The Journal of Economic Education

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/vece20

Gender gap in university studies of economics-business area: Evidence from Spain

Rosario Asián Chaves, Eva María Buitrago Esquinas, Inmaculada Masero Moreno & Rocío Yñíguez Ovando

To cite this article: Rosario Asián Chaves, Eva María Buitrago Esquinas, Inmaculada Masero Moreno & Rocío Yñíguez Ovando (10 Mar 2024): Gender gap in university studies of economics-business area: Evidence from Spain, The Journal of Economic Education, DOI: 10.1080/00220485.2024.2320145

To link to this article: https://doi.org/10.1080/00220485.2024.2320145

THE JOURNAL OF ECONOMIC EDUCATION
https://doi.org/10.1080/00220485.2024.2320145

Routledge
Taylor & Francis Group

Gender gap in university studies of economics-business area: Evidence from Spain

Rosario Asián Chaves[a], Eva María Buitrago Esquinas[b], Inmaculada Masero Moreno[b] and Rocío Yñíguez Ovando[c]

[a]Applied Economy II Department, Universidad de Sevilla, Sevilla, España; [b]Applied Economy III Department, Universidad de Sevilla, Sevilla, España; [c]Economic Analysis and Political Economy Department, Universidad de Sevilla, Sevilla, España

ABSTRACT

This research provides new empirical evidence of the gender gap in university studies in the economics-business area based on econometric analysis (mean difference, OLS, quantile regression, logit/probit). The sample includes 717 first-year students of the 2016–2020 economics, business administration and management, and marketing degree courses at the University of Seville, Spain. Gender differences favoring female students both in the variables prior to entering the university and in university academic success indicators are documented. The findings continue to indicate the underrepresentation of women in these studies (40.4%), even though better academic performance and retention results for women are documented in the estimated models. The dissemination of these results could encourage females to choose these studies, thereby helping to achieve more equality in the profession.

KEYWORDS

Business administration and management; economics; feminist economics; gender gap; marketing; university academic performance; university retention

JEL CODES

A20; A22; B54; I23; I24

In recent decades, gender disparity in university enrollment has been reduced, and the number of females pursuing university studies has increased. Globally, the women's enrollment rate increased from 15 to 41 percent between 1995 and 2018 (UNESCO 2020), and, consequently, several educational indicators have been higher for women than those for men, thereby causing the so-called "female advantage" in higher education (Niemi 2017). Although gender gaps in university studies are closing, their legacy persists in labor market success and outcomes (Williams and Wolniak 2021). Gender is still related to the choice of university studies, and the dividing line between humanistic and scientific degrees remains (Barone 2011).

The percentage of women enrolled in university studies in the social sciences is greater than that of men, but this does not hold true in regard to the economics-business area, where the percentage of women varies between 25 and 40 percent, depending on the country (Beneito et al. 2018). In the case of Spain, those women who study social and legal sciences at the university level (law, education science, economics, business, marketing) represent 59.8 percent of the total number of students enrolled. In the specific area of business, this percentage drops to 49.3 percent and to 38.4 percent in the field of economics (Pastor et al. 2019).

Although there is work that has documented this underrepresentation of women in studies of the economics-business area (e.g., Beneito et al. 2018; Emerson, McGoldrick, and Mumford 2012; Opstad 2019; Worthington and Higgs 2004), as well as the gender gap in their academic results (e.g., Arnold and Rowaan 2014; Ballard and Johnson 2004; Beneito et al. 2018; Boustan and Langan 2019; Johnson, Robson, and Taengnoi 2014), no conclusive results have been achieved because of differences depending on the place, period of time, and/or type of institution considered. In the case of Spain, studies remain scarce

CONTACT Rocío Yñíguez Ovando ovando@us.es Profesora Titular de Universidad, Economic Analysis and Political Economy Department, Facultad de Ciencias Económicas y Empresariales, Universidad de Sevilla, Avda Ramón y Cajal, Nº1, 41018 Sevilla, España.

and include the work of Santos and Vallelado (2013) for the business administration and management degree and the work of Beneito et al. (2018) for the degree in economics. Although both studies document the underrepresentation of women, the former finds better academic results for men while the latter does so for women.

In order to provide new empirical evidence that helps clarify the gender gap in university studies of the economics-business area, we focus on the analysis of a university in southern Spain—the University of Seville. Thus, the possible links of gender are considered, both with aspects prior to entering the university and with the academic performance of first-year students of the degrees taught in the Faculty of Economics and Business Studies (economics: ECO; business administration and management: BAM; and marketing: MKT). These degrees each require the same subjects in the first year, and it is in the second year that a specific syllabus is presented. A complete econometric analysis that combines various techniques (mean difference, OLS, quantile regression, logit/probit) is carried out, utilizing different specifications and considering a wide set of academic success indicators (both of academic performance and of continuation of the degree). Likewise, the analyses are disaggregated in terms of the specific degrees of the Spanish higher education area to test whether the gender gap affects all these degrees equally.

The results obtained herein provide evidence of the existence of a certain gender gap in university studies in the economics-business area of the University of Seville (US), especially in the business administration and management and economics degrees, but the sign of the gap presents differences in relation to previous studies. Although women continue to be underrepresented in these degrees, their academic results are better than those of men, and the probability of women remaining in these university studies is also greater. Opposite results have been obtained regarding the marketing degree.

Although the literature on the gender gap in these areas is wide, the causes of female underrepresentation and differences in female students' academic performance are inconclusive. Therefore, it is necessary to continue researching to acquire new empirical evidence on this issue.

This research could have significant theoretical contributions and practical implications. On the one hand, it expands the literature on the gender gap related to economics and business in university studies, thereby providing new empirical evidence from a university framed in the European Higher Education Area. Moreover, to the best of our knowledge, the results herein are more robust than those of previous research because our work combines a broad set of indicators of academic performance relative to the first year as a whole (and not just to specific subjects), considers various econometric models and techniques, and compares the results from three university degrees. On the other hand, since the results provide evidence of better academic performance by female students, its dissemination may encourage more women to study for this type of degree, thereby reducing their underrepresentation in these areas, and achieving, or at least approaching, gender equality in university studies in the economics-business area.

Literature review on gender gap in university studies of economics-business area

A gender gap in the fields of science, technology, engineering, and mathematics (STEM) has been shown in conventional studies on university performance; despite this gap having narrowed recently, women remain underrepresented in the math-intensive disciplines of STEM (Wang and Degol 2017). Conversely, a greater female presence is identified in the areas of education, health, arts, humanities, and social sciences (UNESCO 2020; UNESCO-IESALC 2021). However, many papers in the literature have identified female underrepresentation in social science studies related to the economics-business field assimilating STEM, and, in general, with no differences in academic area nor geographic area (see Arnold 2020 [economics-Europe]; Ball 2012 [business-USA]; Bayer and Rouse 2016 [economics-USA]; Beneito et al. 2018 [economics-Spain]; Opstad 2019 [business-Norway]; Worthington and Higgs 2004 [economics-Australia]). In this respect, Emerson, McGoldrick, and Mumford (2012), using data from U.S. universities in the area of economics (MIDFIELD dataset), conclude and identify gender as the most consistent and significant predictor of the decision to study economics.

Among the possible causes of this vocational segregation in relation to STEM in the case of Spain, Sáinz (2020) points out the difference in socialization and education between males and females from childhood that determine differences in social conventions shaped by gender in the early years, such as the roles played by the media, social networks, family, and teachers in the transmission of gender roles and stereotypes.

Indeed, in Spain, only 23.2 percent of university lecturers of STEM subjects are women. In the specific case of the Faculty of Economics and Business Studies of the Universidad of Sevilla, this percentage rises to 42 percent, while in Spain as a whole, this percentage is 47 percent in the area of social sciences, where the studies of economics, business, and marketing (Ministerio de Universidades 2022) are found.

Arnold and Rowaan (2014) agree that the social role model is a possible cause of female underrepresentation in the economics-business field in the Netherlands. The traditional stereotype of the male economist is reflected in the behavior of the labor market, which in turn reduces the interest of female students, found in both types of studies in countries with different education systems (Bayer and Rouse 2016 [economics-USA]; Beneito et al. 2018 [economics-Spain]; Calkins and Welki 2006 [economics and business-USA]).

