Is there less gender inequality in the service sector? The gender wage-gap in knowledge-intensive services

Diego Dueñas-Fernández
Department of Economic Foundations, University of Alcalá and University of Valladolid, Spain

Carlos Iglesias-Fernández
Department of Economics and Business, University of Alcalá, Spain

Raquel Llorente-Heras
Department of Economic Theory, Autonomous University of Madrid, Spain

Abstract
The expansion of services and the dissemination of information and communication technologies (ICTs) are identified as important factors for improving employment opportunities for women, reducing labour differences by gender. The objective of the study is to determine to what extent services, and especially those most closely linked with knowledge and ICTs such as knowledge-intensive services (KIS), are changing some of the basics of labour gender differences. To do this, first we measure and characterize employment related to the service sector and KIS, comparing the existing gender wage-gap in these activities with the one observed in the overall economy. Then we carry out an analysis of decomposition over these gaps (in term of total distribution of wages and by quantiles). Our results indicate that, although KIS improve the wage situation of women, they are unable substantially to reduce gender wage inequality in the Spanish labour market, perhaps because the same gendered structures of the workplace are replicated in the KIS activities.

Keywords
Blinder–Oaxaca, gender, inequality, KIS, quantile, wages

Corresponding author:
Carlos Iglesias-Fernández, University of Alcalá, Facultad de Ciencias Económicas, Empresariales y Turismo. Plaza de la Victoria, s/n. 28804 Alcalá de Henares, Spain.
Email: carlos.iglesias@uah.es

Résumé

L'expansion des services et la dissémination des Technologies de l'Information et de la Communication (TICs) sont identifiés comme des facteurs importants pouvant améliorer les opportunités d'emploi des femmes en réduisant les inégalités de genre au travail. L'objectif de l'étude est de déterminer dans quelle mesure les services, en particulier ceux qui sont le plus liés à la connaissance et aux technologies de l'information et de la communication, tels que les services à haute intensité de connaissance (Knowledge-Intensive Services – KIS), modifient les fondamentaux des différences de genre au travail. Pour ce faire, les auteurs mesurent et définissent les emplois liés aux services et aux KIS, en comparant le fossé salarial par sexe dans ces secteurs d'activité par rapport à ce qu'on observe dans l'économie globale, puis ils procèdent à une analyse par décomposition (en termes de distribution totale des salaires et par quantiles). Les résultats montrent que, bien que les KIS améliorent la situation salariale des femmes, ils ne suppriment pas de façon significative l'inégalité de salaires par sexe sur le marché du travail espagnol, et ce peut-être parce que les structures genrées au travail existent également dans le secteur d'activité des KIS.

Mots-clés

Blinder–Oaxaca, genre, inégalité, KIS, quantile, salaire

1. Introduction

Definitive progress has been made in reducing gender differences in the labour market, and Spain is part of this improved situation. Women have significantly increased their participation rates in employment, substantially reducing labour differentials with male employees. A range of factors, such as the effectiveness of antidiscrimination policies, increasing investment in women's education, reduction in fertility rates, the emergence of new technologies related to domestic work and an increase in the supply of part-time work, are typically identified as the basis for this positive trend in female labour activity (Dolado et al., 2002). However, within this generally favourable context, it is widely recognized that a difference persists between women's and men's salaries, as women continue to earn less than men for the same work.

Specifically, two factors are highlighted for their potential to modify gender differences by improving the opportunities that women traditionally have been able to access: one is an expansion of work linked to the service sector; the other is a growing diffusion and application of information and communication technologies (ICT).

The literature clearly identifies how the expansion of the service sector can improve employment opportunities for women. On the one hand, jobs in tertiary activities can be appropriate for women (Goldin, 2006). Compared to manufacturing, jobs in the service sector require a relatively greater use of qualifications related to knowledge and communication while requiring less intense qualifications related to strength and manual tasks. On the other hand, to a certain degree, jobs in the service sector involve the development of tasks that are similar or related to tasks that were previously performed by

women in the domestic environment. Without a doubt, the gradually increasing dominance of the tertiary sector in the economy, which specifically leads to the growth of employment linked to service activities, may have translated into an increase in demand for the female workforce.

