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ARTÍCULO

The labour segregation by gender: An application of "Pollution Theory"

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Abstract: Pollution Theory is currently one of most widespread explanations for labour segregation by gender. This theory establishes by Goldin (2002 and 2006), in general terms, establishes that in labour occupations with a high presence of women, there will be a wage reduction or/and penalization due to the decline in occupational prestige as a result of a process of "pollution" in the labour supply.

In this paper, we attempt to validate this theory in the Spanish labour market, which is a perfect case study. The strategy of validation requires an analysis of the average salary in different labour locations depending on the female presence. Our estimations are focused as closely as possible on Goldin's original model about labour occupations. Nevertheless, we add new perspectives for analysis, including estimations by sectors, companies, and segregation locations. We also consider additional models as well as Goldin's original estimation, including a great number of independent variables. Finally, we propose a dynamic estimation that could approximate the model proposed by Pollution Theory over time.

Our results led instead to a partial validity of Pollution Theory in Spain. Only the estimations from a sectoral perspective provide positive and significant results. According to our results, high levels of training or education acquired by women in Spain over the last decade could be the cause of the lack of salary reductions or wage penalties predicted by Pollution Theory. In addition, the high concentration of women in public employment limits the fulfilment of this theory.

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1. Introduction

Labour segregation is usually associated with an inefficient functioning of the labour market, and/or assumes that men and women work in different workplaces. Various hypotheses have been used to attempt to explain this different labour assignment. Nevertheless, none of them alone offers a definitive or final explanation; the analysis of labour segregation therefore remains a multidisciplinary question. In this paper we offer an additional perspective of analysis in base of Pollution Theory.

The initial explanations for segregation established that a different labour location by gender is related to differences in productivity or aspects of its determining factors, e.g. education (Altonji and Black, 1999). The Theory of Human Capital (Becker, 1994) on specialization by gender based on home negotiation is prominent in academic circles. Furthermore, women and men also can differ in their psychological attributes, social preferences and social attitudes; which would lead them to present unequal attitudes to the risk, competition, and/or behaviour in negotiation (Bertrand, 2010).

A central emerging concept regarding these issues is Gender Identity, which provides an idea of self-identification that determines that people have a specific identity (Akerlof and Kranton 2000). Identity would explain labour outcomes or elections due to being employed in a certain location (occupations or activities), which could be associated with a perfect fit for the self-identity and increase personal satisfaction. According to this argument, breaking away from one's gender role or labour category would reduce the personal satisfaction. Individuals consequently take labour decisions and are employed according to their Gender Identity. Men and women find it appropriate to behave according to the rules and norms of being their gender. Gender Identity theory accounts for occupational segregation (differentiation between male and female occupations and/or activities).

In addition to these ideas based on the observation of different labour characteristics associated with women and men, discrimination is also a common hypothesis for explaining this result. There are a wide range of explanations for the foundations of discriminations. On the one hand, the discrimination could be the result of employers' taste or preferences for discriminating against women (Becker, 1957). Women are only employed in a few jobs due to discriminatory behaviour by employers. The existence of different preferences and labour characteristics, which are distributed unequally between women and men (Bergmann, 1986), could be the foundation for this behaviour. On the other hand, taking decisions in contexts with limited information provides a false index about the productivity of men and women. Accordingly, insofar as the entire group is assigned the same characteristics as the average individual, individuals with characteristics differing widely from the average would be discriminated against (Phelps, 1972, Arrow, 1973).

More recently, Goldin's Pollution Theory (hereinafter PT) (Goldin, 2002 and 2006) returned to the idea of discriminatory behaviours by men as an explanation for the segregation, linking these behaviours with the concept of Gender Identity mentioned above. According to Goldin's proposals, in the labour market men receive utility not only from the salary for labour, but also from other aspects linked to their work, such as labour prestige. Prestige is therefore an important parameter men's labour decision, and they have an interest in defending it the same way as they have an interest in defending labour salaries. The prestige of a job is determined by its level of productivity, which is approximated by the level possessed by a certain characteristic related to productivity (e.g., the level of education).

With imperfect information, men would have problems defending the prestige of their job, and dealing with possible changes. Society as a whole determines the prestige of jobs. Men do not know the real productivity associated with their position, and it is approximated by the average value of the labour characteristics. Women's access to jobs would bring overall changes to labour prestige if it leads to changes in the concentration of labour characteristics that measure prestige. Women's access would be a menace and considered as pollution for the prestige of jobs, which would reduce the associated utility. Men would therefore prevent the entry of women, reinforcing segregation. In short, some implications as regards segregation and wage differences by gender could be deduced from PT:

a) In labour occupations with a high concentration of male labour characteristics, men will not feel threatened by women's access. Women do not change the median value of labour characteristics.
b) In the opposite situation, women's access will be perceived as a threat to labour prestige and therefore to utility. Women will therefore meet barriers to access, and occupational segregation will appear.
c) Changes in the distributions of labour characteristics of men and women will modify the integrated, feminine or masculine nature of the different labour occupations.
d) The final consequence is that wages change according to the segregated nature of occupations. Wages will therefore be high in male occupations and low in female occupations. The differentiation with other theories of discrimination is that pollution theory mainly establishes wage discrimination.

An interesting application to pollution theory in made by Jessica Pan (2015) in relation to tipping. The line of present a different research related with wages.

The level of education is one of the best candidates among the possible characteristics related to productivity to which Goldin's analysis could be applied. Christiansen et al (2016) argue that investment by women in education is one of the main determining factors of both their increase in labour participation and the improvement of their labour outcomes. Goldin (2006) makes a similar argument when she analyses the historical transformations experienced by female employment, identifying access to education as one of the foundations of the revolution that underlies these processes. Women's access to the labour market appears to have largely based on the acquisition of education.

However, if women's level of education is the characteristic taken into account, the effects over segregation may be contrary to those predicted by PT. The increase in education would raise the prestige of a labour occupation and its productivity, which will reduce labour segregation by gender and based on this argument, the wage penalty would disappear.

According to Goldin's theory, the increased access by women with higher levels of education than men to the labour

market should lead to a reduction in levels of segregation, increasing the number of integrated occupations, while at the same time reducing wage discrimination in occupations with a higher presence of women. These arguments are linked to the research of Dolado et al. (2004), which demonstrate how education is decisive in fighting against occupational segregation. Moreover, following their analysis, and in conjunction with Goldin's theory, education and the consequent lower levels of segregation could have a positive impact on female wages, and reduce the gender gap.

According to the approaches above, the aim of this paper is to validate Goldin's PT as an explanation for labour segregation and the gender wage gap in Spain. The case of this country is suitable for the study of this theory, given that its economic and social development has taken place over a few decades. Likewise, the incorporation of women into the labour market has been one of the most important historical events in our recent history (Cebrián and Moreno, 2008; Dueñas et al., 2016).

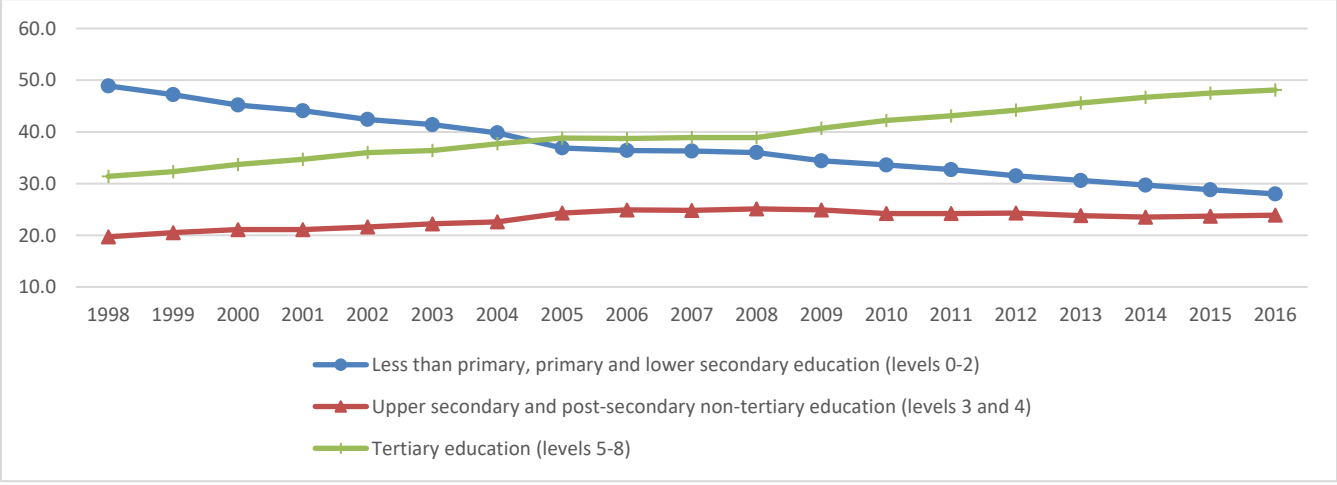
The empirical application of PT to national economies is becoming more widespread, leading to new research on this subject. For example, Goldin establishes historical evidence in her research for 2006 and 2014 for the United States; Goldin and Katz (2016) recently carried out empirical research on labour segregation in Family-Friendly Occupations for the United States, validating some degree of salary penalties for part-time employment, although, this work is somewhat remote from original PT; Olivetti and Petrongolo (2016) review in detail the state of gender gaps in the main industrialized countries; cross-country evidence is presented in section 3 of the OECD Employment Outlook (2002); Ludsteck (2014) uses an interesting approach, analysing the relationship between the proportion of women and the gender wage gap for the case of Germany using longitudinal employer-employee data; finally, Bell (2005) provides an interesting perspective on the presence of women as senior executives and the consequences for female hiring.

