of foreign students and the charge of different tuition rates based on its own criteria, for example, experimental profile of the program or demand level of the program, to achieve supplement institutional revenues, improvement of their institutional quality or to serve other interests. Consequently, the interesting experiences published in the literature on the relationship between tuition and enrollment demand for nonresident students have no applicability to the Spanish university environment at least for now. In this sense our work fills an existing gap and contributes with original insight on this issue.

Therefore, anticipating of a partial liberalization scenario of graduate public tuitions in the Spanish public university system, it seems greatly appropriate to investigate in this context the behavior of the price elasticity of demand (defined as the percentage of change in demand that occurs in response to a percentage of change in price). Another relevant issue is that movility between regions may be negatively affected by tuition increases; Dwenger et al. (2009) highlight how tuition fees affect the Mobility Applicants in German States. Moreover, the recent announcement made by some Spanish autonomous region, for example the Catalonia Community, of the reduction of the official Masters supply as containment and rationalization measure of its university policy, places the purpose of this study more in the focus of today.

The rest of the paper is organized as follows. Section 2 focuses on models for the estimation of the demand for official Masters Programs in Spanish public universities. In Sect. 3 we study the current situation of the supply/demand for Masters Programs in the Spanish public university system. These findings are compared with outputs from

European universities. In particular, we have included two European universities obtained as *total profiles* of the thirty-three French and nine German universities participants in the respective 2009 national Excellence University project. This consideration allows us to carryout an interesting benchmarking exercise between national and international universities. Data were collected from the *French Ministère de l'Enseignement Supérieur et de la Recherche* (MESR) and the *Statistisches Bundesamt* of the German Federal Statistical Office. Main conclusions are presented in Sect. 4.

## Enrollment demand models

### Data and sample

To estimate the demand for official programs in Spanish public universities we propose a panel data model (or cross-sectional data). Because of different socioeconomic characteristics observed in national and international students in this study were raised different models of demand for Spanish students and international students. Demand is included as dependent variable. The variables that ultimately were included as independent variables in this study are shown in Table 1. The demand and the independent variables considered of the seventeen Spanish AACC are relative to the academic years 2007–2008, 2008–2009 and 2009–2010 and can be found in Annex 1. Spanish data were taken from the Ministry of Education.

It is noteworthy that initially the image quality of the Spanish official Masters Programs has been considered as a possible influential variable for demand. To do this, in absence of official rankings of graduate studies we resorted to the *Campus suplement* ranking of the national newspaper *El Mundo*. We consider for each region and each year the number of official Masters Programs placed among the top 5 positions. Contrary to expectations, this variable and any other variation on it were not significant for any of the models considered, so they were discarded and are not reflected in Table 1.

Models for demand estimated at national level might mask variations in price elasticity across regions, so we use regional-level data to fix the relationship between tuition and enrollment. Essentially, we estimate a regional-level model that provides the “average” relationship between regional-level tuition and student enrollment and includes all three academic year AACC in a panel data setting. For a literature review on student demand models we refer the interested reader to Zhang (2007) and references therein.

Let us consider the first enrollment demand with fixed-effects model, given by

$$y_{it} = x_{it}^{\beta} \exp(\mu_i) \exp(\varepsilon_{it}), \varepsilon_{it} \sim \text{IID}(0, \sigma_{\varepsilon}^2) \quad (1)$$

and taking logarithms

$$\ln(y_{it}) = \mu_i + \beta \ln(x_{it}) + \varepsilon_{it}, \quad (2)$$

where  $y_{it}$  is the demand of region  $i$  in period  $t$ ;  $x_{it}$  is a vector of dimension  $K$  of explanatory variables ( $x_{it}$  reports the observation of the  $K$  explanatory variables) which are assumed independent of disturbances  $\varepsilon_{it}$ , a sequence of independent and identically distributed random variables with zero mean and constant variance; and finally,  $\mu_i$  includes the effect of those variables of region  $i$  that are constant overtime and most likely correlated with the variables included in  $x_{it}$ ; see for instance Noorbakhsh and Culp (2002) and Zhang(2007).

An alternative model to (2) commonly used is the random-effects model given by:

**Table 1** Descriptions for variables in the demand models

Domestic demand of official Masters programs	National enrollment demand for official Masters programs of Spanish public universities excluding Open universities Source: Spanish Ministry of Education
International demand of official Masters programs	International enrollment demand for official Masters programs of Spanish public universities excluding Open universities Source: Spanish Ministry of Education
Supply of official Masters programs	Official Masters programs accredited by the Ministry of Education Source: Spanish Ministry of Education
Domestic graduations in public universities	Number of national students finishing national cycle in the Spanish public universities Source: Spanish Ministry of Education
Domestic graduations in private universities	Number of national students finishing national cycle in the Spanish private universities Source: Spanish Ministry of Education
Highest public tuition per year	Highest public tuition per academic year which corresponds to high-experimental level programs Source: Spanish Ministry of Education
Lowest public tuition per year	Lowest public tuition per academic year which corresponds to low-experimental level programs Source: Spanish Ministry of Education
Consumer Price Index	Consumer Price Index by AACC Source: INE (National Institute of Statistics)
GDP per capita	The Gross Domestic Product per capita in Euros by AACC Source: INE (National Institute of Statistics)
Total expenditure per household	The household's annual expenditure in euro by AACC Source: INE (National Institute of Statistics)
Unemployment rate	Spanish unemployment rate by AACC Source: INE (National Institute of Statistics)
Income per worker <sup>a</sup>	The average annual income per worker with a degree level of education, Engineering degree or PhD by AACC Source: CYD Report 2009. The contribution of Spanish Universities to Development

