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GENDER SEGREGATION IN TECHNOLOGICAL UNDERGRADUATE STUDIES IN THE UNIVERSITY OF THE BASQUE COUNTRY (UPV/EHU)

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ABSTRACT

In this work we study the gender segregation in technological undergraduate studies in the University of The Basque Country (UPV/EHU).

For this study we use the data of new admissions at the UPV/EHU. They are from the time period of the years 2003-2013. We focus on the first and last year to check if the segregation has changed over these ten years. We build segregation curves within the Lorenz approach.

Our results show that the gender segregation in technological undergraduate studies in the University of the Basque Country has increased over the last ten years. We also show that the distribution between men and women has changed.

1- INTRODUCTION

Segregation is a very interesting issue because it has a social impact as well as an economic one. There is growing literature on the effects of segregation on society. For instance, Guryan (2004) estimates that for US data, half of the decline in black dropout rates between 1970 and 1980 is attributable to desegregation plans in schools. Del Río and Alonso-Villar (2010) show that men are much more evenly distributed across occupations than women in the Spanish labor market. Also Gobillon, Selod and Zenou (2007) show that blacks who live closer to the city center have worse labor market outcomes.

As far as we know, there has been no research carried out until now on gender segregation in technological undergraduate studies. However, there is clear evidence that the percentage of women that enter this type of studies is very low. Moreover, inside the technological area there are some fields such as architecture with more women than others. This is a very interesting international matter because of its significance, and it is not an isolated situation in our country. We can find in the article of Javier Sampedro in *El País* (2008) that Spanish women form the majority in almost every type of undergraduate studies: 63% in Social and Legal studies; 64% in Humanities; 59% in Experimental Science, and 74% in Health sciences. The exception is more remarkable than ever: Engineering and the rest of technological undergraduate studies, where women are no more than 27%. These results are similar to the rest of developed countries.

Stereotypes are normally the principal reason behind these figures (Grañeras *et al*, 2009). «It is an image question: women still think that machines, unlike maybe the case of an architect, surround an engineer», claims Laura Tremosa, the first woman who graduated in the Industrial University of Barcelona, in 1960 (Ibañez, 2012). Some fields in Engineering studies such as Chemistry are more feminine than others. Moreover Engineering is seen as a profession where people “get dirty”. These ideas were supported by Tània de los Santos, Sub Director of Studies and Communication in the *Universitat Politècnica de Catalunya* (UPC), (Ibañez, 2012)

On the other hand this under-representation of women in technological studies has been traditionally understood as a consequence of women's poorer skills in mathematics. However, there is much scientific evidence that supports the inexistence of this stereotype of feminine incompetence in mathematics. For example, Janet Hyde *et al.* (2008), develop a psychological macro study where they analyze the results in standard mathematics tests from more than seven million students from 10 North American states. They conclude that the differences between genders are statistically irrelevant.

With this study we do not intend to explain why women are under-represented in technological studies. On the contrary, we want to check if women are homogenously distributed among the different technological degrees or if there exists segregation. Also we want to analyze how this potential segregation has evolved over the years and the possible reasons for it. To this end we use the data from new admission at the University of the Basque Country (UPV/EHU)

As mentioned, sociologists and economists have long been interested in how to measure segregation adequately. One of the difficulties of measuring segregation is that it is not clear what it actually means. *Massey and Denton (1988)* identify five dimensions of segregation in a city: evenness, exposure, concentration, centralization and clustering. Each of these dimensions captures some aspect of the idea of segregation.

Evenness refers to the extent to which the members of the different groups are similarly distributed across units. Exposure refers to the extent to which members of the minority group are exposed to members of other groups. Concentration refers to the proportion of space occupied by the members of the minority in the city. Centralization is the degree to which the members of the minority group are located near the center of the city. Finally, clustering refer to the closeness of the units occupied by the members of the minority.