Our article is organized as follows. The next section includes a preliminary view and several assumptions about the methodology applied. Two complementary analyses are performed in section 3. The first validates the inverse relation between wages and the presence of women established by PT from various perspectives, while the second test to determine whether labour segregation by gender in Spain takes place according to Goldin's proposals. In section 4, we offer a new methodology to validate PT by means of a dynamic analysis. Finally, section 5 contains the main findings.

2. Preliminary view and methodolgy

In Spain, women's level of education has risen considerably, increasing the presence of women with higher education in employment. Figure 1 shows the changes in the educational attainment level of female employees.

Figure 1. Female employment by educational attainment level in Spain % (Source: LFS, Eurostat).



Female employment has fallen significantly for workers with lower levels of education, while it has increased for other levels of education, with a very notable growth for tertiary education. As for possible predictions from Goldin's PT and contrary to educational trends, labour segregation in Spain continues to be higher (Dueñas et al, 2014), and as shown in Figure 2, segregation by sector and occupations measured by Duncan-Duncan index (Duncan and Duncan, 1955) is higher in Spain than Europe. On the other hand, the real hourly wage has increased for men and women (see figure 3). The gender gap has experienced cyclical behaviour during the last decade, increasing to 2012 and subsequently falling. According to the Wage Structure Survey (hereinafter the WSS), the gender gap in 2015 was almost 16 percent. Both concepts – labour segregation and wage discrimination – are closely linked in Spain (Hernández, 1996; Palacio and Simon, 2006).

In terms of applied methodology, the pool data used are from the WSS for 2010 and 2014[1]. In our opinion, this survey is the one that is most appropriate for our aims given that it provides information about salaries of workers in "formal" employment, and the characteristics of their jobs, thereby enabling our estimations. The analysis focuses on full-time workers and monthly wages to avoid possible heterogeneity (Amuedo-Dorantes and De la Rica, 2006).

[1] The analysis includes part of the recent crisis experienced by the Spanish economy in which wages underwent a significant devaluation, which may lead to some underestimation of the results.

Figure 2. Labour segregation by gender. (Source: Own elaboration from LFS, Eurostat)[2].

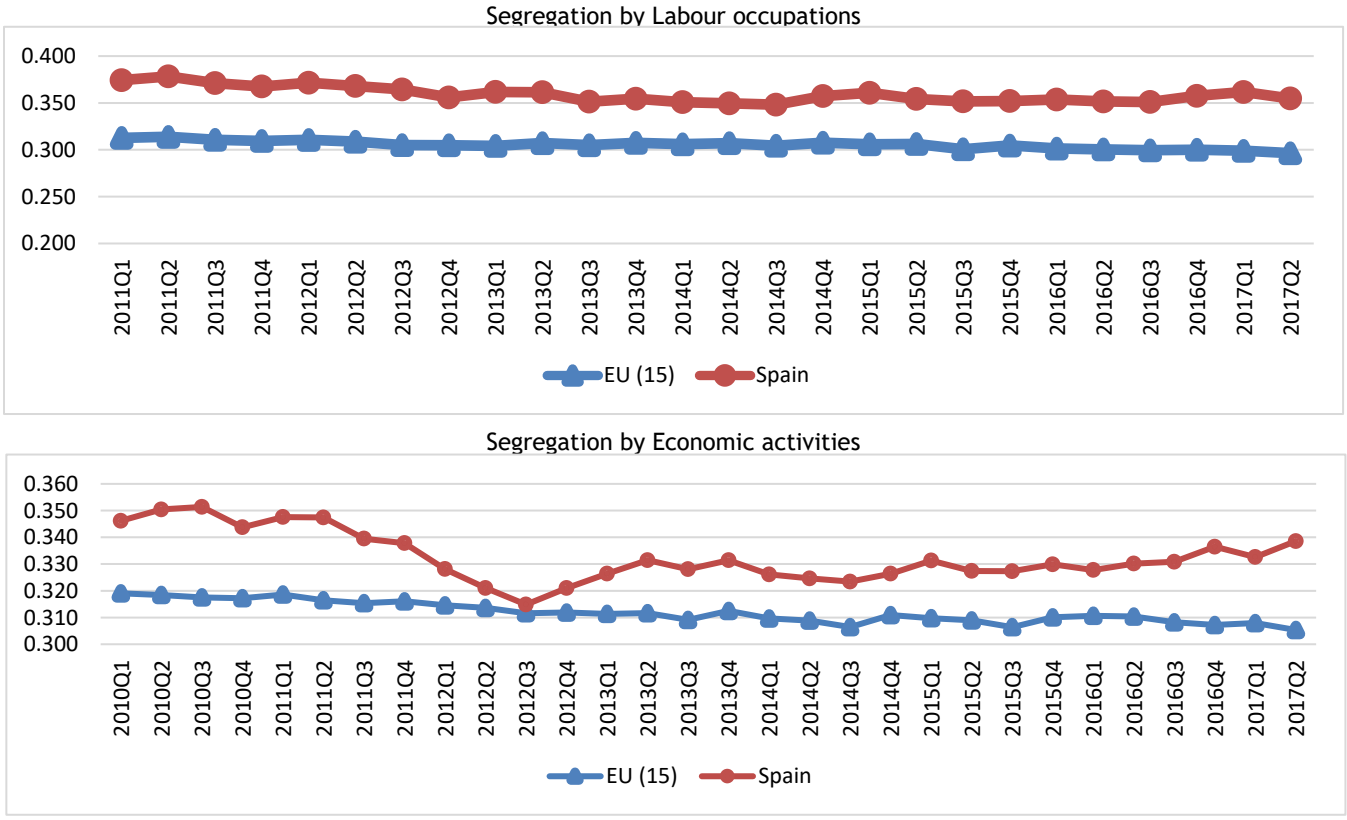
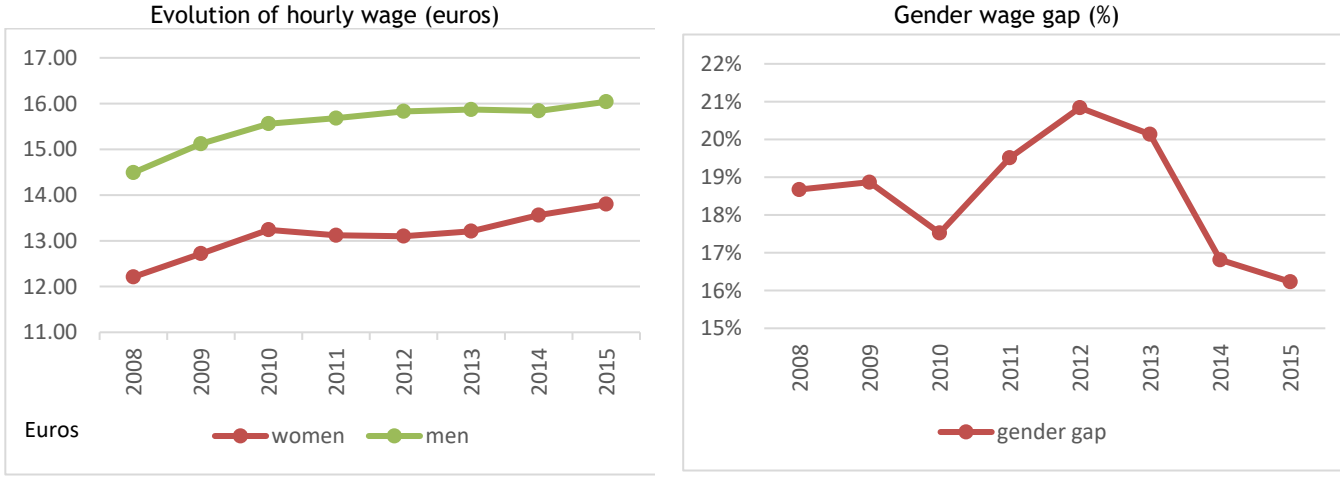


Figure 3. Evolution of hourly wage for men and women and gender wage gap in Spain. (Source: WSS).



In accordance with our aim to apply the PT, we use several models to estimate the influence of the presence of women on wages among both genders. The main difference with the most common wage estimations is the inclusion of the presence of women in different labour locations. In specific terms, our baseline model is estimated using the OLS (*Ordinary Least Square*) following Goldin's original postulates:

$$W_i = \beta_0 + \beta_1 * X_{Goldin} + \frac{0}{0} Women + D_i + \varepsilon_i \quad (1)$$

where W_i is the logarithm of the gross wage of full-time employees over 19 years old[3]; X_{Goldin} includes as explanatory variables only those originally considered in Goldin´s model; $\frac{0}{0} Women_i$ is the main variable to consider, measured as the presence of women (percentage of women in total

[2] The period of analysis begins in 2010 for activities and 2011 for occupations to consider homogeneous classifications and avoid methodological breaks.

[3] Deflated by the annual variation of the Consumer Price Index produced by the National Institute of Statistics (INE) (January to January). The wage are adjusted for inflation.

employment for each labour location i)[4]. Its estimation is called the "Original Model" and will be useful for comparison with Goldin's postulates.

The model is made using a pool of data; then, includes control variables o dummies "D_i" for Spanish regions defined by the Eurostat international definition as NUTS1[5] (see table A1) and for time depending on the year of belonging (2010 and 2014).