Another possible cause that the literature has traditionally offered to explain the underrepresentation of women in studies in the economics-business area involves the mathematical intensity of these degrees (Dynan and Rouse 1997 [economics-USA]; Emerson, McGoldrick, and Mumford 2012 [economics-USA]; Emerson, McGoldrick, and Siegfried 2018 [economics-USA]; Opstad 2019, 2020 [business-Norway]). In the area of economics at Harvard University, Dynan and Rouse (1997) conclude that a mathematical background explains only a limited part of the gender difference, although they identify pre-university mathematical training as an explanatory factor of the gender gap in the decision to study these subjects. Along the same lines, Emerson, McGoldrick, and Mumford (2012) and Emerson, McGoldrick, and Siegfried (2018) point out that mathematical requirements, while relevant, do not by themselves explain the gender gap in several economics studies from U.S. institutions. Indeed, Lindberg et al. (2010) report from a comprehensive meta-analysis that the gap in performance in mathematics has been reduced over time in the United States. Proof of this is found in the increase in the number of women studying for mathematics degrees in recent decades (Beneito et al. 2018). However, Opstad (2019) finds a gender difference in the degree choices of female economics students who prefer non-quantitative courses, which is linked to students' attitudes toward mathematics (enjoyment, value, and self-confidence). In Europe, female students have been shown to tend to choose fields such as marketing and management, while finance attracts male students the most (Arnold 2020; Opstad 2019; Opstad and Årethun 2020).

In relation to the variables that influence success in economics-business studies, the influences of gender, prior education, mathematics, and a background in economics skills have been extensively studied and have revealed various education scenarios (e.g., Arnold and Rowaan 2014 [Netherlands]; Asian-Chaves et al. 2021, 2022 [Spain]; Beattie, Laliberté, and Oreopoulos 2018 [Canada]; Santos and Vallelado 2013 [Spain]). Most of these studies have focused on academic performance in the first year of the course because this has been shown to be a predictor of success in economics-business studies (Alcock, Cockcroft, and Frank 2008; Arnold and Rowaan 2014; Castillo-Manzano et al. 2016), with the conclusion that a background in mathematical skills in students' preparatory education is essential for success (Alcock, Cockcroft, and Frank 2008 [Australia]; Arnold and Rowaan 2014 [Netherlands]; Asian-Chaves et al. 2021, 2022 [Spain]; Johnson and Kuennen 2006 [USA]) since these courses have a solid foundation in mathematics. Nevertheless, in these studies of economics and business (Alcock, Cockcroft, and Frank 2008 [Australia]; Asian-Chaves et al. 2021, 2022 [Spain]; Dolado and Morales 2009 [Spain]), having studied economics subjects in the pre-university stage is not a precursor to success.

Gender gap studies in academic performance in the fields of economics and business have consistently been on the increase, and mixed results have been attained (Arnold and Rowaan 2014 [Netherlands]; Ballard and Johnson 2004 [USA]; Boustan and Langan 2019 [USA]; Dynan and Rouse 1997 [USA]; Hadsell 2010 [USA]; Johnson, Robson, and Taengnoi 2014 [USA]; Mallik and Lodewijks 2010 [Australia]). It has been found in much of the literature that male economics students tend to outperform female students (Arnold and Rowaan 2014 [Netherlands]; Ballard and Johnson 2004 [USA]; Dynan and Rouse 1997 [USA]; Santos and Vallelado 2013 [Spain]); however, in a meta-analysis on the gender gap in these studies in the United States, Johnson, Robson, and Taengnoi (2014) confirm that the gap is inflated and differs depending on the place, type of institution, and/or degree/course analyzed. In this vein, certain studies provide evidence of better results for women: Beneito et al. (2018) for microeconomics courses in Spain, Boustan and Langan (2019) for studies on economics PhDs in the United States, Johnson and Kuennen (2006) for an introductory business statistics course in the United States, and Opstad and Årethun (2020) for marketing and business courses in Norway.

To the best of our knowledge, no studies specifically analyze marketing degrees, and the gender gap in this discipline has been addressed only through marketing courses or subjects within an economics or business syllabus (Arnold 2020 [Europe]; Naqvi and Naqvi 2016 [India]; Opstad and Årethun 2020 [Norway]).

In the Spanish context, research on this topic remains very limited. Santos and Vallelado (2013) analyzed the academic performance in BAM at the University of Valladolid and concluded that the most analytical male students with a high level of attendance are more likely to obtain better results. Beneito et al. (2018) address the gender gap in the context of the economics degree at the University of Valencia, relating it to the low number of women graduates, the lack of information on the importance of the economy, and the performance of women in the subjects of these studies.

In accordance with the above, although the scientific literature has documented the existence of a gender gap in studies in the area, the results remain inconclusive regarding both the possible causes of female underrepresentation and in relation to the academic results obtained by female students. It is therefore necessary to continue delving into this topic in order to provide new empirical evidence that contributes toward shedding light on the subject.

Institutional framework: Studies of economics-business area in the Spanish University System

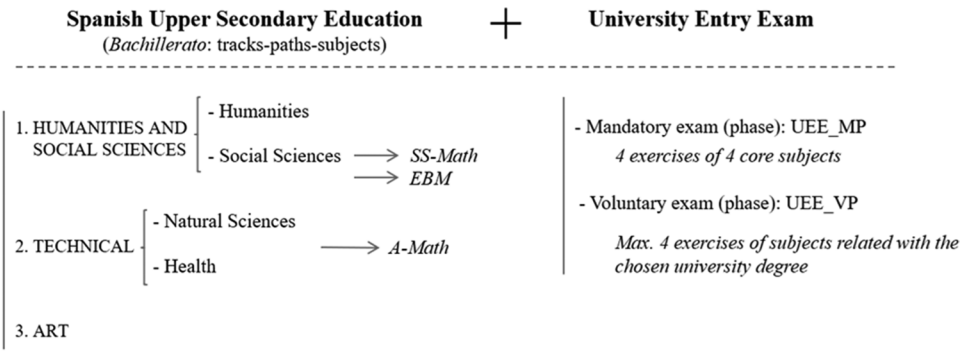
The Spanish University System forms part of the European Higher Education Area and hence shares common elements with other European Union countries. University studies are structured into three cycles (bachelor's degree, master's degree, and PhD doctorate), with a common credit system (European Credit Transfer and Accumulation System, known as ECTS), which reflects the results of learning and the volume of work carried out by the student (see Eurydice 2012).

In Spain, most of the bachelor's degrees in the economics-business area are made up of 240 ECTS credits distributed over four years. The subjects of the first years usually correspond to basic and compulsory training, concentrating on the electives in the last year (ANECA 2005). The University of Seville degrees analyzed in this work (ECO, BAM, and MKT) follow this structure: each year, the student takes 10 subjects that together correspond to 60 ECTS (1500 student work hours). First-year students of these three degrees must take the same 10 basic training subjects: statistics, finance, accounting fundamentals, economic history, private law, introduction to economics, introduction to business and management administration, economics, introduction to marketing, Mathematics I, and microeconomics. Beginning in the second year, each degree has its specific curriculum (see Business Administration and Management Study Plan [Universidad de Sevilla 2010]; Economics Study Plan [Universidad de Sevilla 2019a]; Marketing Study Plan [Universidad de Sevilla 2019b]). There is no specific GPA that students must earn in the degree to continue onto the second year; selection is made prior to beginning the first year, as indicated below.

A student must first comply with the university access requirements and, secondly, be admitted to the requested degree through a competitive admission procedure for access to undergraduate studies at a Spanish public university.

University entrance requirements can be accredited in a variety of ways: the most common (80.7%) involves passing the mandatory phase of the University Entrance Exam (UEE_MP) after having previously completed the two years of upper secondary education (in Spain called *Bachillerato*, see figure 1). It is also possible to access a university if a higher-level training cycle has been completed or by passing a special Access Test for people over 25, 40, or 45 years old.

The admission procedure requires students to complete applications in which they must give the order of their choice of degrees based on their preferences. Given that the demand for most of the degrees is much higher than the supply of university places, the admission procedure is highly competitive and is carried out mainly based on the preferences and the university admission grade that each candidate attains. For most of the students, it is those who enter via the *Bachillerato*; the University Admission Grade (AG) depends on the grades obtained both in *Bachillerato* and in the University Entrance Exam. In Spain, this test has a mandatory phase (UEE_MP) and a voluntary phase (UEE_VP), whereby passing



Source: Authors, based on Ministerio de Educación, Cultura y Deporte 2014.
Note: SS-Math and A-Math stand for social sciences mathematics and advanced mathematics; EBM stands for economics, business, and management.