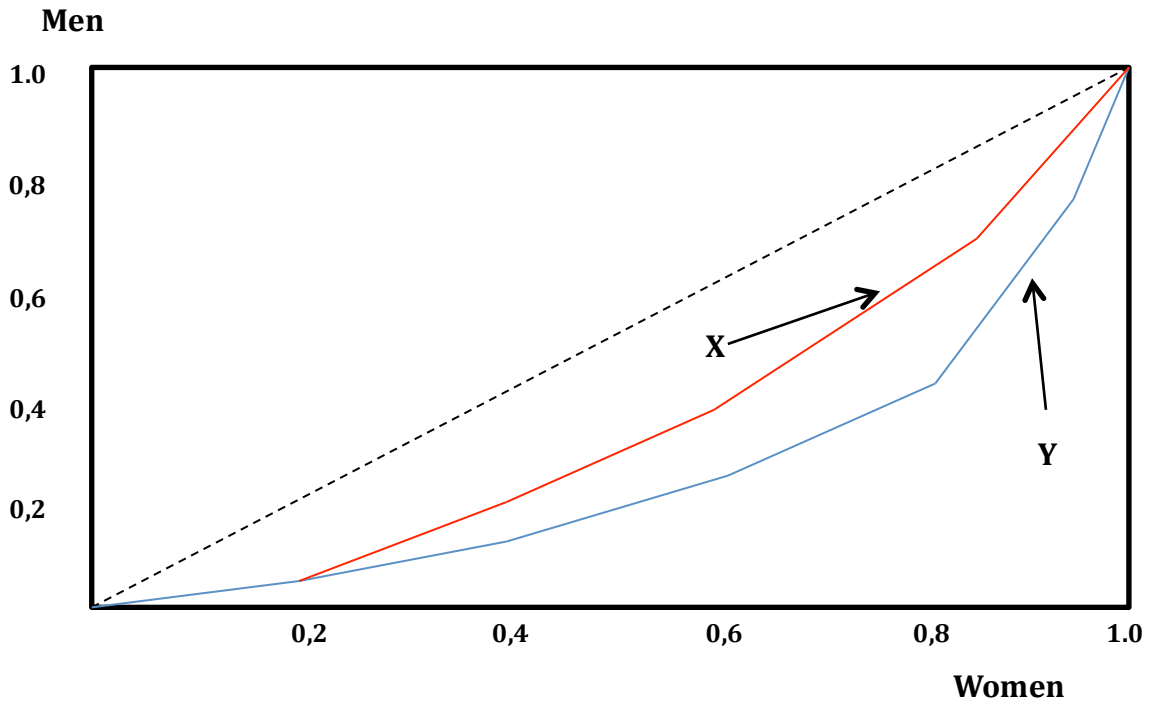
In this survey we concentrate on the more traditional model of segregation in which members of different groups, in this study, men and women, are located in different locations, in this case, the university centers (faculties and schools).

Segregation curves appear in the literature as early as in Duncan and Duncan (1955). For the two-group case, the literature on segregation borrows the device of the Lorenz curve from the income inequality literature and applies it to partially order cities. A segregation curve in the context of segregation is the analogue of the Lorenz curve in the context of income inequality. Indeed, recall that for each fraction, the Lorenz curve depicts the proportion of total income that is owned by the poorest proportion of the population. A segregation curve is essentially a Lorenz curve where one group, say men, is treated as a population, and the other group, say women, is treated as income. With this convention, the lower the proportion of women that study in a university center, the “poorer” is a male individual studying there.

Specifically, given data for two years, the segregation level can be compared, checking if the corresponding segregation curves cross or not.

In the following, we can see in Figure 1 an example where the blue segregation curve represents a more segregate situation than the red curve, according to Lorenz criterion.

Figure 1. The segregation curves of X,Y



Source: Lasso de la Vega C. and O. Volij

This essay consists of a first section where we explain the data we have used throughout the essay as well as their source, a second section where we study in depth the faculties (characteristics, distributions in technological studies and faculties with remarkable distributions), next there is a third section which refers to the measuring tools. Finally we show the results and conclusions.

2- TECHNOLOGICAL STUDIES IN THE UPV/EHU.

2.1 INFORMATION SOURCE

In order to analyze gender segregation among technological undergraduate studies we use the data for new admissions at the University of the Basque Country (UPV/EHU). The UPV/EHU is the only public university of the Basque Country, a Spanish region in the north of Spain with a population of around 2 million people. The number of students of the UPV/EHU is around 53,000, which represents 79% of all university students in the region.

In the Basque Country there are three universities: The UPV/EHU, which is the only public university, and two private universities. The University of Deusto is the biggest private university in the Basque Country with more than 10,000 students and 500 teachers. The other one is the Mondragon University.

Therefore we can say that the data used adequately represents the pattern of the whole Basque Country.

The database that we use refers to the new students in all undergraduate studies of the University of the Basque Country (UPV/EHU) from 2003 to 2013. In particular, we focus on technological studies, for analyzing the segregation between men and women in this area. The database has been provided by the UPV/EHU Admission Office.

2.2. OVERVIEW OF UNDERGRADUATE STUDIES IN THE BASQUE COUNTRY

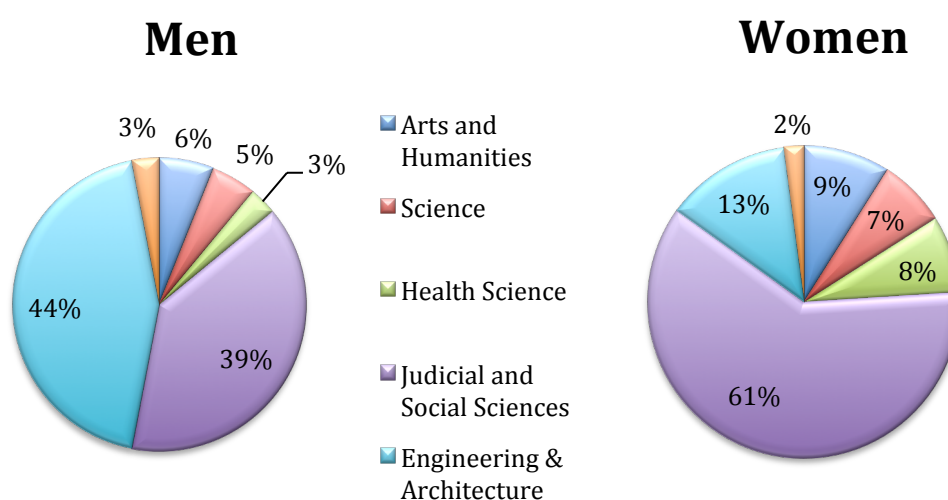
The Basque Statistics Institute published in July 2013 on its web site a press note about the university statistics in the Basque Country from the academic year 2011/2012 (EUSTAT, 2013). The note points out that “the gender distribution in university classrooms reflects a positive difference for women in university access which represents 8 percentage points: 54% are women, compared to 46% of men”. This information can be seen in Table 1.