Second, we extended the "Original Model," adding several new variables apart from those originally considered initially by Goldin (2006). The main aim was to validate the robustness of our results by considering more independent variables, but also to provide an accomplished estimation. The "Extended Model" is:

$$W_i = \beta_0 + \beta_1 * X_{Goldin} + \beta_2 * X_{Extended} + \frac{0}{0} Women + D_i + \varepsilon_i \quad (2)$$

where $X_{Extended}$ includes the additional variables. Finally, ahead of our results and as a possible compensation of the PT, we also consider the percentage of women with higher education, which leads us to what we call the "Compensated Model":

$$W_i = \beta_0 + \beta_1 * X_{Goldin} + \beta_2 * X_{Extended} + \frac{0}{0} Women + \frac{0}{0} WomenHighEduc + D_i + \varepsilon_i \quad (3)$$

Goldin´s original model measures the concentration of women in labour occupations. In our research, we attempt to cover a broader perspective of study, and as such the female concentration also will be measured in labour occupations, but the measures inside sectors and companies will be included, thereby validating PT using a more general perspective. The reason why this analysis is carried out is that we believe that prestige associated with labour occupations as established by Goldin in her theory may also be associated with some sectors of employment or companies, - in the case of Spain, at least. In addition, segregation in Spain is strong in both the occupational and sectoral labour locations (Iglesias and Llorente, 2010; Dueñas et al., 2013).

We also develop a new type of estimation distinguishing between feminized sectors vs. other activities. In this case, the percentage of women in each labour location is not analysed, but rather the membership of a sector previously classified as feminized compared to the rest. This analysis perspective will determine if PT is a pattern that is reproduced for the presence of women or in relation to the "label" of the labour location, i.e., if it has some cumulative effect or is just a signal. For this definition, we apply Hakim´s methodology (Hakim, 1979) which establishes the definition of female, integrated or male activity based on its inclusion in a branch formed by the +/- 10 percent over/inside/under the average presence of women compared to total employment.

As pointed out above, the estimations of the three proposed models (original, expanded and compensated) therefore include different labour locations, according to how employees are classified by labour occupations, sectors of activity, feminized sectors vs. rest and firms where the job is located. The strategy involves determining which is the best perspective of analysis to validate the predictions of PT. Table A1 shows the final set of independent variables. The analysis by occupations considers a higher aggregation of the National Classifications of Occupations-2011 (CNO-11)[6]. The analysis of activity sectors also considers higher aggregations, using the National Classification of Economic Activities-2009 (CNAE-09)[7]. The categories are disaggregated down as much as possible and according to availability. Sectors and occupations are kept separate because they have a different structure and work characteristics. Crossing sectors and occupations would move our estimates from comparison with Goldin's original postulates. Additional in Spain, occupational segregation usually exceeds segregation by sector. The established locations have a sufficient number of employed women and salary differences to carry out the analyses. Important differences are obtained using this disaggregation for female presence and the distribution of average wages. All models make two estimations distinguished by gender, validating the influence of female presence among both men and women.

In its original postulates, Goldin´s theory presents a possible dynamic interpretation. An increase of women in a labour localization could be reduced wages, assuming dynamic influence of female presence. However, Goldin's pioneering estimations are static over annual cross-section data, establishing the direct influence of women's presence on wages by occupations. In an attempt to extend our estimations, we therefore finally propose an additional dynamic analysis that considers the increase in women in different labour locations in relation to the level of wages. Based on those ideas, the new estimations will be as follows:

$$W_i^{2014} = \beta_0 + \beta_1 * X + Growth \frac{0}{0} Women_{2014-2010} + D_i + \varepsilon_i \quad (4)$$

In simple terms, we re-estimate all the previous models (original, extended and compensated) considering the 2014 wages, in relation to the previous increase in the female presence from 2010 to 2014[8]. This model is estimated only from the perspective of sectors and occupations, because wages from the perspective of firms and the female sector vs. the rest are not compared between different waves of the survey.

3. The presence of women and wages in Spain

3.1. The presence of women and wages.

We attempt to validate the influence of women´s presence on wages based on the postulations of PT from several perspectives. To introduce this question, figure 4 shows the simple relationship between average wages by occupation (differenced by gender) in relation to the presence of women (the percentage of women in each occupation). Figure 5

[4] The percentage of women is a relative measure, and as such assuming this analysis perspective avoids a possible correlation with other variables linked to the firm size, such as the number of employees.

[5] According to the higher disaggregation included in and following international definitions by Eurostat.

[6] Maximum available over 16 categories (1-digit CNO)

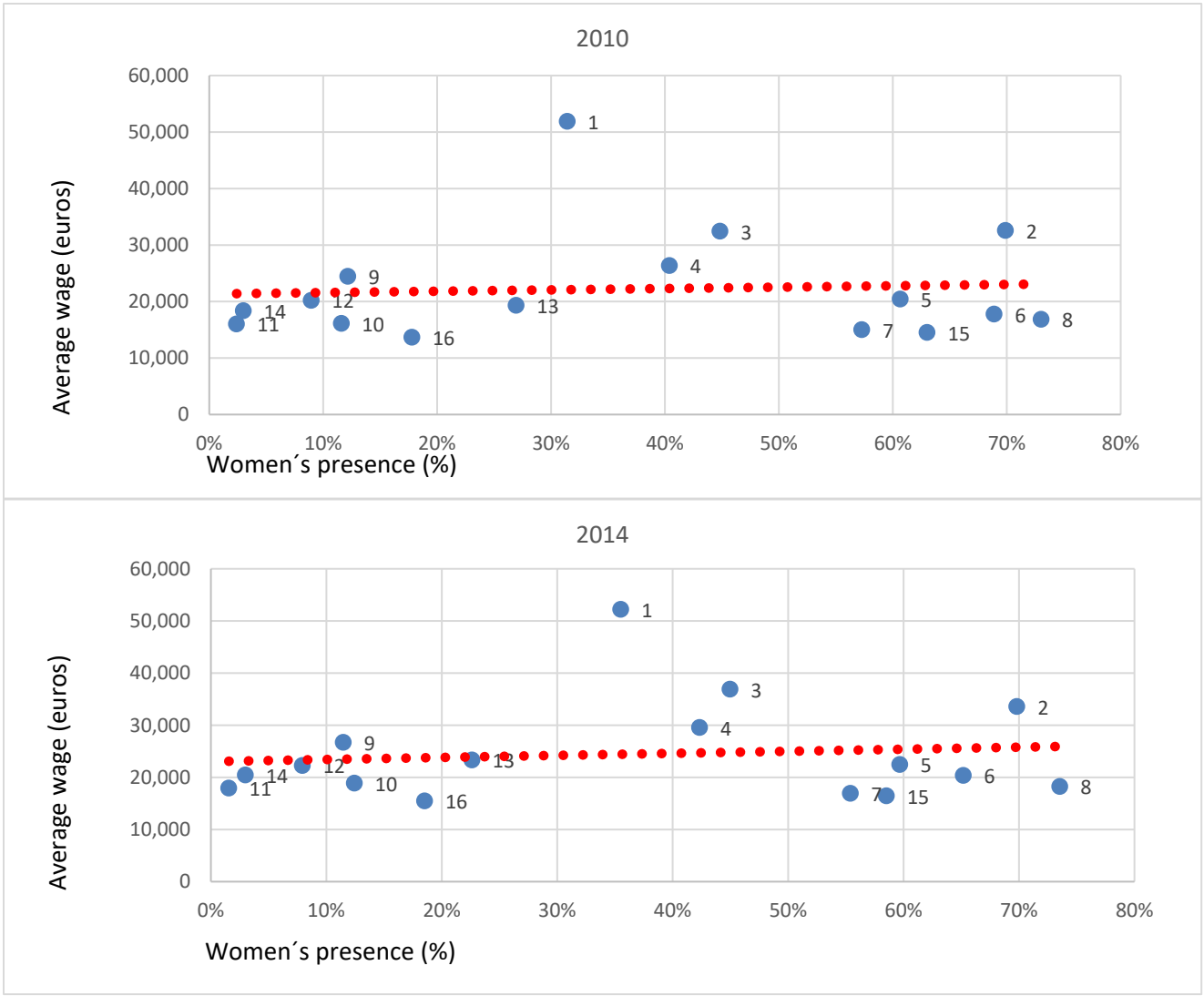
[7] Maximum available over 7 categories (1-digit CNAE)

[8] According to the methodology of WSS, it is not possible to link employees with different wages and establish a panel from 2010 to 2014, and as such the annual wages of workers are not comparable.

shows the same relationship from the perspective of sectors of activity. There is no apparent strong relationship in Figure 4, instead only a weak positive influence. The greater presence of women by occupation is not directly linked to higher wages in average for total employment (women and men). Moreover, occupations associated with the services sector, which are usually linked to a greater presence of women, present higher average wages, while agriculture and construction (traditional male occupations) do not present high wages in average. There is *a priori* a clear differentiation of sectors with differing levels of women determining a high segregation, but there does not appear to be a relationship between gender segregation and a high wage.

In the case of sectors of activity (figure 5), there is present a moderate negative relationship between average wages and women´s presence for both 2010 and 2014. A higher percentage of women in a sector of activity is linked to a lower average wage. Primary and secondary activities, with a lower presence of women, clearly present higher average wage levels. However, this relationship is not clear. Sectors with different rates of female presence in their employment have relatively similar average wages, such as industry on the one hand, and services to production and public services, on the other.