<sup>a</sup> 2007, 2008 and 2009 data is not available and has been updating from the 2006 data with the corresponding regional CPI

$$\ln(y_{it}) = \alpha + \beta \ln(x_{it}) + \mu_i + \varepsilon_{it}, \quad \varepsilon_{it} \sim \text{IID}(0, \sigma_\varepsilon^2); \mu_i \sim \text{IID}(0, \sigma_\mu^2) \quad (3)$$

where  $\alpha$  is the intercept,  $\mu_i + \varepsilon_{it}$  is considered as a disturbances term composed by two components: an specific component for each region  $i$  invariant over time ( $\mu_i$ ) and another specific component that change between individuals and over time ( $\varepsilon_{it}$ ), supposed to be temporarily uncorrelated. Moreover, we assume that  $\mu_i$  and  $\varepsilon_{it}$  are independent between each other and independents of the variables included in  $x_{it}$ . In summary, parameter  $\alpha$  includes all the fixed effects at national level and the regional effects  $\mu_i$  are not fixed (as in model (2)) but random variables that follow a known probability distribution. An interesting application of both fixed-effects and random-effects models for cross-sectional data can be seen in Cheng et al. (2010).

To determine whether the appropriate model is fixed or random effects the Hausman test is used (for further information see for instance Baltagi (2008)). It has been found in all cases in this study that the most efficient model is the one with random effects. Thus, along the paper all findings addressed to model (3).

### Limitations

There are some limitations with this study that should be mentioned. First, this study only examines the effects in demand of the within—region changes. This is the analysis level of this study. We do not estimate demand at national or institutional level data. Reliable disaggregated data by university is not available for the period of time considered. Second, the data is not available for any period of time, so we have considered data between 2007 and 2010.

#### Demand model for national enrollment

We proceed estimating sequentially the proposed models. The first one considers the supply and the tuition per year as explanatory variables:

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}/\text{CPI}_{it}) + \beta_3 \ln(\text{HMPT}_{it}/\text{CPI}_{it}) + \mu_i + \varepsilon_{it} \tag{4}$$

where  $\text{DDOM}_{it}$  represents domestic demand official Masters Degrees in the autonomous region  $i$  and year  $t$ ,  $\text{OMO}_{it}$  is the official Masters offer in the AACC  $i$  and year  $t$ ;  $\text{LMPT}_{it}/\text{CPI}_{it}$  is the ratio between the lowest Masters Programs’ tuition per academic year and the consumer price index in the AACC  $i$  and period  $t$ ; and  $\text{HMPT}_{it}/\text{CPI}_{it}$  is the ratio between the highest Masters Programs’ tuition per academic year and the consumer price index in the AACC  $i$  and period  $t$ . The estimated coefficients and  $t$ -statistics (in parentheses) are as follows:

$$\ln(\text{DDOM}_{it}) = \underset{(0.687)}{2.42} + \underset{(11.23)}{1.15} \ln(\text{OMO}_{it}) - \underset{(-2.486)}{1.27} \ln(\text{LMPT}_{it}/\text{CPI}_{it}) + \underset{(0.789)}{0.99} \ln(\text{HMPT}_{it}/\text{CPI}_{it}) + \mu_i + \varepsilon_{it} \tag{5}$$

We found that the highest Masters Programs’ tuition (HMPT) is positively related to demand although not statistically significant,<sup>1</sup> whereas the lowest Masters Programs’ tuition (LMPT) is negatively related to demand. As economic theories suggest, the price is an important factor to consider in the demand. In general, when the price of a good increases the demand can be expected to decrease, however, this phenomenon does not happen if it is a ‘luxury good’. Under these circumstances, an increase in the price is usually associated with an increase in demand considering that this is a good of higher quality. In the context of enrollment demand, it is possible that students who choose to enroll in the official Masters Programs of more expensive tuition fees, they choose precisely those that have higher prices, driven by the belief that the higher the price the better the quality of the program. However, as the estimated coefficient of the HMPT is not statistically significant, it would suggest that this variable is not an important factor to consider for domestic demand enrollment.

In terms of price elasticity<sup>2</sup> we observe that a 1% increase in relative prices at the LMPT is associated with 1.27% decrease in demand for Spanish students enrolled in official

<sup>1</sup> Roughly speaking, to be statistically significant at the 5% level the corresponding  $t$ -value in absolute value should be greater than 2.

<sup>2</sup> The elasticity is an economic concept introduced by the British economist Alfred Marshall borrowed from physics and quantifies the variation in a variable due to changes in another variable.