Table 1. Total new university students in Basque Country

	Total	Men		Women	
Total	66.472	30.825	46%	35.647	54%
Undergraduates	59.321	27.622		31.699	
Graduates	7.151	3.203		3.948	

Source: Own elaboration from EUSTAT data.

Figure 2. Gender distribution of students in the UPV/EHU

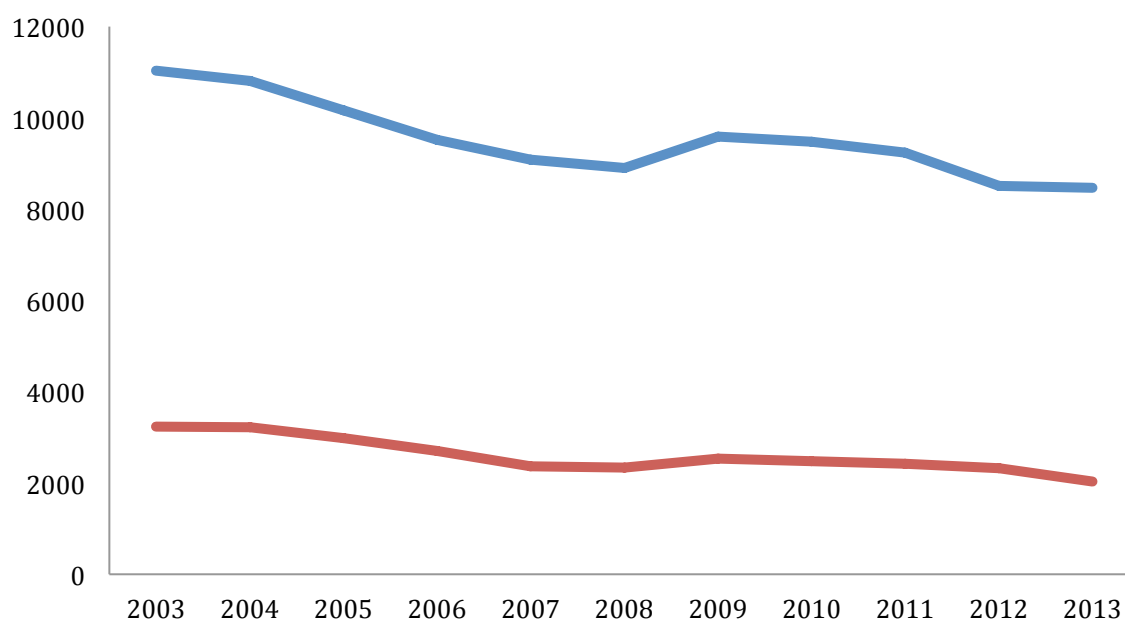


Source: Own elaboration from EUSTAT data.

Data from Table 1 and Figure 2 rule out the first of the possibilities we had mentioned before to explain the higher number of men in technological studies. We can see that for the whole Basque Country and for the academic year 2011-12, 54% of the undergraduate students are women and for the UPV/EHU 55%, Figure 2 shows the distribution of the students based on gender and studies area, given in percentages for the UPV/EHU. In this figure we can observe that 44% of men study Engineering and Architecture while only a 13% of women choose studies of this type.

Figure 3 shows the evolution of students registered in all the undergraduate degrees in the UPV/EHU, where we can see that this decreasing trend of students registered is not only in technological studies but also in all the degree courses.

Figure 3. Evolution of the number of new students in the UPV/EHU and in technological undergraduate studies



Source: Own elaboration

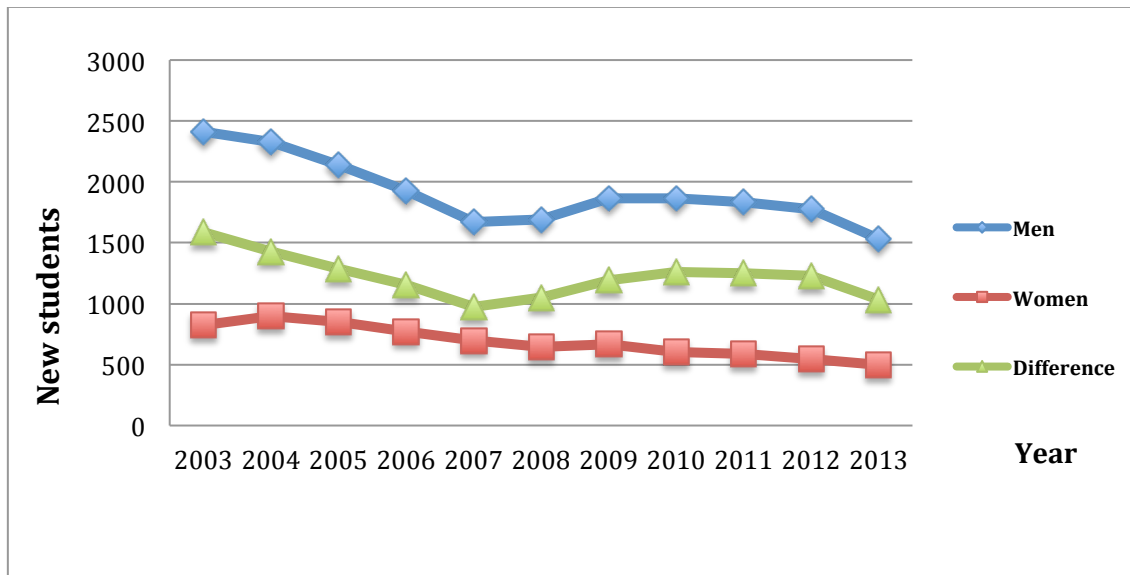
This decrease is directly related to the reduction of 30% in the population between 18 and 24 years old (Departamento de Cultura del Gobierno Vasco, 2009), and the increase in college professional training diplomas. Notice also that the new admissions have stabilized from 2008 on. This period corresponds with the economic crisis. The journalist David Gomez (2008) points out that a lot of young people who left school prematurely to make a living, lost their jobs and now are returning to study. So during the crisis new entries in the university have increased because many unemployed workers try to improve their qualifications. This positive effect compensates the negative effect derived from the reduction in the population.