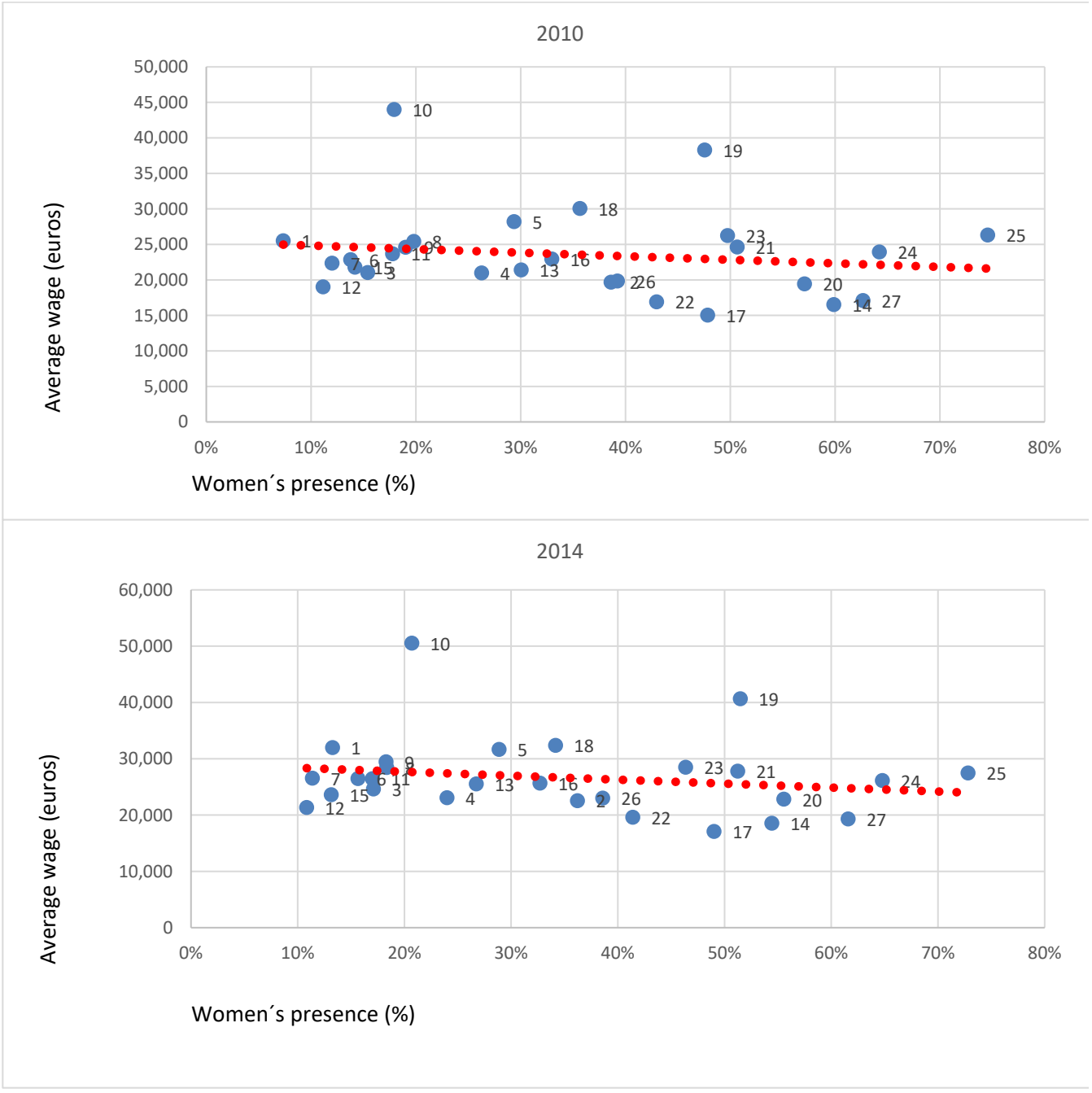
Figure 4. Women´s presence and the average wage (Full-time) by occupations. (Source: own elaboration on WSS data, 2010 and 2014).



Legend:

1 Directors and managers
2 Technicians and professionals
3 Other Tech. and professionals
4 Tech. and prof. support
5 Office employees (not the public)
6 Office employees (to the public)
7 Workers of the Service, Restoration and Trade
8 Workers of the Service, Health and Care
9 Workers of Security
10 Workers qualified agricultural and similar
11 Workers qualified construction
12 Workers qualified manufacturing
13 Operators of facilities and machinery
14 Drivers and op. of other machinery
15 Workers not qualified in Service
16 Elementary Workers

Figure 5. Women´s presence and the average wage (full-time) by sector of activity. (Source: own elaboration on WSS data, 2010 and 2014).



Legend:

1	Extractive industries
2	Basic manufacturing
3	Other manufactures
4	Graphic arts
5	Elemental industry
6	Another industry
7	Metallurgy
8	Manufacture of machinery and equipment
9	Manufacture of vehicles and assimilated
10	Energy supply
11	Water supply and waste management
12	Building
13	Wholesale
14	Retail trade
15	Transport
16	Storage and mail
17	Hostelry
18	Information and communications
19	Financial activities and insurance
20	Real estate activities
21	Professional, scientific and technical activities
22	Administrative activities and auxiliary services
23	Public administration
24	Education
25	Sanitary activities and Ss. social
26	Artistic and similar activities
27	Other services

Based on this initial descriptive analysis, we estimate the equations of wages for different labour locations of women (sectors, occupations, feminized sectors vs. rest, and firms) including different variables with which to approximate the presence of women in them. Table 1 only shows the results in relation to the presence of women. In the light of these results, women´s presence does not reduce the average wage of women or men from the perspective of labour occupations. None of the three models (original, extended and compensated) presents the expected negative sign for the variable of interest; our findings therefore do not confirm the stylized facts of PT. The squared variables attempt to provide the presence of quadratic effects, but in most cases, a negative sign is obtained, showing results that do not overlap.

The results from the perspective of sectors of activity offers negative signs, consistent with the postulates predicted by Goldin's PT. According to the model that includes only the original variables considered by Goldin, the average wage for men and women will fall when the presence of women in the activity sectors is high. The gender differences in the "Expanded Model" are slight, but continue to validate the PT. Likewise, the "Compensated Model" contains negative coefficients that validate the existence of the PT. In short, our findings confirm the stylized facts predicted by the PT from perspective by sectors above. These results disappear from the perspective of firms, in which positive coefficients are again obtained. Contrary to our estimations, a higher presence of women inside firms is not associated with lower wages[9].

Table 1. Wage estimations in relation of women´s presence in different locations. (Source: ESS data pool 2010 and 2014)

Gross wage:			**Men**				**Women**			
			Coef.	**Sig.**	**R^2**	**Sample**	**Coef.**	**Sig.**	**R^2**	**Sample**
Labour locations:	**Model:**									
Occupations:	Original	Fraction female	0,904	0,000 ***	0,463	220.103	0,305	0,000 ***	0,458	132.600
	Goldin (2014)	Fraction female squared	-1,430	0,000 ***			-0,552	0,000 ***		
	Extended	Fraction female	0,456	0,000 ***	0,550	220.103	0,404	0,000 ***	0,543	132.600
		Fraction female squared	-0,848	0,000 ***			-0,644	0,000 ***		
	Compensated	Fraction female	0,356	0,000 ***	0,565	220.103	0,534	0,000 ***	0,566	132.600
		Fraction female squared	-0,944	0,000 ***			-0,960	0,000 ***		
		Fraction female with higher education	0,735	0,000 ***			0,616	0,000 ***		
Sectors:	Original	Fraction female	-0,287	0,000 ***	0,459	220.160	-0,810	0,000 ***	0,457	132.603
	Goldin (2014)	Fraction female squared	0,036	0,488			0,748	0,000 ***		
	Extended	Fraction female	-0,561	0,000 ***	0,551	220.160	-0,525	0,000 ***	0,543	132.603
		Fraction female squared	0,354	0,000 ***			0,383	0,000 ***		
	Compensated	Fraction female	-0,528	0,000 ***	0,555	220.160	-0,517	0,000 ***	0,544	132.603
		Fraction female squared	0,055	0,300			0,226	0,000 ***		
		Fraction female with higher education	0,571	0,000 ***			0,291	0,000 ***		
Feminized sectors vs. rest	Original									
	Goldin (2014)	Feminized sectors	-0,073	0,000 ***	0,456	220.160	-0,023	0,000 ***	0,454	132.603
	Extended	Feminized sectors	-0,079	0,000 ***	0,548	220.160	-0,039	0,000 ***	0,541	132.603
	Compensated	Feminized sectors	-0,113	0,000 ***	0,549	220.160	-0,057	0,000 ***	0,541	132.603
		Fraction female with higher education	0,304	0,000 ***			0,137	0,000 ***		
Firms	Original	Fraction female	0,350	0,000 ***	0,456	220.160	0,259	0,000 ***	0,469	132.603
	Goldin (2014)	Fraction female squared	-0,589	0,000 ***			-0,425	0,000 ***		
	Extended	Fraction female	-0,007	0,769	0,546	220.160	-0,057	0,131	0,546	132.603
		Fraction female squared	-0,163	0,000 ***			-0,100	0,000 ***		
	Compensated	Fraction female	-0,396	0,000 ***	0,505	220.160	0,007	0,888	0,481	132.603
	Original	Fraction female squared	0,113	0,015 **			-0,234	0,000 ***		
	Goldin (2014)	Fraction female with higher education	0,233	0,000 ***			0,162	0,000 ***		

*Note: Shaded cells shows results according with Pollution Theory. ** Significant (90%) *** Significant (99%)*

Finally, as regards the model that differentiates between feminized sectors and the others, we obtain the expected negative coefficients in the "Expanded" and "Compensated" models. This shows that the feminine character of a sector of activity acts as a signal in individuals' behaviour. From this perspective, a worker in a sector considered feminized usually earns a lower wage. The wage penalty goes hand-in-hand with both the presence of women and the signalling of it.