Masters Programs. In other words, a reduction in relative prices will increase the demand, as one can expect according to demand theory. Moreover, since the elasticity is greater than 1, we can say that demand is elastic, i.e. demand for official Masters Programs is sensitive to market prices. Finally, the estimate for supply elasticity suggests that a 1% increase in the supply of Masters Programs is associated with a 1.15% increase in domestic demand enrollment at an institution. We may also conclude that the demand is sensitive to changes in the official Masters supply.

Next, we estimate different models that relate demand with supply and lowest prices expressed in absolute value. It is convenient to consider absolute value because it does not affect the results and the interpretation is more straightforward. The estimated models are:

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{DSG}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 1})$$

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{GDPpc}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 2})$$

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{TEH}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 3})$$

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{SUR}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 4})$$

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{AAI}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 5})$$

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{SUR}_{it}) + \beta_4 \ln(\text{DSGP}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 6})$$

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{SUR}_{it}) + \beta_4 \ln(\text{AAI}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 7})$$

$$\ln(\text{DDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{SUR}_{it}) + \beta_4 \ln(\text{DSGP}_{it}) + \beta_5 \ln(\text{IDOM}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 8})$$

where  $\text{DSG}_{it}$  is the number of domestic students graduated in first and second cycle in public universities in the AACC  $i$  year  $t$ ,  $\text{GDPpc}_{it}$  is GDP per capita in the AACC  $i$  and year  $t$ ,  $\text{TEH}_{it}$  is the total expenditure of households in the AACC  $i$  year  $t$ ,  $\text{SUR}_{it}$  is the Spanish unemployment rate in the AACC  $i$  year  $t$ ,  $\text{AAI}_{it}$  is the average annual income per worker in the AACC  $i$  in year  $t$ ,  $\text{DSGP}_{it}$  is the number of domestic students graduated in first and second cycle in private universities in the AACC  $i$  year  $t$ , and finally,  $\text{IDOM}_{it}$  is the demand of international students enrolled in the official Masters programs in the AACC  $i$  year  $t$ .

The estimates of the coefficients  $\beta_j$ , the values of the t-statistic (in parentheses) and the coefficient of goodness of fit (adjusted  $R^2$ ) are shown in Table 2.

The first conclusion is that all demand models proposed have achieved a goodness of fit above 90%. Thus, supply and the lowest price are relevant variables to explain the demand and we can conclude that the variables used reflect adequately the flow of demand for Spanish students who decide to take official Masters Degrees in Spanish public universities. As a result, either depending on the set of variables available for the institutions or depending on the researcher's interest, one can choose one or the other model in order to estimate the domestic demand for official programs.

It is interesting to see how the price elasticity is negative and decreases with respect to Model 1 if variables GDPpc or TEH are included in the model, see for instance Models 2

**Table 2** Estimates for the domestic demand's models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	9.171 (2.707)	23.252 (4.422)	47.269 (5.202)	8.117 (3.361)	2.844 (0.393)	7.968 (3.769)	4.297 (0.904)	7.416 (4.030)
Ln (OMO)	1.139 (10.306)	1.191 (17.323)	1.263 (17.641)	1.071 (18.372)	1.179 (13.087)	1.172 (17.132)	1.052 (17.154)	1.043 (11.119)
Ln (LMPT)	-1.029 (-2.258)	-0.762 (-1.694)	-0.666 (-1.490)	-1.084 (-3.115)	-1.093 (-2.049)	-1.056 (-3.466)	-1.129 (-3.234)	-0.948 (-3.551)
Ln (DSG)	0.029 (0.195)							
Ln (GDPpc)		-1.638 (-3.161)						
Ln (TEH)			-3.960 (-4.460)					
Ln (SUR)				0.839 (7.588)		0.728 (6.192)	0.834 (7.503)	0.658 (5.438)
Ln (AAI)					1.355 (0.993)		0.833 (0.931)	
Ln (DSGP)						-0.058 (-2.393)		-0.062 (-2.885)
Ln (IDOM)								0.102 (1.783)
Adjusted R <sup>2</sup>	0.942	0.951	0.967	0.978	0.952	0.977	0.977	0.973

and 3, suggesting smaller student responsiveness to changes in prices. Specifically, Model 2 yields that 1% increase in price is associated with 0.76% decrease in student demand. In addition, 1% increase in GDP per capita of the AACC is associated with decrease of 1.64% in demand. This model again yields elasticity coefficients in the expected directions. This result suggests that if a student decides to attend an official Masters Programs in an AACC different from yours, its decision could be biased towards regions where the cost of living is lower. In this sense, it would be interesting to include a variable reflecting the aids for Masters programs that the autonomous community offers to the students, however, this data is not available for the period of time analyzed. Another possible interpretation for this negative elasticity is that increases in per capita GDP tend to be linked to better job opportunities and therefore, in this scenario, students who complete their degree studies prefer to join the workforce to pursue graduate studies. This idea is consistent with the results of models 4 and 7. Model 4 indicates that 1% increase in the unemployment rate causes 0.84% increase in enrollment of students who decide to take an official Masters. Also taking into account average earnings (or average salary) of the population with a bachelor's degree level, superior engineering or doctorate, 1% increase in the average annual salary they receive is associated with an increase of 0.83% demand for official Masters. Finally, results from all the proposed empirical models indicate elastic responsiveness to changes in prices, supply and socioeconomic variables. That is, the flows of domestic demand of official Masters Programs are influenced by both price and supply, as well as other variables.