Next we can see Figure 4, which shows a graph with the total number of men and women who are new students of technological studies in the UPV/EHU.

We can also see the difference between the total numbers of both genders each year.

This Figure 4 is useful to get a first view of the distribution that technological degrees have and we can also see if there has been any remarkable change in the distribution.

Figure 4: New admissions in technological studies



Source: Own elaboration

From Figure 4 we observe the following facts: 1) New admissions in undergraduate technological studies have decreased in the last decade for both women and men. This may be due to the reduction in the young population during this period. 2) In the case of men, new admissions have decreased by 36% although there was a slight rise during the period 2007-2009. 3) In the case of women, the decrease in new admissions represents a reduction of 40%.

In general terms we can see that the total number of women is much lower than the total number of men. Women represent 25% and 24% of new entrances for the years 2003 and 2013 respectively. This difference may be due to two reasons, the number of female high school graduates is lower than the number of male high school graduates, or another reason could be that women opt for other areas of studies. The registrations for men as well as for women has decreased compare to ten years ago.

2.3 UPV/EHU STRUCTURE: THE TECHNOLOGICAL CENTERS.

In this section we describe the main characteristics of the UPV/EHU centers (faculties and schools) where undergraduate technological studies are offered.

Table 2 shows the technological faculties and schools of each province and the studies that these centers offer.

Table 2. Technological studies in the UPV/EHU

Code ¹	VITORIA- GASTEIZ	
163	EU de Ingeniería de Vitoria-Gasteiz	Ingeniería Electrónica Industrial y Automática
		Ingeniería Eléctrica
		Ingeniería en Geomática y Topografía
		Ingeniería Informática de Gestión y Sistemas de Información
		Ingeniería Mecánica
		Ingeniería Química Industrial
GUIPUZKOA		
226	Facultad de Informática	Ingeniería Informática
		Ingeniería Informática de Gestión y Sistemas de Información
240	Escuela Técnica Superior de Arquitectura	Arquitectura
		Fundamentos de Arquitectura
263	EU Politécnica de Donostia-San Sebastián	Arquitectura Técnica
		Ingeniería Electrónica Industrial y Automática
		Ingeniería Civil
		Ingeniería Mecánica
		Ingeniería Química Industrial
264	EU de Ingeniería Técnica Industrial de Eibar	Ingeniería de Energías Renovables
		Ingeniería Electrónica Industrial y Automática
		Ingeniería Mecánica
BIZKAIA		
345	Escuela Técnica Superior de Ingeniería de Bilbao	Ingeniería Ambiental
		Ingeniería en Organización Industrial
		Ingeniería en Tecnología Industrial
		Ingeniería Técnica de Telecomunicación
350	Escuela Técnica Superior de Náutica y Máquinas Navales	Ingeniería Marina
		Ingeniería Náutica y Transporte Marítimo
363	EU de Ingeniería Técnica Industrial de Bilbao	Ingeniería Electrónica Industrial y Automática
		Ingeniería Eléctrica
		Ingeniería Informática de Gestión y Sistemas de Información
		Ingeniería Mecánica
		Ingeniería Química Industrial
364	EU Ingeniería Técnica de Minas y de Obras Públicas	Ingeniería Civil
		Ingeniería de Tecnología de Minas y Energía

Source: Own elaboration from UPV en cifras 2010/2011

¹ The code used for each center corresponds to the code used for the university to distinguish each

Below we evaluate different aspects about the centers that we need to take into account for the analysis.

- *Centers' Location.*

In general terms, there are a low number of students who change their place of residence to access University in the whole country. Considering there is a high dispersion of universities and faculties through the whole national territory the percentage of students who register in the university next to the same region where they do the Access Tests is very high, in most of the cases higher than 70% (Ministerio de Educación, Cultura y Deporte, Gobierno de España, 2014).