Our estimates lead to a partial confirmation of the wage predictions of the PT. If we look at the different estimated models, only the expected coefficients are obtained from the sectoral perspective. Similar results are obtained for the "Extended" models, which control for more variables. From the perspective of occupations and firms, the coefficients contradict the stylized facts of PT. The "Compensated" models lead to positive coefficients for the variable "Fraction female with higher education", with a relevant magnitude in some cases. Our interpretation is that this variable plays a central role in the non-fulfilment of Goldin's postulates for the Spanish labour market. The expected negative effects of

[9] The analysis focuses on determining the existence or not of an effect over wages. Given the weak results obtained, we have not established the effects in marginal terms.

the increase in the presence of women in different labour locations on wages would be offset. Women gaining access to employment would do so with high levels of education, which would push up wages, compensating for the expected effects and leading to the results observed.

The model for compensated estimation by sectors that confirms the PT has been included in the Annex. The coefficients in table A1 show which variables are most determining factors in increasing the wages of men and women. The attainment of higher education and being employed in a public company and a larger firm has a striking effect for women. The importance of education in avoiding the wage gender gap is linked with the findings of Dolado et al (2003). Education could reduce the segregation, and now it is linked with the reduction of gender wage gap. As shown in the graphs above (Figure 5), the female concentration in the public sector, where wages are not too low, may also have limited the fulfilment of the PT. Working in the public sector shows a positive wage premium for both genders, but it is higher for women. According to the results of Alonso-Villar and Del Rio (2010), if the segregation in the public sector is lower, our findings would reflect this question. Employment in the public sector could be one of the behaviours used by women to avoid labour segregation and the wage gap.

3.2. The distribution of estimated wages and segregation in Spain.

The second prediction that we are going to validate refers to the determination of labour segregation by gender, expressed as gender categorization of labour locations (masculine, feminine or integrated jobs) in relation to wages. Accordingly, we will focus the analysis on labour occupations and sectors of activity, the main perspectives addressed above. The original idea of Goldin (2006) in this regard is that the nature of a job is determined by the attitude adopted by men to the possible access of women. This attitude will be a consequence of how "qualifications"[10] are distributed among women (and men). The arguments are as follows:

a) From the start, women who access the labour market will face barriers that prevent their access to male occupations requiring a higher level of qualifications compared to the average distribution of women's qualifications. Men will perceive female access as a menace (in terms of lower social prestige of their jobs) and will try to push out women from these jobs. Lastly, a competitive equilibrium offers a segregation of occupation defined by qualifications.
b) Likewise, the segregation is linked to wage distribution to the extent that the qualifications are unevenly remunerated. The segregation leads to “wage discrimination”.
c) In short, expect higher wages or wages above the average female wage are to be expected in male occupations where the distribution of men’s qualifications predominates, while for mean and low wages, the locations would be mostly integrated and female.

To validate the above predictions, we need a variable that provides an approximation to the concept of "qualification" established by the author in her seminal work. As the author herself points out, "*the characteristic on which productivity is based in the real world is generally not single-dimensional*" (Goldin, 2014), and as such we need a more overall approach to the concept of productivity. Simple information on the educational level or work experience of women would be insufficient. For this reason, like Goldin, we will use a predicted salary from previous models as a proxy for productivity, although we will bring women's productivity closer to the best possible level, especially in labour markets where there is discrimination against them (Simón et al. (2008) can be reviewed in this regard). We will therefore not use the observed salary but instead use the predicted salary based on the "Compensated" model and the coefficients obtained in this estimation for men. Assuming this point of view, we can approximate the maximum possible productivity to achieve the remuneration that women would have if they were paid at the same rate as men.

According to these arguments, in table 2 are shown the wages in logarithms and means by occupations (columns) according to WSS for 2010 and 2014, also are included the Median Feminine wage for all occupations and the Median predicted Feminine wage with Masculine coefficients (more or less shaded rows). Our findings in table 2 show that Goldin's predictions for the Spanish labour market are not applicable, at least from the perspective of occupations. Furthermore, the results that we obtained for 2014 appears to be the opposite of those anticipated. There are several segregated occupations below the median predicted female wage: these are male, integrated or female without no predominance of either. There is therefore no differentiation or categorization of the segregation established by the predicted wages as a representation of productivity. From the perspective of the occupations[11], we did not validate the wage penalty predicted by the contamination process; furthermore, our additional findings did not validate the possible segregation associated with this process. As expected, the two processes go together and are contrary to the established predictions. The results for 2010 are similar, and neither validates the gender segregation predicted in the pollution process. All these results are presented in graph A1, for an enhanced comparison.

Table 3 contains the same information of table 2 but from the perspective of sectors of activity in relation to the masculine, feminine or integrated nature of sectors. The median female wage is also included if women were paid the same as men or the predicted wage for women using the coefficients of male model (intense shaded row). From this perspective, the findings for both years are more consistent with the predictions of PT. Segregated sectors, and especially masculine ones, have a greater presence above the median predicted wage for women. However, female sectors predominate in the lower levels of wage distribution. Nevertheless, there is a mix of types of segregation. Broadly speaking, we could therefore confirm a weak validation in general terms of Goldin's predictions when we use the perspective of the sectors. Segregation and integration would appear to be linked with the distribution of the predicted wages for women, as an approximation of their productivity. Finally, this table shows the public sector’s contribution to overcoming avoid the gender wage gap. In both years, the Public Administration is considered a feminine sector and presents relatively high wages in both years.

[10] “Skills” in Goldin’s original text.

[11] In this case, a greater disaggregation of occupations would not lead to more divergent results.

Table 2. Types of occupations by gender, average wage and median female wages. (Source: WSS, 2010 and 2014).

2010				**2014**			
Occupations	Types of segregation	Log(W)	Wage	Occupations	Types of segregation	Log(W)	Wage
Elementary Workers	Masculine	9,388	11.949	Elementary Workers	Masculine	9,522	13.656
Workers not qualified in Service	Feminine	9,498	13.336	Workers not qualified in Service	Feminine	9,622	15.089
Workers of the Service, Restoration and Trade	Feminine	9,512	13.526	Workers of the Service, Restoration and Trade	Feminine	9,632	15.247
Workers qualified construction	Masculine	9,585	14.550	Workers qualified construction	Masculine	9,690	16.150
Workers qualified agricultural and similar	Masculine	9,598	14.731	Workers of the Service, Health and Care	Feminine	9,729	16.793
Workers of the Service, Health and Care	Feminine	9,629	15.205	Workers qualified agricultural and similar	Masculine	9,765	17.415
Office employees (to the public)	Feminine	9,680	16.001	Office employees (to the public)	Feminine	9,810	18.219
Drivers and op. of other machinery	Masculine	9,710	16.476	Drivers and op. of other machinery	Masculine	9,816	18.330
Operators of facilities and machinery	Masculine	9,762	17.359	Workers qualified manufacturing	Masculine	9,904	20.012
Office employees (not the public)	Feminine	9,805	18.121	Office employees (not the public)	Feminine	9,914	20.216
Workers qualified manufacturing	Masculine	9,814	18.282	Operators of facilities and machinery	Masculine	9,947	20.891
Median Feminine wage		9,833	18.639	Median Feminine wage		9,962	21.201
Median predicted Feminine wage with Masculine coefficients		9,987	21.737	Workers of Security	Masculine	10,082	23.905
Workers of Security	Masculine	9,988	21.765	Median predicted Feminine wage with Masculine coefficients		10,130	25.084
Tech. and prof. support	Integrated	10,059	23.366	Tech. and prof. support	Integrated	10,165	25.986
Technicians and professionals	Feminine	10,266	28.748	Technicians and professionals	Feminine	10,306	29.897
Other Tech. and professionals	Integrated	10,268	28.784	Other Tech. and professionals	Integrated	10,387	32.447
Directors and managers	Masculine	10,724	45.411	Directors and managers	Masculine	10,713	44.933

Table 3. Types of activity sectors by gender, median observed female wage and median predicted female wage. (Source: WSS, 2010 and 2014).

2010				**2014**			
Activity sectors	Types of segregation	Log(W)	Wage	Activity sectors	Types of segregation	Log(W)	Wage
Hostelry	Feminine	9,510	13.496	Hostelry	Feminine	9,638	15.343
Other services	Feminine	9,569	14.315	Other services	Feminine	9,699	16.293
Administrative activities and auxiliary services	Feminine	9,582	14.504	Retail trade	Integrated	9,709	16.472
Retail trade	Integrated	9,584	14.533	Administrative activities and auxiliary services	Feminine	9,732	16.841
Real estate activities	Feminine	9,677	15.955	Real estate activities	Feminine	9,796	17.956
Building	Masculine	9,701	16.340	Building	Masculine	9,803	18.087
Basic manufacturing	Integrated	9,735	16.903	Median Feminine wage		9,833	18.639
Artistic and similar activities	Integrated	9,744	17.057	Artistic and similar activities	Integrated	9,860	19.158
Wholesale	Masculine	9,806	18.149	Basic manufacturing	Masculine	9,868	19.311
Other manufactures	Masculine	9,820	18.391	Transport	Masculine	9,912	20.174
Transport	Masculine	9,825	18.496	Graphic arts	Masculine	9,933	20.596
Graphic arts	Masculine	9,830	18.582	Other manufactures	Masculine	9,976	21.506
Median Feminine wage		9,833	18.639	Wholesale	Masculine	9,977	21.515
Metallurgy	Masculine	9,906	20.051	Median predicted Feminine wage with Masculine coefficients		9,987	21.737
Another industry	Masculine	9,913	20.183	Storage and mail	Masculine	10,029	22.673
Storage and mail	Masculine	9,925	20.436	Professional, scientific and technical activities	Feminine	10,049	23.141
Professional, scientific and technical activities	Feminine	9,935	20.632	Education	Feminine	10,056	23.296
Water supply and waste management	Masculine	9,950	20.955	Another industry	Masculine	10,064	23.473
Education	Feminine	9,959	21.151	Sanitary activities and Ss. social	Feminine	10,072	23.672
Median predicted Feminine wage with Masculine coefficients		9,987	21.737	Metallurgy	Masculine	10,077	23.801
Manufacture of vehicles and assimilated	Masculine	9,993	21.869	Water supply and waste management	Masculine	10,085	23.977
Sanitary activities and Ss. social	Feminine	10,017	22.413	Manufacture of machinery and equipment	Masculine	10,137	25.252
Manufacture of machinery and equipment	Masculine	10,028	22.647	Public administration	Feminine	10,158	25.808
Extractive industries	Masculine	10,034	22.778	Manufacture of vehicles and assimilated	Masculine	10,160	25.857
Public administration	Feminine	10,068	23.586	Information and communications	Masculine	10,212	27.240
Elemental industry	Masculine	10,107	24.523	Extractive industries	Masculine	10,215	27.311
Information and communications	Masculine	10,147	25.520	Elemental industry	Masculine	10,217	27.377
Financial activities and insurance	Feminine	10,444	34.343	Financial activities and insurance	Feminine	10,503	36.438
Energy supply	Masculine	10,566	38.791	Energy supply	Masculine	10,722	45.321