This study makes its clear the following consideration. Standard economic theory suggests that both the supply and the demand of higher education are influenced by prices. Following this logic, we have found that other variables as GDP per capita, average annual

income per worker or unemployment rate, determine also enrollment of students in official Masters Programs. As a result, we have proposed different demand equations (Models 1–8) and we have found that the elasticity coefficients are in the expected directions.

### Demand model for international enrollment

Most foreign students enrolled in a Masters Programs in Spain are from Latin America. Because the increase of the offer in English that many Spanish universities are engaged in, especially the youngest institutions, the profile of demand is expected to change in the next future. Nowadays it represents around 20% of the Masters Programs applicants.

Following the same principles as in the case of domestic demand we consider the following models for the international students' enrollment in official Masters Programs in the Spanish public university system:

$$\ln(\text{IDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{LMPT}_{it}) + \beta_3 \ln(\text{HMPT}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 9})$$

$$\ln(\text{IDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{AAI}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 10})$$

$$\ln(\text{IDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{GDPpc}_{it}) + \beta_3 \ln(\text{HMPT}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 11})$$

$$\ln(\text{IDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{TEH}_{it}) + \beta_3 \ln(\text{HMPT}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 12})$$

$$\ln(\text{IDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_3 \ln(\text{DSG}_{it}) + \beta_4 \ln(\text{AAI}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 13})$$

$$\ln(\text{IDOM}_{it}) = \alpha + \beta_1 \ln(\text{OMO}_{it}) + \beta_2 \ln(\text{HMPT}_{it}) + \beta_3 \ln(\text{AAI}_{it}) + \beta_4 \ln(\text{DSG}_{it}) + \mu_i + \varepsilon_{it} \quad (\text{Model 14})$$

The estimates of the coefficients  $\beta_j$ , the values of the t-statistic (in parentheses) and the coefficient of goodness of fit (adjusted  $R^2$ ) are shown in Table 3.

Model 9 suggests that the highest and the lowest price elasticity (coefficients  $\beta_2$  and  $\beta_3$ ) have opposite signs, as happened with the estimate for domestic demand models. However, for international enrollment, only the highest price is significant. That is, an increase in price at the HMPT might actually increase the demand for international students enrolled in official Masters Programs. Then, international students may choose high-priced regions in the belief that high price means high quality. Indeed, price is often used as a proxy for institutional quality in higher education.

From Table 3 we can observe that supply and prices are statistically significant in all the empirical models, as expected. Other variables that influence demand flows of international students are the number of domestic students graduated in first and second cycle in public universities (DSG) and the average annual income of the AACC population with higher education (AAI). The estimated elasticity coefficient for variable DSG (Models 13 and 14) suggests that the demand is inelastic (elasticity less than 1), i.e., international demand for official Masters Programs is not sensitive to the number of domestic students graduated in first and second cycle in the institutions. However, average annual income elasticity is greater than 1 (Models 10, 13 and 14). We may guess that a foreign student who decides to come to Spain to attend an official Masters, also consider studying in an autonomous region where relative earnings of college graduates are higher than in the rest of the population, perhaps because his/her particular interest after the Masters is to join the

**Table 3** Estimates for the international demand's models

	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Constant	-22.542 (-1.523)	-18.949 (-1.677)	-21.636 (-1.325)	-10.562 (-0.465)	-22.900 (-2.448)	-44.863 (-3.232)
Ln (OMO)	1.023 (5.943)	1.094 (7.423)	0.998 (5.879)	0.995 (5.673)	0.741 (4.381)	0.556 (2.983)
Ln (LMPT)	-0.447 (-0.527)					
Ln (HMPT)	3.557 (1.930)		3.726 (2.016)	3.573 (1.941)		3.382 (2.082)
Ln (DSG)					0.817 (3.491)	0.834 (3.677)
Ln (GDPpc)			-0.520 (-0.482)			
Ln (TEH)				-1.471 (-0.879)		
Ln (AAI)		3.804 (1.674)			3.472 (1.896)	2.982 (1.666)
Adjusted R <sup>2</sup>	0.937	0.943	0.939	0.942	0.941	0.945

workforce. Specifically, according to the Model 13, 1% increase in the average wage is associated with 3.5% increase in international demand.

In conclusion, we can say that the variables that affect the flow of international demand official Masters Programs are the supply, the highest price and the average wage of the population in the AACC with higher education equivalent to a degree, engineering or doctorate. This finding show that international students who decides to come to Spain to attend an official Masters Programs decide to move to autonomous regions with highest prices, driven by the belief that the higher the price the better the quality of the program. It is interesting to note that whereas international demand is sensitive to the highest prices, domestic demand is to the lowest prices.