Given that the UPV/EHU is a multi-campus university, the location of their faculties and schools and the distribution of the population inside the Basque Country may be a relevant variable. In Figure 5 we see a map with the location of all the faculties and schools. We observe that most of the centers are in the main cities, Bilbao (capital of Bizkaia) and Donosti (capital of Gipuzkoa). The other big city, Vitoria (capital of Araba), has just one school offering technological studies.

Figure 5.UPV/EHU technological centers.



Source: Own elaboration

To understand this distribution of the faculties, we need to pay attention to the age of the population of each province. Table 3 shows that Araba has a much lower young population to study in the university compared to the other two provinces. This could explain why there is only one school in Araba as opposed to the four schools and faculties there are in Bizkaia and Gipuzkoa.

We can see as well that the number of men in this age range in all the provinces is higher than the number of women. This is remarkable because as we mentioned before, the percentage of women at university is higher than the percentage of men.

Table 3. Polulation for age and gender

		Both	Men	Women
Araba/Álava	Total	15936	8185	7751
	%		0,51	0,48
Bizkaia	Total	55079	28132	26947
	%		0,51	0,48
Guipuzkoa	Total	35526	18142	17386
	%		0,51	0,48

Source: Own elaboration from INE data.

- *Studies overlap.*

In the year 2010 the new undergraduate studies began in the UPV/EHU because of the new Bologna Accord, substituting the old “diplomaturas y licenciaturas”.

One of the changes that the new undergraduates studies brought about is how long the studies last. The old “licenciaturas” had a duration of five years and the “diplomaturas” or technical studies had a duration of three years. With the establishment of the new undergraduates studies, all of them last four years.

In Table 2 we can see there are some degrees that are offered simultaneously at different centers. This is a fact to take into account, because with the new system all studies are at the same level, all the students will end up with the same diploma and there is no difference of level between one degree and another.

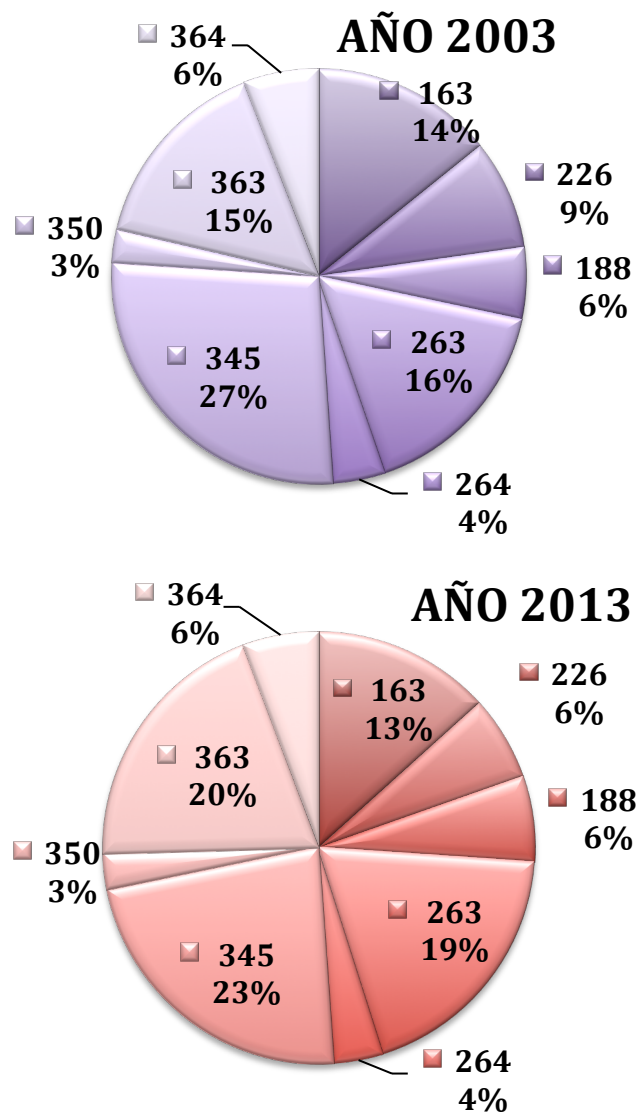
The consequence of this could be that some of the students may go to some center instead of another for the same studies.

- *The size of the centers.*

Another aspect to take into account is the importance of each center depending of the number of students.

Figure 6 shows the percentage of technological students has decreased in the *Facultad de Informatica (240)* and the *Escuela Técnica de Ingeniería de Bilbao (363)* from 2003 to 2013. On the contrary, the respective percentages in the *Escuela Politécnica of San Sebastián (263)* and in the *Escuela Universitaria de Ingeniería Técnica Industrial of Bilbao (363)* have increased.

Figure 6. Distribution of the students in each faculty



Source: Own elaboration

2.4 GENDER DESCRIPTIVE ANALYSIS FOR TECHNOLOGICAL STUDIES IN THE UPV/EHU

In this section we focus our research on the new students, men and women, of technological studies between the years 2003 and 2013. Table 4 shows the number of new students by gender for all the centers of the UPV/EHU. Ratio W/M refers to the ratio of number of women students over male students, which is a relevant variable to be able to build the segregation curves.