Figure 1. Principal access process to Spanish universities.

the first is a necessary requirement to access a university, and the latter enables the University Access Grade to be augmented. The final grade of admission to a university (AG) is calculated from the formulation (1):

$$\mathrm{AG} = 0.6^{*}\mathrm{GPA}\left(\textit{Bachillerato}\right) + 0.4^{*}\ \mathrm{GPA}\left(\mathrm{UEE}_{\mathrm{MP}}\right) + a^{*}\mathrm{G1} + b^{*}\mathrm{G2}, \tag{1}$$

where GPA(*Bachillerato)* is the grade point average of upper secondary education, GPA(UEE_MP) is the University Entrance Exam mandatory phase grade, and G1 and G2 are the grades obtained in the exam subjects passed in the voluntary phase, which, multiplied by the respective parameters *a* and *b*, give the best admission grade for the degree for which the student has applied. The coefficients *a* and *b* are weighting parameters that relate upper secondary school subjects with university degrees. The value can be 0, 0.1, or 0.2, depending on the affinity of the subject with the degree chosen. For access to university studies in the economics-business area, the subjects with weights of 0.2 are advanced mathematics, social science mathematics, economics, business and management, and geography. Given that in Spain, the range of qualifications is from 0 to 10, and that for access via this means, it is necessary to have passed the *Bachillerato* and the obligatory phase of the entrance exam (i.e., to obtain at least 5 points), the AG can vary between 5 and 14.

Methodology

Data and variables

This work is set within the analysis of academic success from the perspective of gender and its relationship with the determinants of academic performance. To this end, our study has been focused on the bachelor's degrees in the economics-business area of the Spanish University System. Our work proposes testing whether the academic performance of these degrees depends on the gender of the students.

The sample includes the full set of first-year students of the 2016–2020 courses of the three bachelor's degrees in the economics-business area taught at the Faculty of Economics and Business of the University of Seville, that is, 717 students. The data source is the official information provided by the Corporate Applications Area of the Computing and Communications Service of the University of Seville.

Table 1 summarizes the variables used in the study, the indices chosen for their measurement, and their range.

Our *dependent variable* is first-year *academic performance*, measured using four indices in order to capture different dimensions of study progress. The *Passed Credits* ("PC") measures the number of

Table 1. Variables studied: description and range.

Variables	Description	Range
Dependent variables: academic success in first year of the degree		
PC	Passed credits in first year	0–60
GPA	Grade point average of subjects passed during the first year	0–10
PR	Performance ratio: % PC multiplied by GPA divided by mandatory phase grade of University Entrance Exam	0–2
Retention	Students who registered for a 2016–2017 year and did formally enroll again in 2017–18. 1 if student continues the degree; 0 if they leave	0 and 1
Exogenous variables		
Gender	1 female; 0 in other cases	0 and 1
AG	Access grade to university	5–14[a]
UEE_MP	Mandatory phase grade of University Entrance Exam	5–10[a]
UEE_EBM	Economics, business and management grade in the University Entrance Exam	0–10
UEE_Math	Mathematics grade in the University Entrance Exam	0–10
NoMath	1 if students have no mathematics in the University Entrance Exam; 0 in other cases	0 and 1
SS-Math	1 if students have social science mathematics in the University Entrance Exam; 0 in other cases	0 and 1
A-Math	1 if students have advanced mathematics in the University Entrance Exam; 0 in other cases	0 and 1
Preference	1 if students have chosen the degree as their 1st option; 0 in other cases	0 and 1
Acc_UEE	Access path: 1 if students access by University Entrance Exam; 0 in other cases[b]	0 and 1
ECO	1 if students have enrolled in economics degree; 0 in other cases	0 and 1
BAM	1 if students have enrolled in business administration and management degree; 0 in other cases	0 and 1
MKT	1 if students have enrolled in marketing degree; 0 in other cases	0 and 1

[a]Given that obtaining at least a 5 in both upper secondary education and the mandatory phase of the University Entrance Exam is required for admission to the university, the minimum range of AG and UEE_MP is 5 (see institutional framework section).
[b]Other paths of access include special access tests for those over 25, 40, or 45 years of age and the completion of a higher-level training cycle.

total credits passed in the first year at the university (between 0 and 60). The "GPA" is the *Grade Point Average* for all first-year courses for which the student has completed the examination. As in Dolado and Morales (2009), a *Performance Ratio* "PR" has been included to assess whether or not the student has improved their university grades compared to their pre-university ones. "PR" is calculated as the ratio between the performance of the first year at the university (percentage of PC multiplied by the GPA) and the grade obtained in the mandatory phase of the University Entrance Exam (UEE_MP). Finally, we consider "*Retention,*" that is, students who continued their university studies in the subsequent academic year.

In accordance with the goals of this study, the main *explanatory variable* is the "*Gender*" of the student, which takes the value of 1 for female and 0 otherwise.

The *control variables* from the main determinants of university academic success are selected as mentioned in the literature review, including that of prior mathematical training because, as indicated, this may explain the possible gender gap.

The *pre-university education* and its grades are approximated using several indicators. On the one hand, the degree's access grade "AG" and the mandatory phase grade of the University Entrance Exam "UEE_MP" are included independently of the means of access. On the other hand, we specifically consider the grades obtained in the subjects of the University Entrance Exam that have a greater link with the university degrees in the economics-business area: economics, business, and management "UEE_EBM," and mathematics "UEE_Math." Students who enter via other means of access and do not undergo this test are assigned a zero qualification. Moreover, a variable is also included to identify the type of mathematics subjects the student took in upper secondary school: none "NoMath"; advanced mathematics "A-Math"; or social science mathematics "SS-Math." Finally, the variable "Acc-UEE" has been included to indicate whether the University Entrance Exam has been the access route to these studies.

As a proxy of *motivation*, we include the variable "Preference," which indicates whether the student has chosen the degree in which they are enrolled as their first choice: this information is drawn from students' university applications.

We have also included variables to indicate the *degree* in which each student is enrolled: economics "ECO," business administration and management "BAM," or Marketing "MKT."

Econometric models

We have verified the differences of means in the variables through Pearson's Chi-squared or the Kruskal-Wallis test, depending on the type of such variables. Regression methods have subsequently been employed to study the influence of gender and the described control variables on academic performance.

First, to test whether there is a significant relationship between gender and the indicators of academic performance of the first university year listed above, *Ordinal Least-Squares regressions* (OLS) were employed. Once these relationships had been verified, the relationship between gender and university performance in the range of academic performance values was confirmed by applying Quantile Regression (QR). Finally, *Logit and Probit models* were used for the analysis of the influence of gender on "Retention."

For the estimation of the *Ordinal Least-Squares regressions,* formulation (2) below was followed:

$$Y_i = \beta_0 + \beta_1\, Gender_i + \beta_2 X_i + \varepsilon_i, \tag{2}$$

where Y_i is one of the performance indicators considered (PC, GPA, and PR), X_i is a vector of the control variables, β_0 is the constant, $\beta_{1,2}$ are the regression coefficients explaining the relationship between the variations in the dependent variable according to the variations in the independent variables, and ε is the random error term. In the model, we introduce variables that the literature has traditionally related to academic performance (gender, grades and previous training, motivation, access path to university) together with dummy variables to test whether there are significant differences among the economics, business, and marketing degrees.

Quantile Regression (QR) (Koenker and Bassett 1978; Koenker and Hallock 2001) has been employed to ascertain whether the influence of gender and the control variables are maintained in nine levels of university performance. These estimations enable the study to be completed in the lower performance levels (quantiles 0.05, 0.10, 0.15), in the higher levels (quantiles 0.85, 0.90, 0.95), and the quantiles 0.25, 0.50, and 0.75.

The QR model is specified in expression (3):

$$Y_{ij} = \beta_{0j} + \beta_{1j}\, Gender_{ij} + \beta_{2j} X_{ij} + \varepsilon_{ij}, \tag{3}$$

where the variables and the coefficients are defined in the same way as in the linear regression and particularized in the nine quantiles ($j = 0.05, 0.1, 0.15, 0.25, 0.50, 0.75, 0.85, 0.90, 0.95$). Quantile analysis was carried out for the three variables of first-year performance (PC, GPA, and PR), both aggregated for the three degrees considered and disaggregated in terms of the degree (ECO, BAM, and MKT).

We estimated *Logit* and *Probit* models (Hair et al. 1999; Johnson 2000; Pérez 2004) for the binary variable "Retention" and computed the average marginal effects. The likelihood of retention is calculated through the expression (4):

$$P\left(retention\right) = p_i = \frac{e^{\beta_{0i} + \beta_i \bar{X}_i}}{1 + e^{\beta_{0i} + \beta_i \bar{X}_i}} = \frac{1}{1 + e^{-\beta_{0i} - \beta_i \bar{X}_i}}, \tag{4}$$

where β_0 is the independent term, and $\beta_i \bar{X}_i = \beta_{1i}\, Gender_i + \beta_{2i} X_{2i}$.