### Analysis of the current situation of supply and demand for official Masters Programs in Spain

Unemployment rate in Spain in February 2011 riches 20.5%. The youth unemployment rate in Spain reached 43.5% in February 2011, the highest in Europe from data published by Eurostat. It means that one in two young people are unemployed, compared to 20.4% of European average. As Eurostat has declared, educational qualifications are still the best insurance against unemployment, which clearly increases the lower the level of education attained. This characteristic was noted in almost every Member State in 2010, as the average unemployment rate in the EU-27 for those having attained at most a lower secondary education was 14.2 %, much higher than the rate of unemployment for those that had obtained a tertiary education qualification (4.9 %).

Thus, this is one of the reasons to focus our analysis in tertiary education, more specifically in tertiary-type A Programs, which represents along with an effective reform of the labor market a powerful tool that may help to leave behind the current unemployment situation suffered by Spain.

As we mentioned in the Introduction we analyze in this Section the supply/demand balance of official Masters Programs within the Spanish public university system. The supply is by far the most influential factor in the Masters Programs demand structure, as it has been proved in Sect. 2. Therefore, any variation in the supply policy of the AACC may drastically affect the demand. Although this study is conducted at regional-level it may shed light at institutional-level bearing in mind that ultimately, universities are responsible for the design and proposal of the current and new Masters Programs.

From the methodological point of view, we assume the deficiencies that the choice of *number of programs* as supply indicator may entail, bearing in mind that this is the most internationally accepted indicator. Therefore, the ongoing study evaluates the balance between supply and demand in terms of similarities (or discrepancies) between distributions of supply and demand. The study result shows that the public universities in Madrid and Catalonia are the two top AACC regarding Masters Programs supply and demand. Moreover, an interesting finding is that in the QS World University Rankings 2011 most of the public universities in Madrid and Catalonia are among the top 200 in the field of Social Science.

In order to compare the Spanish system with some European universities, we have analyzed the thirty-three Excellence French universities and we have obtained the *French profile*. This profile has been obtained as an average of the 33 universities. In the same way, we have obtained the *German profile* as an average of the nine Excellence German universities. The *Spanish profile* represents the average of all the Spanish public universities.

## Analyses

Table 4 shows the distributions of supply and demand for official undergraduate and graduate programs. This information is summarized in Figs. 1 and 2.

As it is shown in Fig. 1, if we compare the percentage (weights) of Graduate Programs on total programs offered by the AACC to the percentage of Graduate applicants on the total students enrollment in the AACC, we observe a more pronounced disparity than in cases of French and German. It seems that the Spanish graduate supply is very generous in relation to the real demand. From the economic point of view this unbalanced situation has to be analyzed carefully by the universities, especially in which concerns Masters Programs due to their direct and indirect costs may impact negatively (or positive) to these institutions.

At a first view and according to Fig. 2, regarding supply distribution we observe that Spanish profile is similar to French and German profiles, i.e., around 60–65% of graduate programs and 35–40% of undergraduate programs. However, regarding the Spanish profile we detect that Masters Programs and PhD Programs supply is lower and higher, respectively, than any other of the European profiles considered. For the German case, the distribution of the supply for graduate programs (61%) is as follows: 37% Masters Programs and 24% PhD Programs. These figures are (58%), 28 and 30% for the French profile, and (65%), 23 and 42% for the Spanish profile. Basically, the Spanish PhD programs supply almost doubles the Masters Programs supply, whereas the proportion is one to one for the French case and 0.6–1 for the German case. Progressively these Spanish official graduate programs are offered in English which increases the low rate of international graduate students which is less than 15% in several AACC (the average in Spain is about 20%). This figure in the French case is larger than 25%.

**Table 4** Distribution of supply and demand for official undergraduate and graduate programs 2008–2009

Autonomous communities	Supply (%)				Demand (%)			
	Undergraduate programs	Graduate programs	Graduate programs		Undergraduate programs	Graduate programs	Graduate programs	
			Masters	PhD			Masters	PhD
Andalucia	31.69	68.31	17.61	50.70	92.34	7.66	2.74	4.92
Aragon	37.70	62.30	14.66	47.64	89.23	10.77	2.46	8.31
Asturias	55.17	44.83	18.97	25.86	94.14	5.86	1.39	4.47
Balearics	41.67	58.33	24.07	34.26	88.87	11.13	4.78	6.35
Canaries	43.97	56.03	11.28	44.75	94.40	5.60	1.31	4.29
Cantabria	31.48	68.52	21.30	47.22	88.44	11.56	3.67	7.89
Castile-La Mancha	66.67	33.33	2.22	31.11	94.75	5.25	0.35	4.90
Castile-Leon	45.03	54.97	13.56	41.41	92.57	7.43	1.65	5.78
Catalonia	33.68	66.32	39.27	27.05	86.97	13.03	6.21	6.82
Extremadura	61.59	38.41	11.59	26.81	94.10	5.90	1.30	4.60
Galicia	36.58	63.42	21.14	42.28	90.05	9.95	2.98	6.97
Madrid	22.05	77.95	25.48	52.47	86.65	13.35	4.18	9.16
Murcia	33.48	66.52	45.37	21.15	93.07	6.93	4.03	2.90
Navarra	40.98	59.02	26.23	32.79	90.42	9.58	4.91	4.67
Basque country	54.08	45.92	25.00	20.92	94.59	5.41	2.31	3.09
Rioja	58.97	41.03	0.00	41.03	92.84	7.16	0.00	7.16
Valencia	29.02	70.98	23.01	47.97	91.06	8.94	5.00	3.94
<b>Spanish profile</b>	<b>34.76</b>	<b>65.24</b>	<b>23.04</b>	<b>42.20</b>	<b>90.45</b>	<b>9.55</b>	<b>3.57</b>	<b>5.98</b>
French profile	42.00	58.00	28.00	30.00	63.00	37.00	31.00	6.00
German profile	39.00	61.00	37.00	24.00	85.00	15.00	5.00	10.00