Consideration of the tertiarization process in labour activities as a variable that explains women's results in the workforce is well described in the literature, both in general terms (Galor & Weil, 1996; Ngai & Petrongolo, 2013; Rendall, 2010) and specifically in the Spanish case (Dueñas et al., 2014; Iglesias et al., 2003; Iglesias et al., 2010). These studies point to the idea that technological changes are characteristic of the activities upon which services are based and require the type of qualifications and competencies in which women enjoy a comparative advantage.

Similarly to the above-mentioned case of employment linked to services, employment growth related to the use of ICTs can improve women's work opportunities, given that these jobs may also be more appropriate for them (OECD, 2007). Again, the diffusion of new technologies might be inducing a change in demand due to qualifications that favour women (Carnoy, 2002).

The existing literature on this topic supports the idea that the diffusion of ICTs generally improves women's labour situation, based on the empowering effect that it can have on women by increasing their labour opportunities (Hafkin & Huyer, 2006; Melhem et al., 2009; Ng & Mitter, 2005). Although scarce, documents that analyse the consequences of ICT for women's labour conditions conclude that increasing the level of ICT infrastructure tends to improve gender equality in education and employment, ultimately improving gender equality on the whole (Chen, 2004). However, it has also been noted that gender inequality in the workplace is present in jobs that are strongly linked to ICT. Unlike men, women tend to be concentrated within the ICT occupations that require fewer qualifications, which leads to situations of labour segregation and salary gaps to women's detriment, even in ICT-related jobs (Castaño & Webster, 2011; ILO, 2001; OECD, 2007; Truss et al., 2012).

Adopting that perspective, literature related to the Spanish case concludes that ICT has positive effects on labour variables related to women, such as over-education (Iglesias et al., 2010), segregation (Dueñas et al., 2014) and salaries (Castaño et al., 2010). Studies that focus on employment tied to ICT conclude that, according to these different perspectives, the use of ICT reduces gender inequality to a certain degree, even though these positive effects seem to be less intense than initially expected.

Bridging points between service activities and the use of ICT, knowledge-intensive services (KIS) include those service activities that are particularly related to the use, application and development of ICTs, including tertiary activities such as research and development, strategic consultancy and management services, market research and business intelligence, among others. These services depend to a large degree on professional knowledge and provide high-value-added support to innovation processes in small and medium enterprises (SMEs). These are considered a central element in the development of innovation processes, highlighted by their dynamism and rapid growth within the tertiary sector (Boden & Miles, 2000). KIS bring together some of the more relevant elements related to transformations induced by tertiarization processes in the productive structure because they are part of the reason for the association of new service activities

with processes such as the evolution of productivity, technological change and innovation processes.

Based on the framework of the previous arguments, the purpose of this research is to determine to what extent the expansion of tertiary employment, specifically that related to KIS, is capable of improving women's labour position in general, thus reducing gender differences in the labour market. To that end, this study focuses on gender pay gaps (GPGs) because they are one of the most relevant expressions of the differences between women's and men's experiences in the workforce.

Accordingly, the work first characterizes employment related to the service sector in general and that of KIS in particular, then compares the salary differences between women and men in both service-sector fields to the corresponding differences in other economic activities. The objective will be to determine whether the service sector, particularly KIS, significantly modifies salary differences. To reach these objectives, and based on a study of the labour characteristics of KIS activities from the gender perspective for the rest of the service sector (from here on, non-KIS) compared to all other productive sectors of the Spanish economy (from here on, non-Service), this research is organized around three analytical themes:

1. Measuring the pay gap between women and men.
2. Explaining the GPG through its decomposition into the aspect that can be explained by the existence of differences in women's and men's characteristics with respect to labour and the aspect that cannot be explained in that way, which to a certain degree may be linked to discrimination.
3. Analysing the GPG along the salary distribution to determine whether the trends found with respect to salary differences are generally present for all women or, on the contrary, whether women at different (increasing) salary levels present different (increasing) patterns in terms of their salary differences compared to men (i.e. the glass ceiling).

Because the analysis allows for differentiation between KIS tertiary activities, non-KIS and all other employment sectors, the results allow us to determine whether employment linked to more advanced tertiary activities significantly improves the observed situation with respect to the GPG.