Findings and discussion

Gender gap in economics-business area: Degree selection and aspects previous to university enrollment

The number of women in social science degrees of the Spanish University System is higher than that of men, whereby the percentage of females in this type of study at the University of Seville is close to 60 percent. However, in both the economics and business administration and management degrees, which are characterized by a higher mathematical requirement, gender inequality is observed as the percentage

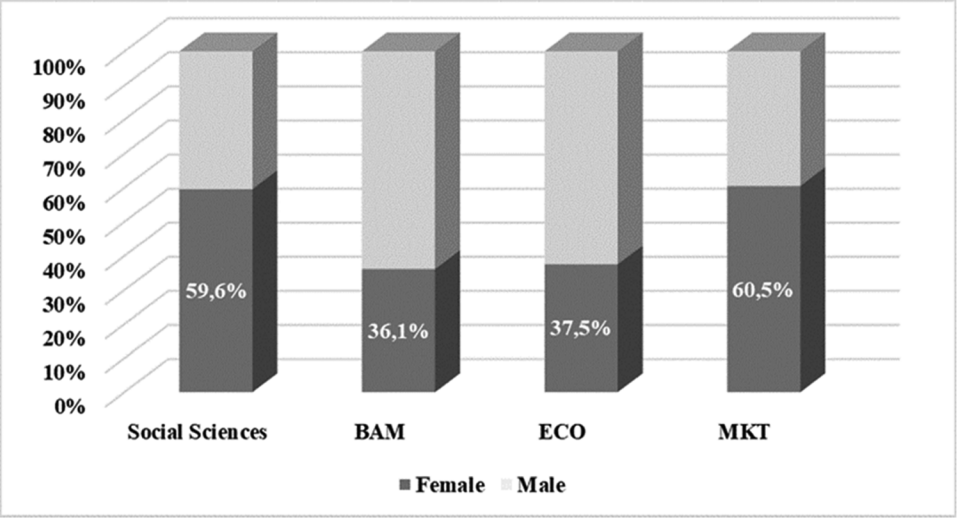
of females falls to 37.5 percent and 36.1 percent, respectively (see figure 2). These last percentages are closer to those in STEM (25.0% on average in architecture and engineering) than those of social sciences and are in line with those obtained by Pastor et al. (2019) for the Spanish University System.

According to Emerson, McGoldrick, and Mumford (2012), Emerson, McGoldrick, and Siegfried (2018), and Opstad (2019), who analyze the studies of economics and business, the former in the United States and the latter in Norway, the lower female presence in those university studies may be related to the mathematical intensity of degrees of the economics-business area. This reason could provide an explanation of the results obtained in this work. In fact, as shown in figure 3, the percentage of women enrolled in economics and business administration and management degrees who studied advanced mathematics "A-Math" in upper secondary school is even lower (20.3%).

For an in-depth analysis of the possible gender gaps in university studies in the economics-business area, the descriptive statistics and the comparison tests of the means based on gender are analyzed. First, the variables related to the selection of the degree and those with the aspects previous to university enrollment are analyzed; variables of performance of first-year undergraduates enrolled in university economics-business area degrees are subsequently studied, both aggregated and disaggregated in terms of degree.

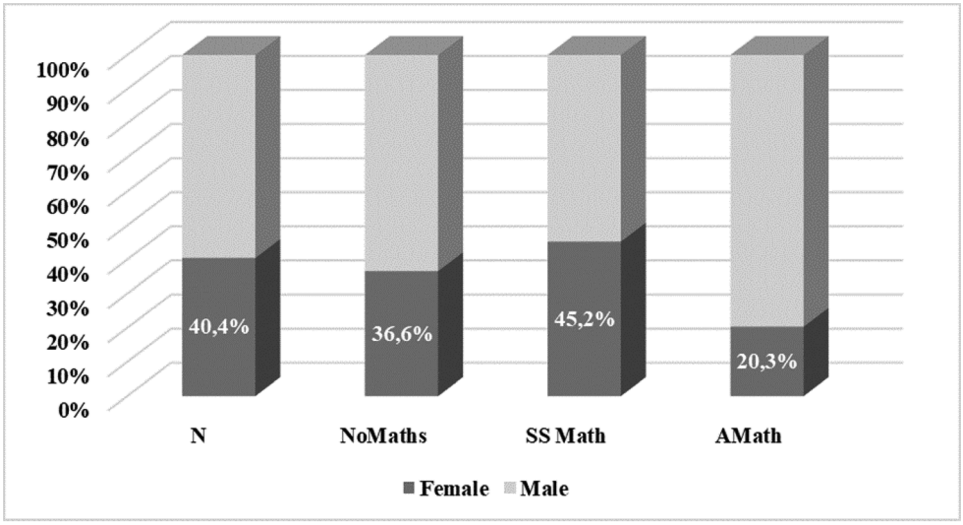
Table 2 shows significant differences between genders both in the degrees chosen and in the variables of aspects previous to university enrollment. As for the *degree selected*, the differences between women and men are significant, with a confidence level of 99 percent. There is a smaller number than expected of female students in BAM and ECO, whereas this number is greater in MKT. This underrepresentation of female students in BAM and ECO and the overrepresentation in MKT confirm the results of earlier studies focused on Spain, such as those by Santos and Vallelado (2013) for BAM and Beneito et al. (2018) for ECO. The results are also confirmed in studies on other European countries whose institutional frameworks differ slightly from that of Spain, such as the cases of Norway by Opstad (2019) and Europe by Arnold (2020) for MKT courses, and on other continents—Ball (2012) for BAM in the United States, and Emerson, McGoldrick, and Mumford (2012) and Emerson, McGoldrick, and Siegfried (2018) for ECO in the United States.

Similarly, there are significant differences in the *access grade*, whereby better grades than statistically expected are achieved by female students. Moreover, in the average grades of the mandatory phase of the UEE and in the subject of mathematics, the differences are significant, with a confidence level of 99 percent. The results obtained fail to verify the hypothesis that one of the causes of female underrepresentation in economics-business area studies is their mathematical intensity because, although the



Source: Ministerio de Universidades 2022.

Figure 2. Gender distribution of university studies (University of Seville).



Source: University of Seville, Computing and Communications Service (Corporate Applications Area)

Figure 3. Distribution by gender of the students of ECO, BAM, and MKT, according to the type of mathematics studied in upper secondary school (University of Seville).

Table 2. Descriptive statistics and means test for gender: Selection of the degree and variables of aspects previous to university enrollment.

	Mean or %	SD	Min	Max	Female	Male	Difference[a]	*p* Value
					40.4%	59.6%		
Degree							23.917[b]	0.000
ECO	20.1%				18.6%	21.1%		
BAM	63.3%				56.6%	67.9%		
MKT	16.6%				24.8%	11.0%		
AG	9.34	1.53	5.04	13.81	9.72	9.08	31.022[b]	0.000
UEE_MP	7.10	0.99	5.01	9.87	7.33	6.95	24.815[b]	0.000
UEE_EBM	7.53	1.38	5.00	10	7.63	7.45	2.212[b]	0.137
UEE_Math	0.13	1.34	5.00	10	7.34	6.98	7.892[b]	0.005
Types of mathematics							14.928[b]	0.000
NoMath	31.7%				28.6%	33.7%		
SSMath	60.1%				67.2%	55.3%		
Amath	8.2%				4.1%	11.0%		
Preference (% 1st option)					82.1%	76.1%	3.633[c]	0.057
Acc_UEE (% UEE)	78.5%				91.4%	89.9%	0.423[c]	0.526
N	90.5%				290	427		

Note: See table 1 for definitions of variables.
[a]Standard test comparing means difference.
[b]Kruskal–Wallis.
[c]Pearson's Chi-squared.

percentage of women who have studied advanced mathematics in secondary education is lower than expected, their mathematics scores on the entrance test are higher.

Finally, *the percentag*e of students who chose these degrees as their first option is 78.5 percent (81.9% in ECO, 73.3% in BAM, and 94.1% in MKT). This ratio is higher among women (82.1%) compared to men (76.1%), whereby the "Preference" variable is significant at 94 percent.

Regarding the access route, 90.5 percent of the students of the analyzed degrees access through the University Entrance Exam, of which 40.8 percent are women. Of the remaining 9.5 percent of students who do not access through the University Entrance Exam, 36.8 percent are women. No significant differences were observed in terms of gender according to the access route.

Hence, the following section analyzes whether there is indeed a gender gap in academic results in these areas in order to define whether this may be one of the causes for female underrepresentation.