Regarding the graduate programs demand shown in Fig. 2 and consequently to the structure of the French Tertiary-type programs, we observe a remarkable 37% for this profile, i.e., almost four in ten French students are applicants in graduate programs, of which three are involved in Masters Programs and one in PhD Programs. Although the graduate demand for Spanish and German profiles is close, 10 and 15%, respectively, Spanish graduate demand is 5 points lower than the German one and 27 points lower than the French one. The distribution of this demand between Masters and PhD Programs follows a similar pattern and conversely to French case, i.e., one applicant for Masters Programs by every three applicants for PhD programs.

At the regional level, it is remarkable that Madrid and Catalonia are the two top AACC regarding Masters Programs supply and demand. They recorded together the 43% of total Spanish Masters Programs supply and the 45% of total Spanish Masters Programs demand. Moreover, as is shown in Table 4, the graduate supply in Madrid and Catalonia are also larger than French and German supply, but smaller than French and German demand. In particular, eight over every ten official programs in Madrid are graduate programs, which five of them are PhD Programs and three are Masters Programs. In Catalonia these figures are reverse: seven over ten programs are graduate programs, which four of them are Masters Programs and

Modeling the enrollment demand of masters programs

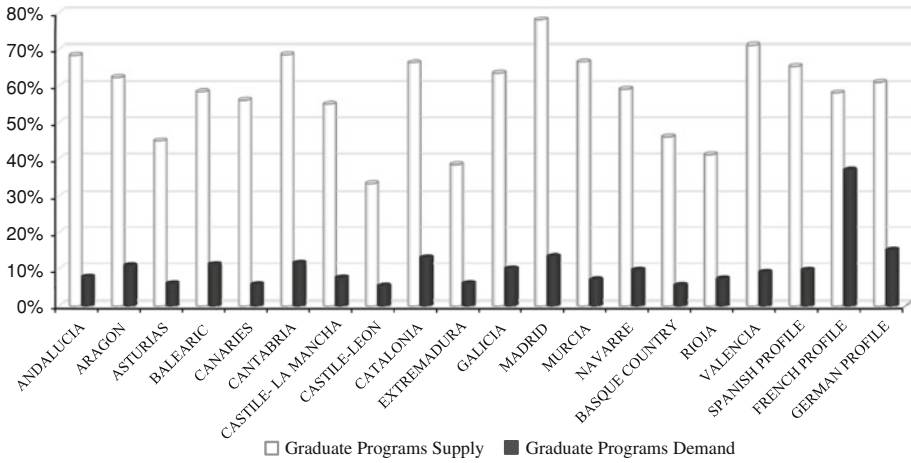


Fig. 1 Graduate programs supply and demand

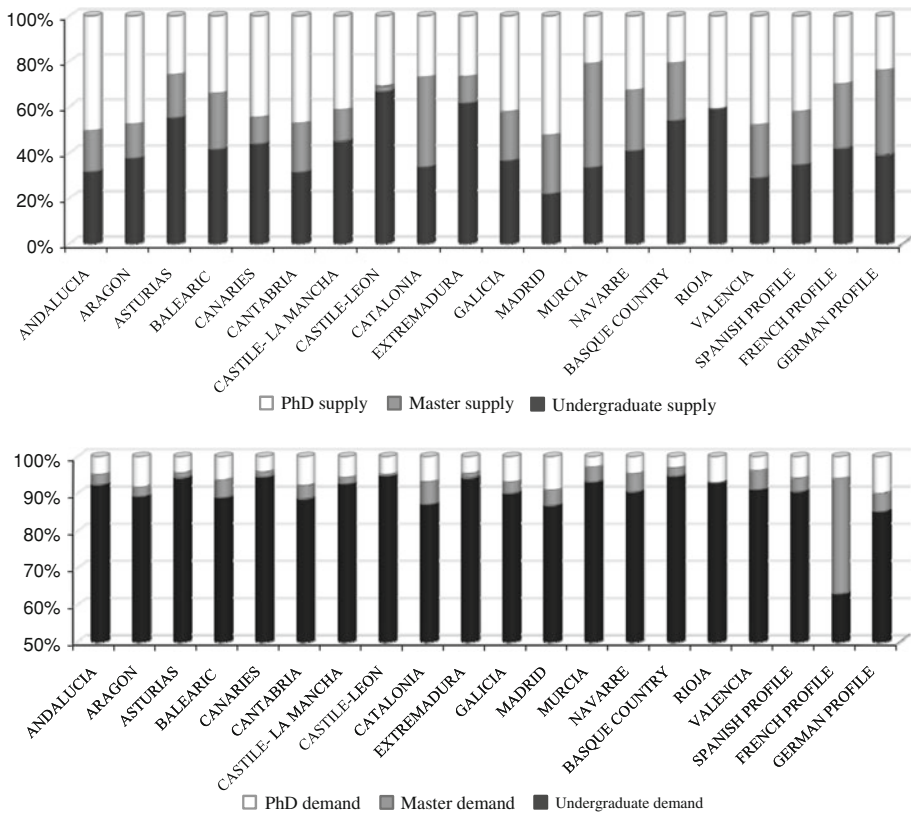


Fig. 2 Undergraduate, master and PhD programs supply and demand

three of them are PhD Programs. Regarding Madrid, the PhD programs demand doubles the demand for Masters Programs widely, while in Catalonia are at similar rate. In Madrid and in Catalonia the 13% of applicants are graduate students, 3 points higher than the Spanish profile, but 34 points lower than the French profile and 2 points lower than the German profile. This fact is in accordance with the corresponding supply structure. Valencia presents the 17% of the Spanish Master students. In Valencia one over two programs are PhD programs, but only four over hundred applicants are PhD students. The same pattern appears in Andalusia which represents 16% of the Spanish Master students. One over two programs are PhD Programs while from the side of demand, only five over hundred applicants are PhD students. Although these figures are eloquent from the economic viewpoint university policies must be sensitive to the cost carried out for the Masters Programs, typically much more costly than PhD Programs. Costs carried out by PhD programs are basically staff costs, having in mind that already implemented research resources usually cover the necessities generated by PhD applicants.

## Conclusions

The supply of official Master's Programs in the Spanish Public University System is a powerful pull factor for demand, both domestically and internationally. A 1% increase in supply is associated with an increase of around 1.2% in domestic student demand (domestic demand elasticity is positive on the offer) and close to 1% changes in international demand.

For domestic applicants, an increase of 1% in the official master lowest price is associated with a decrease of around 1% of demand.