In our opinion, the present article contributes four findings to the existing literature on gender inequality in the labour market. These contributions also represent the main motivations driving our study.

First, though several studies have illustrated the relevance of the service sector to understanding gender inequality in the labour market, fewer studies have shown why service activities more effectively mitigate labour differences by gender, apart from the fact that the required skills and work schedules in this sector better suit women. This article thus presents comprehensive information on the explicative linkages between service activities and the gender wage-gap via an ICT analysis of the specific case of the KIS sector. It is well known that the KIS sector efficiently executes ICT technology production and application. We thus anticipate that a study of KIS activities can enrich our understanding of how ICTs have changed the labour market and possibly decreased gender inequality in the workplace.

Second, the KIS sector has recently been examined extensively in the field of economics. Given the KIS sector's unique relation to critical economic concepts such as knowledge, innovation, technology and productivity, the sector emphasizes central foundations of economic growth. Though the KIS sector's importance in sustaining modern economic growth is well recognized, very few studies have examined labour characteristics of these critical economic activities. To address this knowledge gap, our study examines the relevant issue of income gender inequality.

Third, as we show below, our analysis of the Spanish case is especially relevant given the recent emergence of differentially intense employment growth linked to ICT usage and the KIS sector in conjunction with higher and more persistent levels of gender inequality observed in the Spanish labour market overall. This specific case study of gendered wage inequality thus highlights the relationships among ICT, the service sector and gendered labour inequality.

Finally, the data we use reveal wage patterns at the personal, professional and family levels, allowing us to understand labour market wage processes from a gendered perspective.

The article centres its analysis on the Spanish case – a decision justified by two arguments that, in our opinion, make the study of the Spanish economy particularly relevant. First, the use of ICTs, the expansion of tertiary activities and the growth in employment linked to KIS activities are processes that have occurred with greater intensity in Spain than in EU-15 countries, despite a late start, thus allowing Spain to move its situation closer to those of neighbouring countries (Figure 1a). Second, despite the fact that, as mentioned previously, gender differences have been reduced considerably in Spain, they are still present to a greater degree and are more persistent than in the rest of the European Union (EU) (Figure 1b). Third, the unadjusted[1] GPG in Spain, although similar to that of the EU as a whole, has persisted over time and has slightly increased since 2010 (Figure 1c). Accordingly, the case of the Spanish labour market accentuates the relationship between KIS employment and labour inequalities by gender, and thus its analysis may be particularly relevant and instructive.

The rest of the article is organized as follows. Section 2 focuses on reviewing existing economic literature related to analysing the GPG. Section 3 specifies the database used and definitions applied while descriptively analysing the fundamental employment characteristics in the service sector in general and that of the KIS in particular. Section 4 describes the empirical strategy, applied methodology and results obtained. The article ends with a discussion and conclusion based on the research findings.