Gender gap in economics-business area: Indicators of academic success of first-year undergraduates

Table 3 reports significant differences between female and male students in all the indicators of first-year undergraduates' academic success. Women obtain higher than expected results both in the number of credits passed and in their grade point average and performance ratio; likewise, a higher percentage of women remain studying the following year.

When disaggregating in terms of degree subjects (table 4), the results show significant differences at a 5 percent level between female and male students for all the indicators of academic success in the ECO and BAM degrees. In these two degrees, women obtain better results than men in all the indicators. However, no significant differences are observed in the MKT degree.

Once the existence of a difference in means based on gender was verified, the study was expanded by using different regression methods and controlling for the main determinants of academic performance.

First, an *OLS regression* model is estimated, thereby explaining the academic performance (PC, GPA, PR) of first-year university students of degrees in the economics-business area (table 5).

In all specifications, the variable "Gender" is significant at a 5 percent level, and, if the endogenous variable considered is GPA, it is significant at 1 percent or less. "Gender" is positively related to all three endogenous variables considered, which shows that, for a woman, a greater number of credits passed in the first year, a higher grade point average, and a higher performance ratio than for a man are all indicated. These results contradict those found in most of the literature where male performance is found to be higher (see, among others, Arnold and Rowaan [2014] for economics in the Netherlands; Ballard and Johnson [2004] for economics in the United States; Dynan and Rouse [1997] for economics in the United States; Emerson, McGoldrick, and Siegfried [2018] for economics in the United States; Santos and Vallelado [2013] for business in Spain).

However, the results of this work are in line with those obtained by Beneito et al. (2018) for microeconomics courses in Spain, Boustan and Langan (2019) for studies on economics PhDs in the United States, Johnson and Kuennen (2006) for an introductory business statistics course in the United States, and Opstad and Årethun (2020) for marketing and business courses in Norway. Neither do the studies

Table 3. Descriptive statistics and means test for gender: Performance of first-year undergraduates of university degrees in the economics-business area.

	Mean or %	SD	Min	Max	Female	Male	Difference[a]	*p* Value
PC	31.27	19.96	0	60	35.50	28.40	2.654[b]	.000
GPA	5.46	1.87	0	9.50	5.87	5.19	29.525[b]	.000
PR	0.44	0.29	0	1.19	0.50	0.41	17.791[b]	.000
Retention	78.1%				84.8%	73.5%	12.875[c]	.000

Note: See table 1 for definitions of variables.
[a]Standard test comparing means difference.
[b]Kruskal–Wallis.
[c]Pearson's Chi-squared.

Table 4. Descriptive statistics and means test for gender: Performance of first-year undergraduates (disaggregated into three degrees: ECO, BAM, and MKT).

	ECO				BAM				MKT			
	Female	Male	Differ.[a]	*p* Value	Female	Male	Differ.[a]	*p* Value	Female	Male	Differ.[a]	*p* Value
PC	39.33	30.00	7.672[b]	.006	32.23	25.94	10.638[b]	.001	40.08	40.47	0.111[b]	.740
GPA	6.19	5.62	4.261[b]	.039	5.66	4.93	19.232[b]	.000	6.10	5.99	0.523[b]	.470
PR	0.52	0.40	5.999[b]	.014	0.47	0.38	9.954[b]	.002	0.55	0.57	0.639[b]	.424
Retention	88.9%	66.7%	8.889[c]	.003	81.1%	74.5%	6.414[c]	.011	84.7%	89.4%	0.526[c]	.468

Note: See table 1 for definitions of variables.
[a]Standard test comparing means difference.
[b]Kruskal–Wallis.
[c]Pearson's Chi-squared.

Table 5. Gender gap in university academic performance (PC, GPA, and PR) of economics-business area.

	PC		GPA		PR	
β_0	−58.032***	(5.868)	0.306	(0.613)	−0.541***	(0.093)
Gender	2.673**	(1.293)	0.401***	(0.135)	0.041**	(0.020)
UEE_MP	9.430***	(0.687)	0.509***	(0.072)	0.094***	(0.011)
UEE_EBM	0.708***	(0.205)	0.066***	(0.021)	0.009***	(0.003)
UEE_Math	0.537***	(0.196)	0.033	(0.021)	0.007**	(0.003)
A-Math	9.600***	(2.579)	0.632**	(0.269)	0.133***	(0.041)
Preference	1.069	(1.541)	0.186	(0.161)	−0.001	(0.024)
Acc_UEE	11.650***	(2.505)	0.837***	(0.262)	0.172***	(0.040)
BAM	3.107*	(1.636)	−0.128	(0.171)	0.058**	(0.026)
MKT	4.441**	(2.050)	0.012	(0.214)	0.086***	(0.032)
R^2	0.339		0.178		0.211	
F-value	40.217***		16.914***		20.930***	

Notes: OLS results for University of Seville. See table 1 for definitions of variables. The variance inflation factors (VIF) are below 2.0. Standard errors are in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$

whose results coincide with those of this work nor do those that do not coincide have a common denominator regarding the subject matter of study or in relation to the country's educational system. In fact, in the few studies on this subject focused on Spain, there are no coincidences either. However, these results question the hypothesis that female underrepresentation is due to their relatively low achievements.

The sign and significance of the remaining control variables are in line with the results of the previous literature. The grades of the entrance exam and the level of mathematical skill exert a positive and significant relationship with the performance indicators (Arnold and Rowaan 2014; Asian-Chaves et al. 2021, 2022; Beattie, Laliberté, and Oreopoulos 2018; Cyrenne and Chan 2012; Mallik and Lodewijks 2010).

The *strategic quantiles* (0.05, 0.10, 0.15, 0.25, 0.5, 0.75, 0.85, 0.9, and 0.95) are then estimated to test whether gender has the same influence (magnitude, sign, and significance) on the first-year students' academic performance indicators in the middle sections (0.25, 0.5, 0.75) as in the lower sections (0.05, 0.10, 0.15) and higher sections (0.85, 0.90, 0.95). This enables a better characterization of the possible gender gap and constitutes an innovation with respect to the previous literature. Because the findings are very similar for the three performance variables considered, only the aggregated results for the three grades considered for GPA are presented in table 6 (the results for PC and PR are available upon request).

The results shown in table 6 confirm those of the OLS regression for the variable of performance GPA in the aggregated economics-business area degrees. In relation to *gender*, being female has a positive influence on explaining the quantiles q05 to q75 of the GPA results of the first year of university degrees in the economics-business area; that is, it positively influences the performance results except for the highest grades.

The sign and significance of the control variables are as expected. A positive and significant relationship is found between the GPA and the attainment of better results in every quantile of UEE_MP except q05. In relation to mathematical education, the act of having studied advanced mathematics positively influences q50 and q75, and the grade in mathematics in the UEE has a positive influence from the quantiles q25 to q90.

Given that both the characteristics of each of the three considered degrees and the corresponding student profiles are different, in order to define the gender gap in these studies, the quantile analysis disaggregated by degree is replicated. In table 7, the values of the "Gender" variable are shown for each degree together with the performance indicators.

In the BAM degree, being female has a positive and significant influence in practically all the quantiles of GPA and in the lower quantiles of PC and PR. These findings are in contrast with those of Santos and Vallelado (2013) for the University of Valladolid, where the most analytical male BAM students of high attendance obtain the best results.

The results for the ECO degree provide insufficient evidence to conclude that gender constitutes an influential factor in first-year students' performance. In the MKT degree, gender exerts a significative influence only on the q50 for the performance measured by PC and PR, and this is negative, which indicates that women attain lower results in that quantile. This latter result confirms those achieved by Naqvi and Naqvi (2016) but contradicts those of Opstad and Årethun (2020), who find better performance in the case of female students.

Table 6. Gender gap in university academic performance (GPA) of economics-business area. Quantile regression results for University of Seville.