For domestic applicants, increases in the unemployment rate and the regional GDP per capita is associated with negative changes in demand. An increase of 1% is associated with a decrease of 1.64% of demand (domestic demand has a negative elasticity with respect to the regional GDP per capita), and/or total expenditure of households on the AACC and/or GDP regional per capita.

For international applicants, the official master highest price is associated with a positive change in demand. A 1% increase in this price is associated with an increase of almost 3% points of demand (global demand has positive elasticity with respect to highest).

For international applicants, the regional average wage is associated with a positive change in demand. An increase of 1% of regional average wage is associated with an increase of 3% of demand (global demand has positive elasticity with respect to the regional average wage).

It will be interesting for future applicants to have official rankings about graduate programs quality.

The Spanish official Graduate supply appears very generous and for such offer the demand should be increased. This effect is more clear for PhD Programs.

Nevertheless, supply reduction may be the most rational policy for some AACC but it should be carefully adopted and especially for official Master Programs, the most costly programs for the university institutions.

## Annex

See Table 5



**Table 5** Data set for the demand model

Autonomous communities	Domestic demand official masters programs	International demand official masters programs	Supply of official masters programs	Lowest public tuition per year (in €)	Highest public tuition per year (in €)	Domestic graduation in public universities	Domestic graduation in private universities	Unemployment rate	Consumer price index	Total expenditure per household (in €)	GDP per capita (in €)	Income per worker <sup>a</sup>
Academic course 2007–2008												
Andalucía	3.138	865	177	1.560	1.560	30.695	–	12.76	102.77	30.268	18.134	93.94
Aragón	492	91	32	1.720	1.010	4.093	101	5.24	102.92	29.910	25.541	104.05
Asturias	264	24	14	1.630	1.003	3.954	–	8.48	102.62	29.092	21.650	106.92
Baleares	354	11	23	1.620	1.290	1.689	–	6.98	102.66	35.080	25.420	97.80
Canaries	293	30	24	1.634	1.634	5.044	–	10.44	102.33	29.744	20.717	88.32
Cantabria	264	48	26	1.502	850	1.750	–	5.9	102.75	32.226	23.534	97.76
Castile-la mancha	65	28	3	1.348	869	4.433	–	7.61	102.62	28.333	18.200	92.25
Castile-leon	577	248	81	1.720	1.474	11.577	2.589	7.18	102.82	28.806	22.645	95.65
Catalonia	4.987	2.171	379	1.720	922	23.220	3.632	6.55	102.97	34.204	27.526	115.72
Extremadura	229	7	12	1.444	799	3.623	–	13.06	102.68	25.780	16.164	84.16
Galicia	1.337	58	64	1.632	1.109	9.608	–	7.64	102.45	29.277	19.829	91.70
Madrid	4.870	1.300	381	1.737	1.365	28.609	7.297	6.3	102.78	37.485	30.562	128.04
Murcia	556	56	95	1.680	1.260	4.533	950	7.56	103.07	32.219	19.401	89.79
Navarre	320	8	50	1.413	1.413	1.254	1.611	4.76	102.44	34.871	29.526	116.50
Basque country	458	142	88	1.756	1.259	7.089	2.864	6.12	102.85	33.981	30.561	125.07
Rioja	5	0	2	1.200	1.200	1.045	–	5.66	102.83	29.363	25.008	96.95
Valencia	4.340	1.266	221	1.740	799	16.052	2.445	8.76	102.83	30.872	21.275	97.94
Academic course 2008–2009												
Andalucía	4.952	1.191	264	1.626	1.626	30.695	–	17.83	106.89	30.624	18.359	118.52
Aragón	648	103	33	1.792	1.053	4.093	0	7.15	107.48	30.341	26.107	131.46