2. Theoretical framework for the explanation of the GPG

Explaining the presence of the GPG is complex, and the literature contains many hypotheses. According to Altonji and Blank (1999), the starting-point for explaining the GPG is the presence of *differences in the characteristics and preferences* of women and men. The GPG can be seen in the differences between men's and women's labour results, but its explanation can be found in the fact that, economically, women and men are not the same. Men and women are paid different salaries, as they present different characteristics that indirectly determine productivity levels and, therefore, salary levels. Complementarily, it may also be possible that part of this difference is because women and men also have
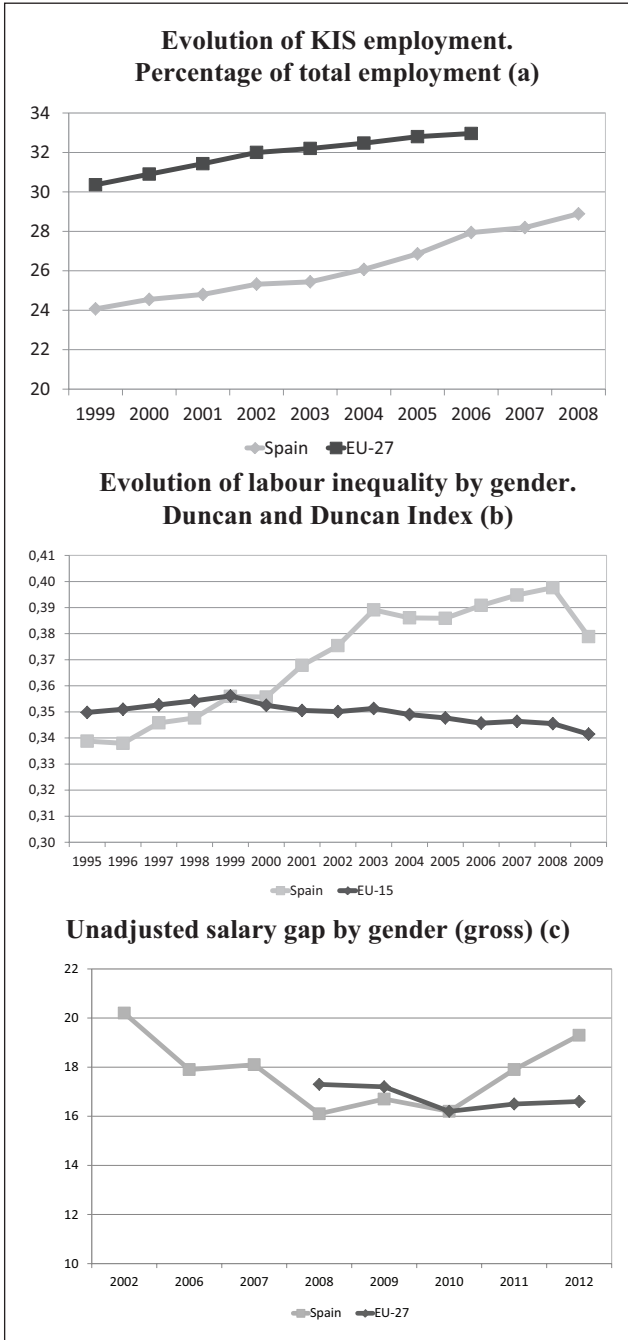
Figure 1. Spanish employment characteristics compared to the EU as a whole.
Source: Eurostat.

different preferences and, thus, make different workplace decisions. Finally, and to the degree that these differences cannot explain the pay gap entirely, the remaining unexplained difference is attributable to the presence of *discrimination* against women, or at least differential treatment.

From the perspective of characteristics, differences in human capital are the most relevant (Becker, 1965). There are three principal hypotheses that aim to explain the occurrence of discrimination: the theory of taste for discrimination (Becker, 1957); occupational exclusion (Bergmann, 1974); and statistical discrimination (Arrow, 1973; Phelps, 1972). We must note that discrimination may occur not only within the labour market but also before individuals gain access to the labour market, determining their characteristics and preferences or influencing the processes that lead to their formation (Altonji & Blank, 1999). These processes, typically called *pre-market discrimination*, refer, for instance, to acquiring an education or to the processes that occur in this environment (i.e. family and intergenerational transmission).

This reasoning framework has been developed through new elements referencing the fact that women and men can also be differentiated through their *psychological attributes and social preferences* (Bertrand, 2010). When these attributes and preferences are rewarded by the market, they interfere in salary determinations and thus become part of the explanation for the GPG.

One important issue is the link between preferences (women's and men's psychological attributes and social preferences), gender identity (Akerlof & Kranton, 2000) and social norms (Fernández, 2007). Gender identity may involve specific preferences and in practice translates to social norms that, although persistent, may nevertheless change over time.

In conclusion, it can be said that labour gender differences in general, and the GPG in particular, can be explained by two different components: the presence of differences in men's and women's characteristics and preferences, on the one hand, and the presence of discrimination or unequal treatment, on the other. Women and men exhibit differences because some of their characteristics are different, which is important in understanding the results of the labour market. The fact that men and women occupy different jobs and/ or receive different salaries can be explained by differences in men's and women's human capital, the varied aspects that explain those differences and the different variables that support the characteristics of various jobs. To the degree that these characteristics do not completely explain the differences observed between men and women, the presence of discrimination – i.e. the fact that economically equal groups are treated differently – constitutes a complementary explanation. Furthermore, it is also worth examining the potential effects of a glass ceiling, which can be defined as 'the unseen, yet unbreakable barrier that keeps minorities and women from rising to the upper rungs of the corporate ladder, regardless of their qualifications or achievements' (Federal Glass Ceiling Commission, 1995), one of the more relevant characteristics of the GPG.