	Q05	q10	q15	q25	q50	q75	q85	q90	q95
β_0	−6.728*	−7.067**	−3.362***	−2.145	2.811***	3.194***	3.455***	3.396***	4.162***
	(3.588)	(2.803)	(1.195)	(1.878)	(0.287)	(0.359)	(0.335)	(0.396)	(0.412)
Gender	2.844**	2.025**	0.343*	0.161**	0.158**	0.144**	0.056	0.036	0.039
	(1.044)	(0.729)	(0.216)	(0.068)	(0.066)	(0.070)	(0.070)	(0.064)	(0.093)
UEE_MP	0.683	0.883**	0.431***	0.383***	0.327***	0.377***	0.391***	0.443***	0.410***
	(0.424)	(0.373)	(0.144)	(0.037)	(0.037)	(0.048)	(0.045)	(0.046)	(0.044)
UEE_EBM	0.053	0.088	0.090	0.030**	0.027**	0.019	0.026**	0.020	0.020
	(0.126)	(0.148)	(0.099)	(0.012)	(0.011)	(0.012)	(0.013)	(0.017)	(0.021)
UEE_Math	0.051	0.087	0.016	0.030***	0.023**	0.028*	0.036***	0.037***	0.019
	(0.080)	(0.089)	(0.028)	(0.008)	(0.009)	(0.015)	(0.008)	(0.013)	(0.021)
A-Math	−1.12	0.920	0.773	0.284*	0.470***	0.329**	0.268	0.270	0.291
	(1.803)	(1.576)	(1.049)	(0.156)	(0.123)	(0.135)	(0.183)	(0.206)	(0.209)
Preference	0.018	0.402	0.207	0.155*	0.107*	−0.012	−0.042	−0.069	0.008
	(0.613)	(1.040)	(0.678)	(0.088)	(0.055)	(0.116)	(0.098)	(0.111)	(0.117)
Acc_UEE	3.475***	2.196*	4.519***	4.379**	0.207	−0.038	−0.130	−0.111	−0.292
	(1.302)	(1.231)	(1.023)	(2.045)	(0.174)	(0.185)	(0.140)	(0.227)	(0.321)
BAM	−1.604	−0.579	−0.058	−0.030	0.103	0.211**	0.128	0.003	−0.099
	(1.080)	(0.486)	(0.122)	(0.054)	(0.076)	(0.106)	(0.130)	(0.169)	(0.186)
MKT	−0.039	0.019	0.143	0.227***	0.229***	0.214*	0.098	−0.106	−0.204
	(1.311)	(0.324)	(0.124)	(0.055)	(0.066)	(0.126)	(0.169)	(0.187)	(0.161)
R^2	0.149	0.2319	0.1529	0.1066	0.1071	0.1106	0.1322	0.1462	0.1743

Notes: See table 1 for definitions of variables. The Variance Inflation Factors (VIF) are below 2.0. Standard errors are in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$

Table 7. Gender gap in university academic performance (PC, GPA, and PR) of ECO, BAM and MKT degrees. Quantile regression results for University of Seville (coefficients of "gender" variable).

	Q05	q10	q15	q25	q50	q75	q85	q90	q95
ECO PC	5.787	4.501	4.055	5.662	0.510	−0.654	−3.180	0.367	3.789
	(3.943)	(3.172)	(3.649)	(3.824)	(3.061)	(3.651)	(3.691)	(3.292)	(3.694)
ECO GPA	0.226	0.299	0.159	0.079	−0.017	−0.106	−0.373	−0.366	−0.331
	(0.196)	(0.207)	(0.136)	(0.107)	(0.095)	(0.173)	(0.313)	(0.419)	(0.346)
ECO PR	0.098**	0.076	0.055	0.048	0.059	−0.048	−0.094	−0.022	0.043
	(0.039)	(0.050)	(0.040)	(0.038)	(0.063)	(0.056)	(0.065)	(0.074)	(0.074)
BAM PC	2.559	6.582***	5.380**	6.644**	4.927	0.844	0.714	2.642	0.544
	(2.356)	(2.550)	(2.613)	(2.959)	(3.071)	(2.068)	(2.099)	(2.154)	(1.477)
BAM GPA	1.363*	2.546**	0.921	0.404***	0.279***	0.243***	0.151*	0.052	0.068
	(0.795)	(1.177)	(1.039)	(0.102)	(0.065)	(0.083)	(0.080)	(0.093)	(0.136)
BAM PR	0.075***	0.097***	0.093***	0.129***	0.084	0.022	0.033	0.018	0.018
	(0.028)	(0.036)	(0.036)	(0.046)	(0.053)	(0.053)	(0.053)	(0.062)	(0.070)
MKT PC	−0.165	−5.587	−8.288	−6.614	−6.823**	−3.365	−1.399	−1.004	−1.297
	(6.652)	(5.999)	(6.704)	(5.698)	(3.303)	(2.708)	(2.642)	(2.418)	(1.748)
MKT GPA	−0.171	−0.141	−0.165	−0.140	−0.151	0.002	0.033	0.053	0.179
	(1.298)	(0.174)	(0.166)	(0.122)	(0.171)	(0.154)	(0.136)	(0.136)	(0.268)
MKT PR	0.020	−0.080	−0.103	−0.081	−0.077*	−0.062	−0.009	−0.009	−0.017
	(0.108)	(0.086)	(0.075)	(0.067)	(0.046)	(0.055)	(0.059)	(0.075)	(0.065)

Notes: See table 1 for definitions of variables. The Variance Inflation Factors (VIF) are below 2.0. Standard errors are in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$

Finally, in order to analyze the link between gender and the dichotomous variable "Retention," a Logit model (table 8) is estimated, both aggregated for the three degrees (Model 1) and disaggregated for each degree (Models 2 to 4). To the best of our knowledge, this variable has not been studied previously for the degrees of the economics-business area.

The aggregated results confirm that the following variables increase the likelihood of retention in first-year degree students: being a woman (9.1%), obtaining better marks in the access exam (6%), accessing via the University Entrance Exam (11%), having studied advanced mathematics in upper secondary school (14.9%), and studying for a BAM degree (7.7%).

In the BAM and economics degrees, the "Gender" variable has a positive and significant relationship with retention. The estimated average marginal effects indicate that the likelihood of retention is

Table 8. Gender gap in the retention of university students of the economics-business area. Logit results for University of Seville.

	Model 1		Model 2 ECO		Model 3 BAM		Model 4 MKT	
		ME		ME		ME		ME
β_0	−3.145***		−5.823***		−1.896*		−2.773	
	(0.919)		(1.926)		(1.050)		(3.370)	
Gender	0.568***	0.091***	1.135**	0.173**	0.587**	0.098**	−0.655	−0.069
	(0.206)	(0.032)	(0.524)	(0.076)	(0.273)	(0.042)	(0.699)	(0.070)
UEE_MP	0.816***	0.060***	0.631***	0.096***	0.318**	0.053**	0.192	0.020
	(0.110)	(0.017)	(0.234)	(0.032)	(0.140)	(0.023)	(0.363)	(0.038)
UEE_EBM	0.026	0.004	−0.045	−0.007	0.042	0.007	0.048	0.005
	(0.030)	(0.005)	(0.070)	(0.010)	(0.037)	(0.069)	(0.091)	(0.010)
UEE_Math	0.019	0.003	0.905	0.013	0.005	0.001	−0.035	−0.004
	(0.029)	(0.004)	(0.065)	(0.009)	(0.037)	(0.006)	(0.096)	(0.010)
A-Math	0.935**	0.149**	−0.426	−0.065	1.938**	0.324**	0.299	0.031
	(0.459)	(0.072)	(0.806)	(0.122)	(0.772)	(0.128)	(1.372)	(0.144)
Preference	0.332	0.052	0.380	0.058	0.255	0.042	1.229	0.129
	(0.219)	(0.034))	(0.530)	(0.080)	(0.257)	(0.043)	(0.938)	(0.098)
Acc_UEE	0.691**	0.110**	1.635*	0.249*	0.290	0.048	2.595**	0.273**
	(0.346)	(0.054)	(0.932)	(0.136)	(0.415)	(0.069)	(1.212)	(0.122)
BAM	0.489**	0.077**						
	(0.243)	(0.038)						
MKT	0.529	0.084						
	(0.343)	(0.054)						
Pseudo R^2	0.0632		0.1662		0.0544		0.0898	
Correctly classified	78.60%		80.56%		76.99%		87.39%	

Notes: See table 1 for definitions of variables. ME = Marginal effects. Standard errors are in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$

augmented by 9.8 percent and 17.3 percent, according to the degree, either BAM or economics, respectively, for female students. In the marketing degree, the variable "Gender" shows no significant results.

Approximately 78.6 percent of the sample has been correctly classified in the three degrees, with 76.99 percent in the BAM degree, 80.56 percent in economics, and, lastly, 87.39 percent in the marketing degree.

The *Probit model* results are similar and are available upon request.

Conclusions

With this work, we have striven to extend the empirical evidence regarding the gender gap in university studies in the economics-business area. Although the existence of the gap is well-documented in the literature, no conclusive results have yet been reached on the causes of female underrepresentation or on the differentials in academic performance.

Based on a complete econometric analysis, the analysis carried out has enabled us to delimit the gender gap in the studies of the economics-business area at the University of Seville, which is especially relevant in the degree of business administration and management. Both the variables prior to entering the university and a set of indicators of academic success have been analyzed. One of the contributions of this work is that, in addition to the joint analyses for the degrees of the economics-business area, they have also been disaggregated for the economics, business administration and management, and marketing degrees, which has made it possible to compare results. Likewise, the study is completed with a quantile analysis of the academic performance variables to define the possible gender gap with greater precision and an analysis of first-year university retention, both of which also constitute a contribution in regard to previous literature.