4. Dynamic analysis

Finally, based on a dynamic analysis, Table 4 estimates the influence of an increase in female presence from 2010 to 2014 on wages in 2014 from the perspective of sectors of activity and labour occupations. In this case, as a control for time and general economic trends, new dummies for the growth of employment by sectors and occupations are included as percentage points.

For occupations, our new formulation of the PT is not validated for either gender. Our findings are contrary to the anticipated predictions. An increase in the presence of women contributes to higher wages in all estimated models (original, extended and compensated). An increase in women with higher education has also been considered as one of the most determinant variables in both genders receiving high wages. In this case, this female presence could be indirectly linked to higher productivity.

The results from the perspective of sector also do not validate the novel formulation of the PT considered as a dynamic estimation. The coefficients linked to the increase in women are positive in the various different estimations (original, extended and compensated model). Furthermore, the results are not significant when the increased female presence with higher education is taken into consideration. The compensated model by sectors is included in annex for detailed consultation of the additional results.

Table 4. Wage estimations in relation of gross increase of female presence from different labour locations. (Source: ESS data pool 2010 and 2014).

Gross wage:			**Men**				**Women**			
			Coef.	**Sig.**	**R^2**	**Sample**	**Coef.**	**Sig.**	**R^2**	**Sample**
Labour location	**Models**	**Gross increase of:**								
Occupations	Original	female presence	0,054	0,000 ***	0,475	107.984	0,052	0,000 ***	0,475	64.355
	Goldin (2014)	female presence squared	0,006	0,000 ***			0,004	0,000 ***		
	Extended	female presence	0,046	0,000 ***	0,557	107.984	0,044	0,000 ***	0,550	64.355
		female presence squared	0,003	0,000 ***			0,002	0,000 ***		
	Compensated	female presence	0,046	0,000 ***	0,557	107.984	0,045	0,000 ***	0,550	64.355
		female presence squared	0,003	0,000 ***			0,002	0,000 ***		
		female presence with high education	-0,001	0,821			0,000	0,929		
Sectors	Original	female presence	0,021	0,000 ***	0,450	107.984	0,019	0,000 ***	0,443	64.355
	Goldin (2014)	female presence squared	0,000	0,683			0,003	0,000 ***		
	Extended	female presence	0,020	0,000 ***	0,545	107.984	0,026	0,000 ***	0,532	64.355
		female presence squared	0,001	0,040 **			0,003	0,000 ***		
	Compensated	female presence	0,023	0,000 ***	0,545	107.984	0,035	0,000 ***	0,533	64.355
		female presence squared	0,001	0,004 ***			0,004	0,000 ***		
		female presence with high education	-0,007	0,012 **			-0,016	0,000 ***		

Note: The variables about growth are from 2010 to 2014.

5. Conclusions

We aimed to validate the predictions of the PT in the Spanish labour market from multiple analysis perspectives. To that end, we first estimated several models for the possible existence of a negative relationship between the female presence in the labour market and wages. Several models similar to Goldin's original estimation and their extensions were estimated, and novel perspectives added to the analysis. Second, we determined whether the segregated nature of jobs is related to the distribution of wages as an approximation of productivity, i.e. if there is a wage gap in the distribution of men and women in different labour locations. Finally, we propose a new dynamic formulation of PT.

Our findings lead to a weak validation of Goldin's PT, which would have a limited or partial explanatory capacity to explain gender segregation in Spain. The models of the female presence generally show a positive relationship with wages. PT is only validated from the perspective of sectors of activity. Interestingly, the “Compensated” model establishes that a higher presence of women with higher education compensates for the wage penalization predicted by Goldin's Theory. Our interpretation is that this is the cause of the partial validation of PT in Spain. The inclusion of women in the labour market has taken place at the same time as an increase in the education of female employees, leading to higher productivity and compensating for the possible wage gap.

Meanwhile, the average female wage or average predicted female wage as an approximation of productivity does not divide sectors or occupations according to their segregated nature by gender (male, female or integrated). from the perspective of sector of activity in isolation, our findings are close to the postulates of PT, but in very general terms. Finally, the dynamic approaches do not validate the PT, meaning that the growth of female presence by sectors and occupations does not determine lead to either gender receiving lower wages.

Based on our findings, we would consider the possible reasons or causes for non-compliance or partial validation in the case of the Spanish labour market. In our opinion, there are two main types of factors. First, one cause may be due to a methodological approach. Goldin's theory is developed using data from the beginning of the century, which are almost a historical analysis. Our period of analysis is from 2010 to 2014, which is the most recent period for which data

is available. Only the WSS provides adequate microdata on wages to validate these hypotheses, and we had to partially limit our research due to the characteristics of the data source. However, it is interesting to obtain a partial validation of PT. Our findings will provide a path to carrying out this type of analysis in non-historical periods.

Second, the Spanish labour market has some specific characteristics that may influence our results:

a) In Spain, female access to labour market has been accompanied by a higher and notable increase of female education. As a result, one possible reason why the growth of female employment has not led to lower wages is due to the higher potential productivity associated with females as a group. The predicted wage penalty would be offset by the increase in female employees with higher education. The "Compensated" models estimated therefore show that a female presence with higher education is a positive factor in wage increases considering different labour locations. This trend would therefore be able to partially invalidate the expected issues.

b) In the Spanish labour market there is a high level of concentration of female employment in the public sector. The incorporation of women in employment has used education in Spain as an instrument and the public sector as a channel. It is a special sector, with highly regulated labour relations which does not *a priori* permit the defensive behaviour postulated by Goldin and other types of discriminatory attitudes. One way of showing this is to observe the various results obtained in our estimations.

c) The analysis focuses on the period 2010-2014, which can be considered a time of economic and employment crisis, with very high growth rates of unemployment, especially among men, which undoubtedly is a factor in the opportunities for observing social and labour relations between men and women, such as those proposed by Goldin. Segregation by gender has been reduced in a fictitious way. Our results show that Goldin's PT does not have to be fulfilled in the short term, but there are some scenarios where its predictions cannot be performed.

d) With the available data, we assume the official and available classifications of activities and occupations. It would be interesting to make estimations with a greater degree of disaggregation; however, these data are not available. The aggregate results already indicate that the analysis by occupations is not significant. However, we obtain interesting result in the case of sectors of activity. Additionally, the heterogeneity in term of the nature of labour location (feminine, masculine or integrated) is quite broad.

To conclude, Goldin's PT is only partially valid for the Spanish case. The high level of labour segregation in the country does not seem to have one single cause. Our research sheds new light on gender segregation as it applies to Spanish case in modern and international PT.

Bibliography

Alonso-Villar, O., & Del Río, C. (2010). Segregation of female and male workers in Spain: Occupations and industries. *Hacienda Pública Española*, 194(3), 91-121.

Amuedo-Dorantes, C. and De la Rica, S. (2006). The role of segregation and pay structure on the gender wage gap: evidence from matched employer-employee data for Spain, *The BE Journal of Economic Analysis & Policy*, 5(1), 1-34.

Akerlof, G.A. and Kranton, R.E. (2000). Economics and Identity, *Quarterly Journal of Economics*, CXV, 3, 715-753.

Altonji, J. and Blank, R. (1999). *Race and Gender in the Labor Market*, in O. Ashenfelter and D. Card., *Handbook of Labor Economics*. Elsevier.

Arrow, K. (1973). *The Theory of Discrimination*, in O. Ashenfelter and A. Rees, *Discrimination in the Labor Market*. Princenton University Press.

Becker, G.S. (1994). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, (3rd Edition). The University of Chicago Press.

Bell, L.A. (2005). Women-led firms and the gender gap in top executive jobs, *IZA Discussion Paper*. No. 1689.

Becker, G. S. (1957). *The Economics of Discrimination*. Chicago University Press.

Bergmann, B.R. (1986). *The Economic Emergence of Women*. Basic Books, Nueva York.

Bertrand, M. (2010). *New Perspectives on Gender*, in O. Ashenfelter and D. Card., *Handbook of Labor Economics*. Elsevier.

Cebrian, I. and Moreno, G. (2008). La situación de las mujeres en el Mercado de trabajo español: desajustes y retos, *Economía Industrial*, 367, 121-137.

Christiansen, L., Lin, H., Pereira, J., Topalova, P. and Turk, R. (2016). Individual choice or Policies? Drivers of female employment in Europe, *IMF Working Paper*, 16/49.