Table 4. New students of each faculty

AÑO 2003	264	350	226	263	363	163	345	364	240	Total
Men	119	72	234	426	387	339	625	130	82	2414
Women	18	16	57	132	138	140	292	67	106	966
Total	137	88	291	558	525	479	917	197	188	3380
Ratio W/M	0,15	0,22	0,24	0,31	0,36	0,41	0,47	0,52	1,29	0,4
AÑO 2013	264	350	226	263	363	163	345	364	240	Total
Men	53	48	115	309	337	212	322	79	59	1534
Women	21	7	14	80	65	58	145	36	72	498
Total	74	55	129	389	402	270	467	115	131	2032
Ratio W/M	0,4	0,15	0,12	0,26	0,19	0,27	0,45	0,46	1,22	0,32

Source: Own elaboration

We have already seen that the total number of men as well as women have decreased between 2003 and 2013 (see Figure 6). Table 4 shows that there is also a decrease in the ratio women/men in almost all the centers, which means that in the year 2013 there are fewer women per man than in the year 2003.

Moreover, we can observe there has been a change in the order of the centers considering the women/men ratio. The center with more women per man in both years is the *Escuela Técnica Superior de Arquitectura (240)*, which is the only center with a ratio greater than 1.

In the year 2003 the center with fewer women per man was the *Escuela de Ingeniería Técnica Industrial de Eibar (264)*, with a ratio of 0.15. Ten years later this faculty has a

ratio of 0.40, being the only center which shows an increase in the proportion of women per man, reaching the top three in the ranking. The main reason to explain this increase is the change of the studies offer with the new Bologna Accord; now this school offers a new degree, *Ingeniería en Energías Renovables*, with one of the highest cut-off marks.

We can also highlight that the center which has the lowest women/men ratio is the *Facultad de Informática (240)*, with, in the year 2013, 0.12 women per man, half that of ten years earlier. These numbers are worrying data for this center. Last October in the newspaper *El Correo*, the dean of the Faculty, Iñaki Alegría, states: “I can’t stop thinking about this unknown which is not due to a single factor but an addition of several things which have been transmitted to the students, parents and teachers, that computers are not for girls”.

That is why throughout this article they point out that the main reasons for having more men in this faculty is the stereotype related to the IT guy of “ a young antisocial male geek, who doesn’t come out from his room and lives surrounded by wires”, the change of name in the degree from “Licenciado en Informática” to “Ingeniero en Informática”, and because most of the computer games are for a male public.

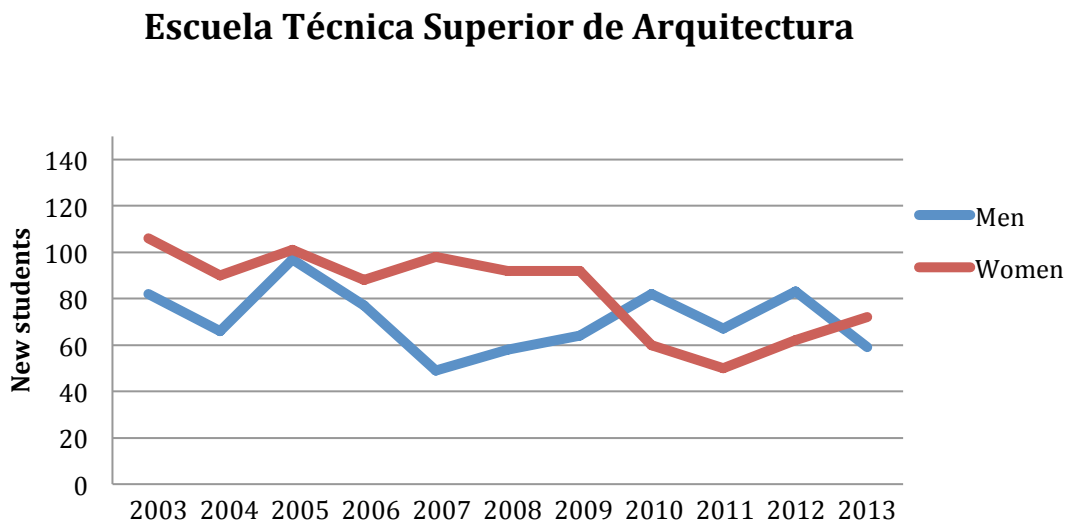
2.5 UPV/EHU CENTERS WITH REMARKABLE GENDER DISTRIBUTION.

Previously we have seen the general trend in the number of new students over the years in a curve that includes all the centers (Figure 1). Next we will analyze each one of the centers considering the total number of students, to check if all the centers have the same trend or if any of them has a remarkable evolution to show, and we will try to analyze the reason.

- *Escuela técnica superior de Arquitectura.*

The first remarkable faculty is the *Escuela Técnica Superior de Arquitectura (240)*. As we can observe in Figure 7, for most of the years the number of women is higher than the number of men, the only technological center where this happens.