In line with the previous literature, we show the underrepresentation of women in the degrees of business administration and management (Ball 2012; Santos and Vallelado 2013) and of economics (Beneito et al. 2018; Emerson, McGoldrick, and Mumford 2012; Emerson, McGoldrick, and Siegfried 2018), while women are overrepresented in the marketing degree (Arnold 2020; Opstad 2019). However, by delving into the gender differences both in the variables prior to entering the university and in the academic performance in these degrees, our findings challenge certain results obtained in the previous

literature, although they do remain aligned with those of others. Because the results centered on the same areas of study and the same educational systems do not coincide, future exploration of the possibility that the explanation of the gender gap regarding academic performance may be related to cultural and social reasons of local character rather than to characteristics of curricula or educational systems could be conducted.

On the one hand, we document gender differences in favor of female students in the variables prior to entering the university: entrance grade, grades in the university entrance exam, and motivation. In this respect, it should be noted that significant mean differences between the mathematics qualifications were verified in favor of women. This result leads us to question the hypothesis that one of the causes of female underrepresentation in these studies is mathematical intensity (Dynan and Rouse 1997; Marshall and Underwood 2022; Emerson, McGoldrick and Mumford 2012; Emerson, McGoldrick, and Siegfried 2018; Opstad 2019, 2020). On the other hand, the greater motivation found in female students contradicts the conclusions of previous studies (Arnold and Rowaan 2014; Hadsell 2010), which may make it necessary to revise the hypothesis that women have less interest in subjects related to economics (Calkins and Welki 2006; Dynan and Rouse 1997). Perhaps this is a more current issue, in the respect that women who decide to study in the economics-business area currently do so with ever-greater motivation than men, as shown in this work.

Similarly, finding differences of gender in favor of women in all the indicators of academic success considered (credits passed, average grade, rate of performance, and students' retention), which are maintained in all the specifications and estimated models, the conclusions of much of the previous literature are questioned (Arnold and Rowaan 2014; Ballard and Johnson 2004; Dynan and Rouse 1997; Santos and Vallelado 2013). Thus, no evidence was found to support the hypothesis that female underrepresentation is linked to worse academic results. Likewise, female underrepresentation cannot be explained by the possible differences in the difficulty (or quantitative character) of the chosen subjects by men or women because, at the University of Seville, the subjects of economics, business, and marketing are necessarily the same for all first-year students. The results broken down in terms of each degree type show certain differences between them. In the business administration and management degree, there is a positive and significant link between being a woman and all the variables of academic performance (and in the majority of the quantiles), as well as with retention. In the economics degree, however, the gender variable yields significant results only for retention, and, in the marketing degree, the results are not significant.

Although our results point toward a change of direction in that they reveal a reverse gender gap in the academic performance of the degrees in the area, the underrepresentation of women remains. As pointed out by Beneito et al. (2018), the consequences of the relative scarcity of women in the discipline are not restricted to the major issue of gender equity but rather limit progress in the knowledge and practice of the discipline since these would be enriched by diversity (Bayer and Rouse 2016). Furthermore, the gender gap could indeed be self-perpetuating (Emerson, McGoldrick, and Mumford 2012) because the lower presence of women encourages the stereotype of the male economist, which, in turn, is reflected in labor market preferences (Williams and Wolniak 2021), thereby discouraging women from entering into training in these areas.

In this respect, we consider it essential to disseminate results, such as those achieved in this work, where better results are shown in the academic performance of female students, which may encourage future female students to enter the profession, thus helping to break the aforementioned vicious circles. In fact, Arnold (2020) states that women show a relatively higher sensitivity to grades. The dissemination of these results should be especially intense in secondary education because early interest in economics has been shown to have a positive impact on the decision to study it at the university level (Emerson, McGoldrick, and Mumford 2012). On the other hand, it would be desirable, also to those in secondary education, to grant greater visibility to the role of significant female economists, such as Christine Lagarde, the current president of the European Central Bank, and Janet Yellen, the president of the American Federal Reserve until 2018; this would undoubtedly contribute toward dismantling the long tradition of the male economist stereotype. If we look at only the number of men and women who have won the Nobel Prize in economics throughout history, it can be observed that only two women (2009 and 2019) have achieved this award, and it was shared with male economists both years.

According to the report titled "*The socio-economic contribution of the Spanish University System*," "a typical feature that characterises developed societies is that of gender equality, both in the workplace and in the private sphere, and this is an aspect in which education (university and pre-university) can and should play a fundamental role" (Pastor et al. 2019, 31). In this vein, education is key to achieving a more equitable society in which the potential advantages of its diversity are fully exploited (Caraballo and Buitrago 2019).

Likewise, in order to contribute toward overcoming the traditional gender gap that exists in the studies of the economics-business area, further in-depth analysis is necessary along these lines of research. This study could thereby be extended by considering other universities within different territories or by disaggregating the analyses in terms of subjects to test whether there are gender differences based on their typology or even by exploring the possibility that local social and cultural characteristics could be decisive in explaining the different results obtained in the literature.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Alcock, J., S. Cockcroft, and F. Frank. 2008. Quantifying the advantage of secondary mathematics study for accounting and finance undergraduates. *Accounting & Finance* 48 (5): 697–718. doi:10.1111/j.1467-629X.2008.00261.x.

ANECA (Agencia Nacional de Evaluación de la Calidad y Acreditación). 2005. *Libro Blanco: Título de Grado en Economía y en Empresa*. Madrid: Agencia Nacional de Evaluación de la Calidad y Acreditación.

Arnold, I. J. M. 2020. Gender and major choice within economics: Evidence from Europe. *International Review of Economics Education* 35 (November): 100191. doi:10.1016/j.iree.2020.100191.

Arnold, I. J. M., and W. Rowaan. 2014. First-year study success in economics and econometrics: The role of gender, motivation, and math skills. *Journal of Economic Education* 45 (1): 25–35. doi:10.1080/00220485.2014.859957.

Asian-Chaves, R., E. M. Buitrago, I. Masero-Moreno, and R. Yñiguez. 2021. Advanced mathematics: An advantage for business and management administration students. *The International Journal of Management Education* 19 (2): 100498. doi:10.1016/j.ijme.2021.100498.

Asian-Chaves, R., E. M. Buitrago Esquinas, I. Masero, and R. Yñiguez Ovando. 2022. Mathematical background as a success factor in economics and business degrees. *Journal of College Student Retention: Research, Theory & Practice* 24 (3): 758–72. doi:10.1177/1521025120946452.

Ball, J. A. 2012. The gender gap in undergraduate business programs in the United States. *Journal of Education for Business* 87 (5): 260–65. doi:10.1080/08832323.2011.617792.

Ballard, C., and M. F. Johnson. 2004. Basic math skills and performance in an introductory economics class. *Journal of Economic Education* 35 (1): 3–23. doi:10.3200/JECE.35.1.3-23.

Barone, C. 2011. Some things never change: Gender segregation in higher education across eight nations and three decades. *Sociology of Education* 84 (2): 157–76. doi:10.1177/0038040711402099.

Bayer, A., and C. E. Rouse. 2016. Diversity in the economics profession: A new attack on an old problem. *Journal of Economic Perspectives* 30 (4): 221–42. doi:10.1257/jep.30.4.221.

Beattie, G., J.-W P. Laliberté, and P. Oreopoulos. 2018. Thrivers and divers: Using non-academic measures to predict college success and failure. *Economics of Education Review* 62 (February): 170–82. doi:10.1016/j.econedurev.2017.09.008.

Beneito, P., J. E. Boscá, J. Ferri, and M. García. 2018. Women across subfields in economics: Relative performance and beliefs. FEDEA Working Paper No 2018-06. Madrid: Fundación de Estudios de Economía Aplicada (FEDEA). https://documentos.fedea.net/pubs/dt/2018/dt2018-06.pdf.

Boustan, L., and A. Langan. 2019. Variation in women's success across PhD programs in economics. *Journal of Economic Perspectives* 33 (1): 23–42. doi:10.1257/jep.33.1.23.

Calkins, L. N., and A. Welki. 2006. Factors that influence choice of major: Why some students never consider economics. *International Journal of Social Economics* 33 (8): 547–64. doi:10.1108/03068290610678707.

Caraballo, M. A., and E. M. Buitrago. 2019. Ethnolinguistic diversity and education. A successful pairing. *Sustainability* 11 (23): 6625. doi:10.3390/su11236625.