Dolado, J.J., Felgueroso, F., and Jimeno, J.F. (2003). Where do women work?: Analysing patterns in occupational segregation by gender, *Annales d'Economie et de Statistique*, 71/72, 293-315.

Dueñas, D., Iglesias, C. y Llorente, R. (2016). ¿Por qué las mujeres no se distribuyen de forma homogénea en el mercado de trabajo español?: El "efecto rechazo" y el "efecto atracción", *El Trimestre Económico*, 330, 339-369.

Dueñas, D., Iglesias, C. and Llorente, R. (2014). Occupational segregation by sex in Spain: Exclusion or confinement?, *International Labour Review*, 153(2), 311-336.

Duncan, O.D., and Duncan, B. (1955). A methodological analysis of segregation indexes, *American sociological review*, 20(2), 210-217.

Dueñas, D., Iglesias, C. and Llorente, R. (2014). Push in or push out?: la discriminación de la mujer en el mercado de trabajo español, *Revista del Ministerio de Empleo y Seguridad Social*, 111, 37-62.

Dueñas, D., Iglesias, C. and Llorente, R. (2013). La segregación laboral en las regiones españolas durante el periodo 1996 – 2010, *Investigaciones Regional: Journal of Regional Research*, 27, 91-113.

Goldin, C. (2014). A pollution theory of discrimination: male and female differences in occupations and earnings". In *Human capital in history: The American record*. University of Chicago Press, 313-348.

Goldin, C., and Katz, L.F. (2016). A most egalitarian profession: pharmacy and the evolution of a family-friendly occupation, *Journal of Labor Economics*, 34(3), 705-746.

Goldin, C. (2006). The Quiet Revolution That Transformed Women's Employment, Education, and Family, *The American Economic Review*, 96, 2, 1-21.

Goldin, C. (2002). A pollution theory of discrimination: male and female differences in occupations and earnings,

National Bureau of Economic Research, Working Paper 8985.

Hakim, C. (1979). *Occupational Segregation: A comparative study of the degree and pattern of the differentiation between men and women's work in Britain, the United States and other countries*. Leicester University.

Hernández, P.J. (1996). Segregación ocupacional de la mujer y discriminación salarial, *Revista de Economía Aplicada*, 11, 57-80.

Iglesias, C., and Llorente, R. (2010). Evolución reciente de la segregación laboral por género en España, *Revista Universitaria de Ciencias del Trabajo*, 11, 81-105.

Ludsteck, J. (2014). The impact of segregation and sorting on the gender wage gap: Evidence from German linked longitudinal employer-employee data, *International Labour Review*, 67(2), 362-394.

OECD. Publishing, & Organisation for Economic Co-operation and Development Staff. (2002). OECD Employment Outlook 2002.

Olivetti, C., and Petrongolo, B. (2016). The evolution of gender gaps in industrialized countries, *Annual review of Economics*, 8, 405-434.

Palacio, J.I. and Simón, H. (2006). Segregación laboral y diferencias salariales por razón de sexo en España, *Estadística Española*, 48(163), 493-524.

Pan, J. (2015). Gender segregation in occupations: The role of tipping and social interactions. *Journal of Labor Economics*, 33(2), 365-408.

Phelps, E. (1972). The Statistical Theory of Racism and Sexism, *American Economic Review, 62*, 4, 659-661

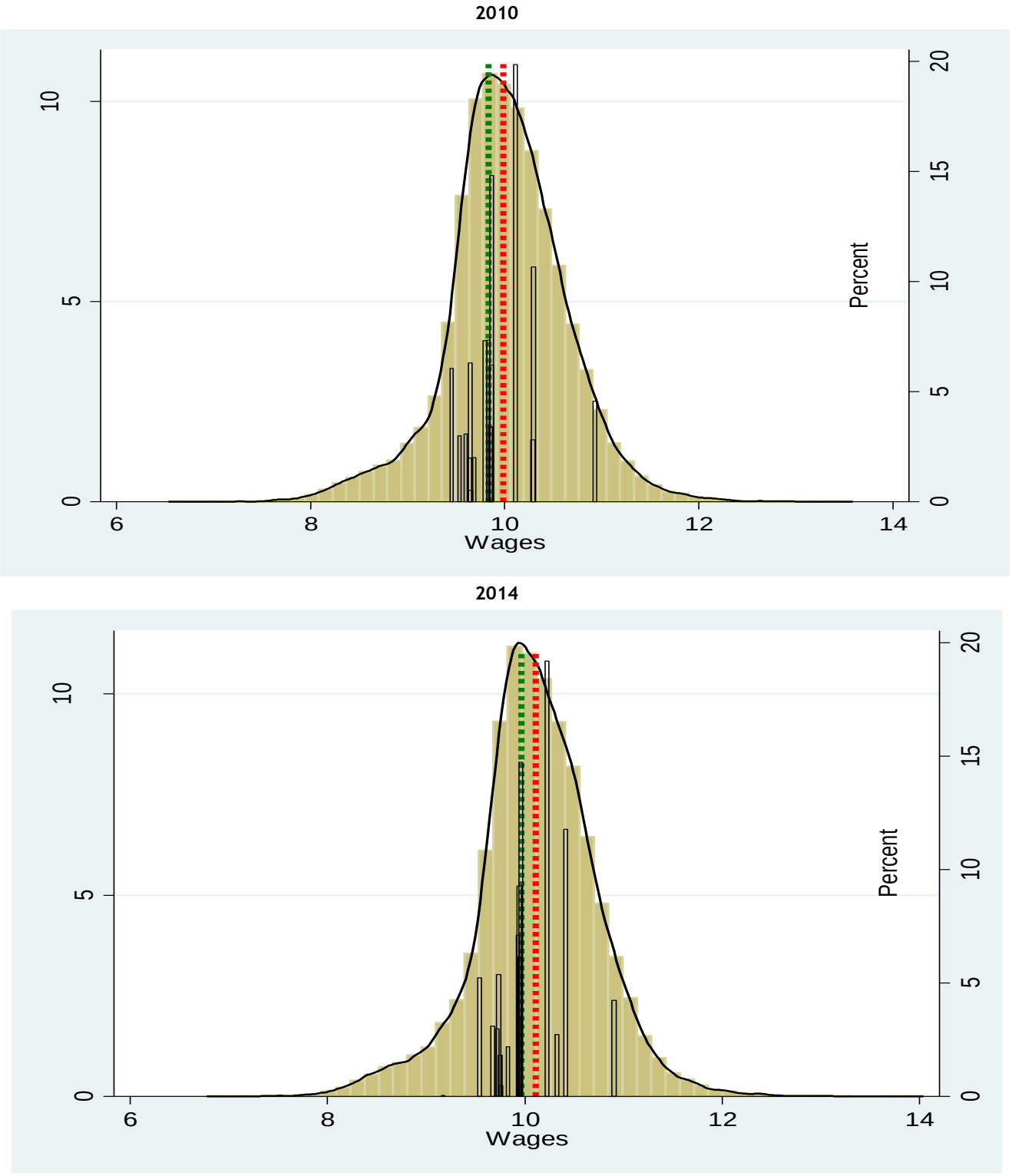
Simón, H.J., Ramos, R., & Sanromá, E. (2008). Evolución de las diferencias salariales por razón de sexo, *Revista de Economía Aplicada*, 16(48), 37-68.

ANNEXS

Table A1. Wage estimations to women´s presence by sector. Compensated model (Source: ESS data pool 2010 and 2014).

Gross wage		Men				Women			
		Coef.	Robust Std. Err.	P>t	Sig.	Coef.	Robust Std. Err.	P>t	Sig.
Presence of women		-0,528	0,040	0,000	***	-0,517	0,051	0,000	***
Presence of women2		0,055	0,053	0,300		0,226	0,053	0,000	***
Presence of women with higher education		0,571	0,029	0,000	***	0,291	0,025	0,000	***
Seniority		0,033	0,001	0,000	***	0,032	0,001	0,000	***
Seniority squared		-0,001	0,000	0,000	***	-0,001	0,000	0,000	***
Age	30-39	-0,164	0,011	0,000	***	-0,112	0,012	0,000	***
	40-49	-0,062	0,010	0,000	***	-0,020	0,011	0,060	*
	50-59	-0,037	0,009	0,000	***	0,014	0,010	0,167	
	more than 59	-0,021	0,009	0,020	**	0,017	0,010	0,076	*
Education	Primary	0,015	0,012	0,214		0,033	0,022	0,139	
	Secondary I	0,050	0,012	0,000	***	0,062	0,022	0,004	***
	Secondary II	0,171	0,012	0,000	***	0,153	0,022	0,000	***
	Vocational training	0,205	0,013	0,000	***	0,211	0,022	0,000	***
	Diploma and bachelor	0,391	0,013	0,000	***	0,402	0,022	0,000	***
	Engineer and doctors	0,551	0,013	0,000	***	0,572	0,022	0,000	***
Nationality	Spanish	-0,034	0,008	0,000	***	-0,006	0,011	0,590	
Responsibility		0,226	0,004	0,000	***	0,194	0,006	0,000	***
Permanent contract		-0,303	0,006	0,000	***	-0,228	0,007	0,000	***
Overtime		0,067	0,005	0,000	***	0,051	0,013	0,000	***
Supplement at wage		0,101	0,005	0,000	***	0,130	0,005	0,000	***
Complements at wage		0,067	0,004	0,000	***	0,061	0,005	0,000	***
Extraordinary complements		0,131	0,005	0,000	***	0,131	0,005	0,000	***
Collective bargaining	Under sectoral	-0,075	0,004	0,000	***	-0,081	0,005	0,000	***
CONVENIO4_2	Company and others	-0,071	0,004	0,000	***	-0,068	0,005	0,000	***
Public firms		0,037	0,005	0,000	***	0,117	0,005	0,000	***
Firms an international market		0,098	0,005	0,000	***	0,103	0,006	0,000	***
Side of firms	More than 50 workers	0,122	0,004	0,000	***	0,105	0,004	0,000	***
NUTS1	Northeast	0,126	0,005	0,000	***	0,124	0,007	0,000	***
	Madrid	0,119	0,006	0,000	***	0,130	0,007	0,000	***
	Centre	-0,020	0,006	0,000	***	-0,002	0,007	0,820	
	East	0,097	0,005	0,000	***	0,089	0,006	0,000	***
	South	0,037	0,006	0,000	***	0,046	0,008	0,000	***
	Canary Islands	-0,041	0,009	0,000	***	0,029	0,010	0,005	***
Year	2010	-0,052	0,003	0,000	***	-0,062	0,004	0,000	***
Constant		9,479	0,018	0,000	***	9,247	0,027	0,000	***
Nº observations		220.160				132.603			
R^2		0,555				0,544			

Graph A1. Male wage distribution, average wage by occupations, median female wage and median female wage predicted. Logarithms (Source: ESS, 2010 and 2014).