Figure 7. Gender distribution in the *Escuela Técnica Superior de Arquitectura*



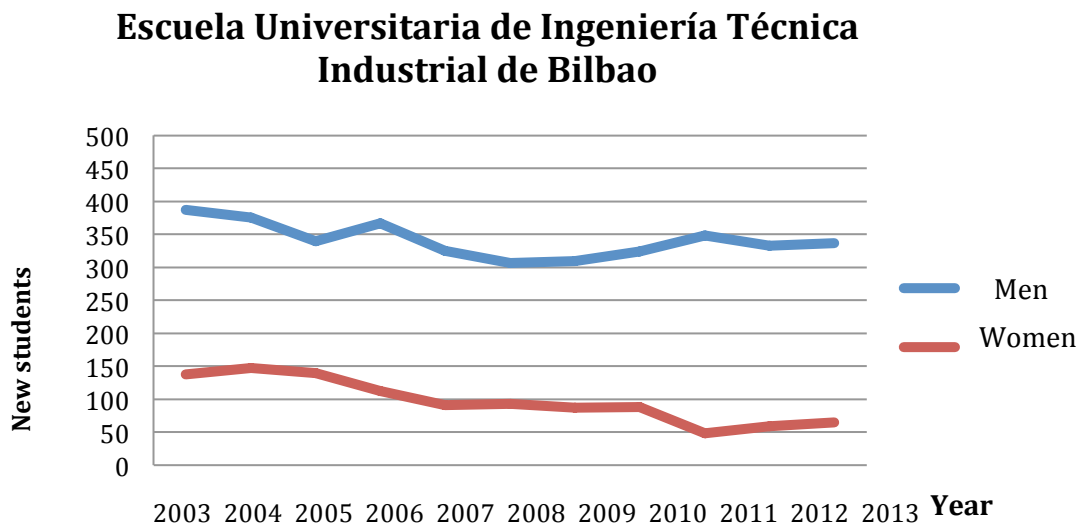
Source: Own elaboration

- *Escuela Universitaria de Ingeniería Técnica Industrial de Bilbao(363) and Escuela Técnica Superior de Ingeniería de Bilbao (345)*

The *Escuela Universitaria de Ingeniería Técnica Industrial de Bilbao (363)* is the only center where the total number of students increases during the last three years (see Figure 8). This increase can be complemented with the sharp decrease in the *Escuela Técnica Superior de Ingeniería de Bilbao (345)* during the same years (see Figure 9).

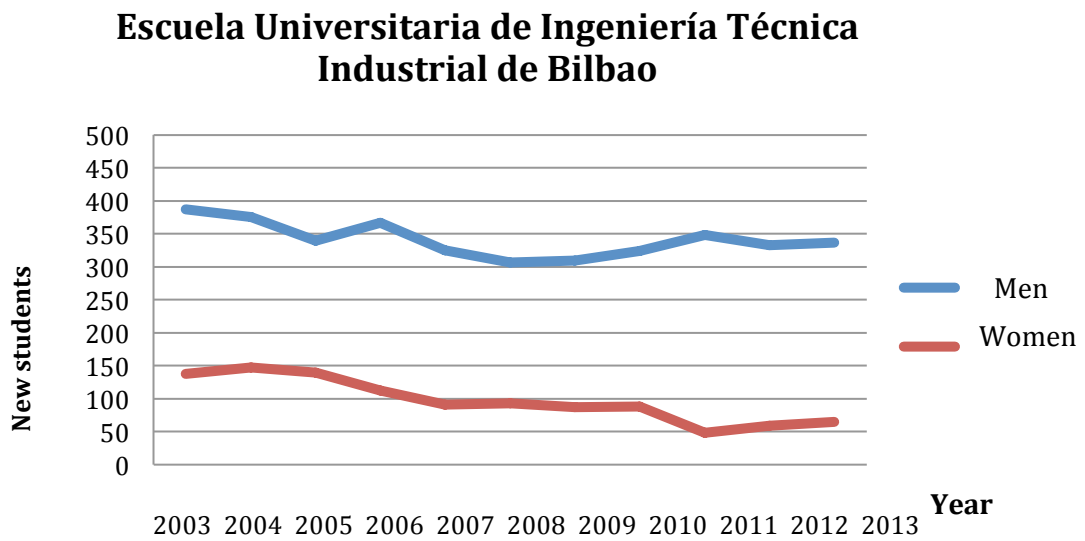
Both schools are in the center of Bilbao, so we may think that there has been a shift in the preferences of new students from one center to other. Before the implementation of the undergraduate studies under the Bologna Accord, in the *Escuela Técnica Industrial de Bilbao (363)* studies were offered which lasted 3 years compared to the 5 years duration and higher qualification in the *Escuela Superior de Ingeniería de Bilbao (345)*. In the year 2010, with the implementation of the Bologna Accord, these differences in study duration disappeared.

Figure 8. Gender distribution in the *Escuela Universitaria de Ingeniería Técnica Industrial de Bilbao*



Source: Own elaboration.

Figure 9. Gender distribution in the *Escuela Técnica Superior de Ingeniería de Bilbao*



Source: Own elaboration

3- MEASURING THE GENDER SEGREGATION

The tools that are used for this work are the segregation curves that are similar to Lorenz curves. These curves indicate graphically the segregation between men and women. The Lorenz curve plots the cumulative income share, ranked in increasing order, on the vertical axis against the cumulative population shares on the horizontal axis.

Formally, how is a segregation curve built? First, we order the centers in non-decreasing order of the proportion of women. Second, we normalize the number of women and men in each center. Third, we compute the cumulative percentages of men and women. Finally we plot the pairs and connect the dots.