Table 5 continued

Autonomous communities	Domestic demand official masters programs	International demand official masters programs	Supply of official masters programs	Lowest public tuition per year (in €)	Highest public tuition per year (in €)	Domestic graduation in public universities	Domestic graduation in private universities	Unemployment rate	Consumer price index	Total expenditure per household (in €)	GDP per capita (in €)	Income per worker <sup>a</sup>
Asturias	283	34	16	1.725	1.061	3.954	-	8.45	106.97	30.592	22.443	133.44
Balearics	480	112	26	1.688	1.344	1.689	-	10.18	106.60	33.412	25.838	136.96
Canaries	455	51	39	1.703	1.703	5.044	-	17.36	106.85	28.249	20.994	139.72
Cantabria	336	62	23	1.565	886	1.750	-	7.17	107.20	32.046	24.466	134.84
Castile-la mancha	69	25	3	1.404	906	4.433	-	11.59	107.02	27.646	18.222	134.67
Castile-leon	940	296	98	1.861	1.595	11.577	2.507	9.51	107.16	29.384	23.183	115.33
Catalonia	6.412	3.231	464	1.792	961	23.243	3.633	9	107.18	34.511	27.914	145.13
Extremadura	293	6	17	1.504	832	3.623	-	15.2	106.90	25.280	16.714	116.61
Galicia	1.944	133	97	1.700	1.156	9.608	-	8.73	106.76	30.149	20.572	121.95
Madrid	6.730	2.164	455	1.832	1.440	28.384	7.297	8.69	106.77	37.862	30.998	156.85
Murcia	1.226	63	139	1.751	1.313	4.533	950	12.63	107.16	30.074	19.541	125.78
Navarre	354	36	50	1.472	1.472	1.254	1.611	6.72	106.43	36.036	30.402	142.64
Basque country	727	255	101	1.879	1.348	7.089	2.864	6.45	107.07	34.210	31.952	152.77
Rioja	70	1	6	1.262	1.262	1.045	-	7.79	107.04	29.186	25.621	120.28
Valencia	5.127	1.605	215	1.792	832	16.052	2.445	12.13	106.95	29.464	21.336	118.00
Academic course 2009–2010												
Andalucia	11.110	1.732	287	1.626	1.626	32.353	-	25.35	106.39	28.911	17.485	152.89
Aragon	1.356	168	49	1.792	1.053	4.392	7	12.82	107.05	28.852	24.639	163.57
Asturias	801	135	41	1.790	1.102	3.813	-	13.42	106.49	30.423	21.523	161.23
Balearics	875	138	30	1.688	1.344	1.697	-	18.02	106.42	29.665	24.510	167.82
Canaries	685	58	42	1.703	1.399	5.149	-	26.19	105.77	26.289	19.867	159.50

**Table 5** continued

Autonomous communities	Domestic demand official masters programs	International demand official masters programs	Supply of official masters programs	Lowest public tuition per year (in €)	Highest public tuition per year (in €)	Domestic graduation in public universities	Domestic graduation in private universities	Unemployment rate	Consumer price index	Total expenditure per household (in €)	GDP per capita (in €)	Income per worker <sup>a</sup>
Cantabria	482	70	24	1.565	886	1.625	-	11.99	106.84	32.270	23.343	151.18
Castile-la mancha	873	35	18	1.404	906	4.359	-	18.81	105.79	26.528	17.208	167.89
Castile-leon	1.773	377	125	1.861	1.595	11.188	2.177	13.78	106.39	26.936	22.314	139.37
Catalonia	9.266	3.677	486	1.793	1.080	24.283	3.761	16.25	107.35	33.344	26.831	180.13
Extremadura	1.080	58	27	1.504	832	3.734	-	20.55	106.40	24.531	16.301	149.17
Galicia	3.474	283	166	1.700	1.156	9.485	-	12.59	106.14	29.001	19.995	154.11
Madrid	9.639	3.054	495	1.879	1.477	28.455	7.705	14.03	106.70	35.804	30.029	203.15
Murcia	2.006	172	101	1.751	1.313	4.181	1.009	20.73	106.51	27.479	18.619	159.01
Navarre	543	63	49	1.472	1.472	1.426	1.503	10.89	105.81	34.811	29.598	174.06
Basque country	1.200	320	124	1.878	1.348	7.243	2.495	11.04	107.36	33.264	30.703	177.35
Rioja	134	3	8	1.680	1.020	1.070	-	12.75	106.54	28.921	24.754	141.69
Valencia	9.393	1.904	263	1.792	832	17.098	2.653	21.24	106.69	28.148	20.259	149.47

<sup>a</sup> National income is fixed to 100

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