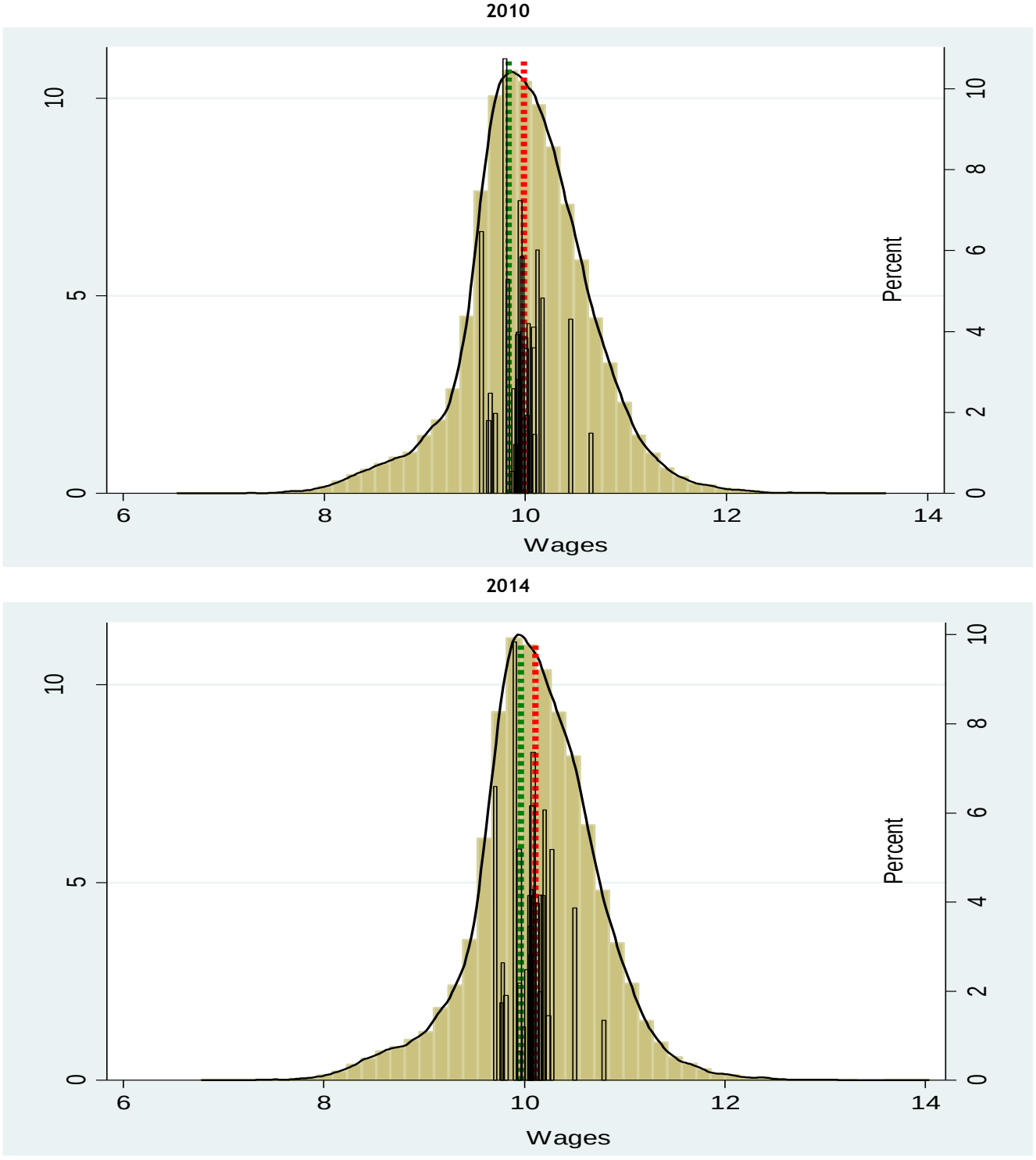


Note: The graduation marks on the left show the observed wage distribution for men, on the right show the distribution of the average wage of each occupation.

Legend:

Brown area		Observed wage distribution by men
Black line		Density function of observed wage distribution by men
Columns		Observed average wage in each occupation (Total)
Green line		Median observed female wage
Red line		Median female wage that women would have if they were paid as men o median predicted female wage using estimation of male model.

Graph A2. Male wage distribution, average wage by sector, median observed female wage and median predicted female wage. Logarithms (Source: ESS, 2010 and 2014).



Note: The graduation marks on the left show the observed wage distribution for men, on the right show the distribution of the average wage of each sector of activity.

Legend:

Brown area		Observed wage distribution by men
Black line		Density function of observed wage distribution by men
Columns		Observed average wage in each sector (Total)
Green line		Median observed female wage
Red line		Median female wage that women would have if they were paid as men o median predicted female wage using estimation of male model.

Table A2. Wage estimations to a gross increase of female presence by sectors. Dynamic Compensated model (Source: ESS data 2014).

Gross wage 2014 by sectors		**Men**				**Women**			
		Coef.	**Robust Std. Err.**	**P>t**	**Sig.**	**Coef.**	**Robust Std. Err.**	**P>t**	**Sig.**
2010-2014:									
Gross increase of female presence		0,023	0,002	0,000	***	0,035	0,002	0,000	***
Gross increase of female presence squared		0,001	0,000	0,004	***	0,004	0,000	0,000	***
Gross increase of female presence with high education		-0,007	0,003	0,012	**	-0,016	0,003	0,000	***
Growth of employment by sectors		0,000	0,001	0,619		0,002	0,001	0,013	**
Growth of employment by sectors squared		0,000	0,000	0,181		0,000	0,000	0,026	**
Situation in 2014:									
Seniority		0,034	0,001	0,000	***	0,031	0,001	0,000	***
Seniority squared		-0,001	0,000	0,000	***	0,000	0,000	0,000	***
Age	30-39	-0,180	0,016	0,000	***	-0,125	0,017	0,000	***
	40-49	-0,046	0,014	0,001	***	-0,025	0,013	0,055	*
	50-59	-0,023	0,013	0,093	*	0,022	0,012	0,074	*
	more than 59	-0,017	0,013	0,192		0,027	0,012	0,020	**
Education	Primary	0,020	0,021	0,327		0,008	0,025	0,760	
	Secondary I	0,062	0,021	0,003	***	0,047	0,024	0,049	**
	Secondary II	0,178	0,021	0,000	***	0,135	0,024	0,000	***
	Vocational training	0,223	0,022	0,000	***	0,223	0,025	0,000	***
	Diploma and bachelor	0,389	0,022	0,000	***	0,383	0,024	0,000	***
	Engineer and doctors	0,553	0,022	0,000	***	0,556	0,024	0,000	***
Nationality	Spanish	-0,047	0,013	0,000	***	-0,007	0,015	0,642	
Responsibility		0,224	0,007	0,000	***	0,208	0,008	0,000	***
Permanent contract		-0,305	0,009	0,000	***	-0,225	0,010	0,000	***
Overtime		0,061	0,009	0,000	***	0,027	0,017	0,117	
Supplement at wage		0,093	0,007	0,000	***	0,118	0,008	0,000	***
Complements at wage		0,076	0,006	0,000	***	0,062	0,007	0,000	***
Extraordinary complements		0,149	0,006	0,000	***	0,137	0,007	0,000	***
Collective bargaining	Under sectoral	-0,073	0,006	0,000	***	-0,081	0,007	0,000	***
	Company and others	-0,068	0,006	0,000	***	-0,069	0,007	0,000	***
Public firms		0,037	0,007	0,000	***	0,112	0,007	0,000	***
Firms an international market		0,126	0,006	0,000	***	0,132	0,008	0,000	***
Side of firms	More than 50 workers	0,093	0,005	0,000	***	0,082	0,006	0,000	***
NUTS1	Northeast	0,132	0,008	0,000	***	0,147	0,009	0,000	***
	Madrid	0,109	0,009	0,000	***	0,144	0,010	0,000	***
	Centre	-0,025	0,009	0,003	***	0,021	0,010	0,035	**
	East	0,098	0,008	0,000	***	0,098	0,009	0,000	***
	South	0,029	0,009	0,001	***	0,053	0,011	0,000	***
	Canary Islands	-0,061	0,012	0,000	***	0,035	0,016	0,027	**
Constant		9,383	0,027	0,000	***	9,172	0,028	0,000	***