Castillo-Manzano, J. I., M. Castro-Nuño, M. T. Sanz, and R. Yñiguez. 2016. Does pressing a button make it easier to pass an exam? Evaluating the effectiveness of interactive technologies in higher education. *British Journal of Educational Technology* 47 (4): 710–20. doi:10.1111/bjet.12258.

Cyrenne, P., and A. Chan. 2012. High school grades and university performance: A case study. *Economics of Education Review* 31 (5): 524–42. doi:10.1016/j.econedurev.2012.03.005.

Dolado, J. J., and E. Morales. 2009. Which factors determine academic performance of economics freshers? Some Spanish evidence. *Investigaciones Económicas* 33 (2): 179–210.

Dynan, K., and C. Rouse. 1997. The underrepresentation of women in economics: A study of undergraduate economics students. *Journal of Economic Education* 28 (4): 350–68. doi:10.2307/1183419.
Emerson, T., K. McGoldrick, and K. J. Mumford. 2012. Women and the choice to study economics. *Journal of Economic Education* 43 (4): 349–62. doi:10.1080/00220485.2012.714306.
Emerson, T., K. McGoldrick, and J. J. Siegfried. 2018. The gender gap in economics degrees: An investigation of the role model and quantitative requirements hypotheses. *Southern Economic Journal* 84 (3): 898–911. doi:10.1002/soej.12247.
Eurydice (European Education and Culture Executive Agency [EACEA]). 2012. *Higher education in Europe 2009: Developments in the Bologna process*. Luxembourg: European Union Publications Office.
Hadsell, L. 2010. Achievement goals, locus of control, and academic success in economics. *American Economic Review* 100 (2): 272–76. doi:10.1257/aer.100.2.272.
Hair, J., R. Anderson, R. Tatham, and W. Black. 1999. *Análsis multivariante*. 5th ed. Madrid: Prentice Hall.
Johnson, D. E. 2000. *Modelos multivariados aplicados al análisis de datos* [Multivariate models applied to data analysis]. Mexico City: International Thomson Ed.
Johnson, M., and E. Kuennen. 2006. Basic math skills and performance in an introductory statistics course. *Journal of Statistics Education* 14 (2). doi:10.1080/10691898.2006.11910581.
Johnson, M., D. Robson, and S. Taengnoi. 2014. A meta-analysis of the gender gap in performance in collegiate economics courses. *Review of Social Economy* 72 (4): 436–459. doi:10.1080/00346764.2014.958902.
Koenker, R., and G. Bassett. 1978. Regression quantiles. *Econometrica* 46 (1): 33. doi:10.2307/1913643.
Koenker, R., and K. Hallock. 2001. Quantile regression. *Journal of Economic Perspectives* 15 (4): 143–56. doi:10.1257/jep.15.4.143.
Lindberg, S. M., J. S. Hyde, J. L. Petersen, and M. C. Linn. 2010. New trends in gender and mathematics performance: A meta-analysis. *Psychological Bulletin* 136 (6): 1123–35. doi:10.1037/a0021276.
Mallik, G., and J. Lodewijks. 2010. Student performance in a large first year economics subject: Which variables are significant? *Economic Papers* 29 (1): 80–86. doi:10.1111/j.1759-3441.2010.00051.x.
Marshall, E. C., and A. Underwood. 2022. Is economics STEM? Process of (re)classification, requirements, and quantitative rigor. *Journal of Economic Education* 53 (3): 250–58. doi:10.1080/00220485.2022.2075508.
Ministerio de Educación, Cultura y Deporte. 2014. *Real Decreto 412/2014, de 6 de junio, por el que se establece la normativa básica de los procedimientos de admisión a las enseñanzas universitarias oficiales de Grado* [Royal Decree 412/2014 of 6 June establishing the basic regulations for admission to official undergraduate university education]. Boletín Oficial del Estado n° 138.7/6/2014. Madrid: State Agency Official State Gazette.
Ministerio de Universidades. 2022. *Datos y cifras del Sistema universitario español* [Data and figures of the Spanish University System]. Publicación 2021-2022. Madrid: Ministry of Science, Innovation and Universities, Secretaría General de Universidades España.
Naqvi, A., and F. Naqvi. 2016. A study on learning styles, gender and academic performance of post graduate management students in India. *International Journal of Economics & Management Sciences* 06 (01): 1–6. doi:10.4172/2162-6359.1000398.
Niemi, N. S. 2017. *Degrees of difference: Women, men, and the value of higher education*. New York: Taylor & Francis. doi:10.4324/9781315521817.
Opstad, L. 2019. Different attitudes towards mathematics among economic and business students and choice of business course major in Norway. *Social Sciences and Education Research Review* 6 (2): 6–30.
———. 2020. Attitudes towards statistics among business students: Do gender, mathematical skills and personal traits matter? *Sustainability* 12 (15): 6104. doi:10.3390/su12156104.
Opstad, L., and T. Årethun. 2020. Factors that explain undergraduate business students' performance in their chosen field. Does gender matter? *Global Conference on Business and Finance Proceedings* 15 (2): 2–21.
Pastor, J. M., J. Aldás-Manzano, F. J. Goerlich, P. J. Pérez, L. Serrano, A. Catalán, Á. Soler, I. Zaera, and S. Mollá. 2019. *La contribución socioeconómica del sistema universitario español* [The socio-economic contribution of the Spanish University System]. Madrid: Conferencia de Rectores de las Universidades Españolas (CRUE), Conferencia de Consejos Sociales.
Pérez, C. 2004. *Técnicas de análisis multivariante de datos. aplicaciones con SPSS* [Analysis techniques of multivariate data applications with SPSS]. Madrid: Pearson Prentice Hall.
Sáinz, M. 2020. *Brechas y sesgos de género en la elección de estudios STEM ¿Por qué ocurren y cómo actuar para eliminarlas?* [Gender gaps and biases in the choice of STEM studies. Why do they occur and how to act to eliminate them?]. Sevilla: Fundación Pública Andaluza Centro de Estudios Andaluces.
Santos, M. V., and E. Vallelado. 2013. Algunas dimensiones relacionadas con el rendimiento académico de estudiantes de administración y dirección de empresas [Some dimensions related to the academic performance of business administration and management students]. *Universitas Psychologica* 12 (3): 739–52. doi:10.11144/Javeriana.UPSY12-3.adrr.
UNESCO. 2020. A new generation: 25 years of efforts for gender equality in education. *Global education monitoring report 2020*. Paris: UNESCO.
UNESCO-IESALC. 2021. Women in higher education: Has the female advantage put an end to gender inequalities? Paris: UNESCO.
Universidad de Sevilla. 2010. *Resolución de 20 de diciembre de 2010, de la Universidad de Sevilla, por la que se publica el plan de estudios de graduado en administración y dirección de empresas* [Resolution of December 20, 2010, of the University of Seville, by which the study plan for graduate in business administration and management is published]. Boletín Oficial Del Estado n° 17.20/01/2011. https://alojawebapps.us.es/fichape/Doc/MVBOE/151_memVerBOE.pdf (accessed February 9, 2024).

———. 2019a. *Resolución de 22 de julio de 2019, de la Universidad de Sevilla, por la que se publica la modificación del plan de estudios de graduado en economía* [Resolution of July 22, 2019, of the University of Seville, by which the modification of the graduate in economics study plan is published]. Boletín Oficial Del Estado n° 193.13/08/2019. https://alojawebapps.us.es/fichape/Doc/MVBOE/156_memVerBOE.pdf (accessed February 9, 2024).

———. 2019b. *Resolución de 22 de julio de 2019, de la Universidad de Sevilla, por la que se publica la modificación del plan de estudios de graduado en marketing e investigación de mercados* [Resolution of July 22, 2019, of the University of Seville, by which the modification of the graduate in marketing and market research study plan is published]. Boletín Oficial Del Estado n° 193.13/08/2019. https://alojawebapps.us.es/fichape/Doc/MVBOE/180_memVerBOE.pdf (accessed February 9, 2024).

Wang, M., and J. L. Degol. 2017. Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review* 29 (1): 119–40. doi:10.1007/s10648-015-9355-x.

Williams, T. M., and G. C. Wolniak. 2021. Unpacking the "female advantage" in the career and economic impacts of college. In *The Wiley handbook of gender equity in higher education*, ed. N. S. Niemi and M. B. Weaver-Hightower, 7–28. New York: John Wiley & Sons.

Worthington, A., and H. Higgs. 2004. Factors explaining the choice of an economics major: The role of student characteristics, personality and perceptions of the profession. *International Journal of Social Economics* 31 (5/6): 593–613. doi:10.1108/03068290410529416.