The segregation curves provide a partial order of centers. This ranking is consistent with the fact that any segregation index must be consistent with the partial order derived from the segregation curves.²

These segregation curves are drawn like the Lorenz curves where one group is taken as population and the other group as income. If the curves cross we can say nothing about the segregation and we would need to calculate some segregation index, the most famous being the counterpart of the Gini Index. Graphically the Gini Index can be computed as twice the area between the line of equality and the Lorenz curve.

The Gini Index is based on the Lorenz curve, which plots the proportion of the total income of the population (y axis) that is cumulatively earned by the bottom x% of the population. The Gini Index is going to be a value between 0 and 1. If our Gini Index is near 1, this means the total segregation, but if it's near 0 segregation doesn't exist.

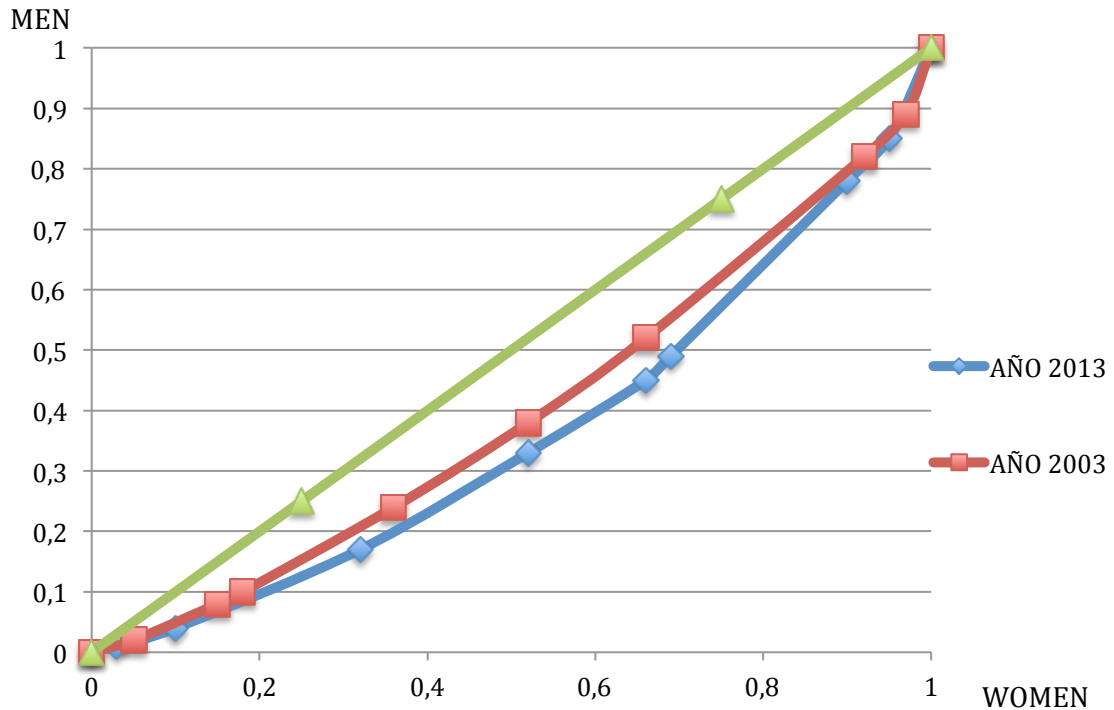
If they do not cross then the year whose segregation curve lies below that of the other one is deemed, according to the Lorenz criterion, the more segregated one.

² It was stated without proof by James and Taeuber (1985). A proof of this result for the case where all locations contain the same number of members of one group (e.g., all centers contain the same number of women), was proved by Hutchens (1991). Lasso de la Vega and Volij (2014) generalize this result for the case where locations may have any number of members of any group, including zero.

4- RESULTS

The segregation curves that we obtain from our case are the following:

Figure 10. Results: segregation curves



Source: Own elaboration

In Figure 10 we can see two segregation curves, the blue curve, which is about the year 2013, and the red curve, which is about the year 2003.

Women are represented on the vertical axis and men are represented on the horizontal axis, so the segregation curves are showing how many women correspond to each man.

The blue curve is below the red curve. This shows that in 2013 the segregation between men and women in technological studies is higher than in the year 2003, so the segregation is growing.

5- CONCLUSIONS

Throughout this essay we have seen that segregation not only exists in technological undergraduate studies in the UPV/EHU, but also that this segregation has increased in the last ten years.

This essay could be deeper, thinking of what the consequences of the low presence of women in certain technological undergraduate studies could be. One of the things we could think about is the cost for society of not having feminine qualities in the labor market.

On the other hand, the European Union has asked the state members to reduce the gap between the number of women and men with graduate studies in mathematics, science and technologies by half in the next ten years. This was one of the commitments achieved at the Education, Youth and Culture Council in 2003. (Instituto de Evaluación, 2008)

Some of the countries, like Germany, are very close to achieving this goal thanks to the specific programs that encourage girls to study these technological subjects. Spain is very far away from achieving this goal. In fact, based on our results for the UPV/EHU the gap between women and men is not being reduced, but rather it is increasing. That is why it would be interesting to make a deeper study which would analyze the reasons for the low percentage of women in technological undergraduate studies in our country, in order to make the proper decisions in this direction, or even an essay where we could compare the differences between technological undergraduate studies in Spain and in Germany.

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