3. Data, definitions and descriptive analysis

The data used in this study are drawn from the Spanish Labour Force Survey (Encuesta de Población Activa, abbreviated as EPA) for the second quarter of 2010 and from data

pools that combine transverse Life Condition Surveys (Encuesta de Condiciones de Vida, abbreviated as ECV) developed by the Institute of National Statistics (Instituto Nacional de Estadística, abbreviated as INE) for 2009–2012.[2] The first source of data will help us build a general framework and describe tertiary employment, KIS and non-KIS. The second database will allow us to analyse the existing pay gap between men and women.

Compared to other available data sources, the ECV stands out due to its wealth of data related to labour and family balance, and the possibilities of developing the Heckman filter, as explained in Section 4. The ECV offers information on individuals' gross and net income along with a large amount of personal, family and social data that can be used to statistically justify individual incomes.

Due to the strategic importance of different activity fields for economic activity, productivity and growth, Eurostat develops statistics with which to learn about those fields' technological intensity. Through the use of sectorial and product criteria, Eurostat's statistics refer to different sectorial groups: industry groups are identified on the basis of their technological intensity level (high-tech industry), and service groups are identified on the basis of the presence of employment in tertiary activities (KIS). This way, KIS are the services activities that have a closer relationship to the use, production and application of new technologies (i.e. ICT). According to Eurostat (2013), KIS are composed of the aggregation of different tertiary activities (Table 1).

Data corresponding to the EPA for the second quarter of 2010 show that the Spanish economy is clearly a service economy. A total of 72.4% of all employment activities involve tertiary activities. In comparison, primary and secondary activities occupy 27.4% of the employed population. More specifically, more advanced services activities – i.e. KIS – represent 34.2% of all employment and 47.2% of employment in the service sector, occupying 6.3 million people.

Table 2 compares the fundamental characteristics of employment in KIS, all other service activities (non-KIS) and non-service activities (agriculture, industry and construction). There is a verifiably greater presence of women in the service sector. Both in KIS and in non-KIS, more than half of those employed are women, compared to only 20% in non-tertiary activities. Although age does not introduce significant differences among the three sectors, married individuals are relatively less common in services. The presence of foreign individuals is notably lower in KIS activities, with an immigrant presence four and three times lower than that observed in non-KIS and non-tertiary activities, respectively. Another feature that introduces a remarkable difference between KIS employment and its alternatives is the level of its employees' education, which is much higher in the case of KIS. In this type of activity, 64% of employees hold university degrees, compared to 21% and 24% in the other groups. The proportion of salaried employees in KIS is also notably more common, which could indicate activities that are conducted in business organizations characterized by a greater level of formalization and a larger size. The distribution of employment by occupations again points to the existence of important differences – in terms of qualifications – among the three sectors. Whereas employment in non-tertiary activities is particularly concentrated in people with traditional manual qualifications and employment in non-KIS is concentrated in people with non-manual, intermediate qualifications, the employment in KIS exhibits

Table 1. Definition of KIS – Knowledge Intensive Services.

Digit	Title	Codes NACE Rev. 2 by 2 digits
5	Knowledge-intensive market services	50–51: Water transport; Air transport 69–71: Legal and accounting activities, Activities of head offices; Management consultancy activities; Architectural and engineering activities; Technical testing and analysis 73–74: Advertising and market research; Other professional, scientific and technical activities 78: Employment activities 80: Security and investigation activities
6	High-tech Knowledge-intensive services	59–63: Motion picture, video and television programme production, sound recording and music Publishing activities; Programming and broadcasting activities, Telecommunications, Computer Programming, consultancy and related activities; information service activities 72: Scientific research and development
7	Knowledge-intensive financial services	64–66: Financial and insurance activities (section K)
8	Other Knowledge-intensive services	58: Publishing activities 75: Veterinary activities 84–93: Public administration, defence and compulsory social security (section O), Education (section P); Human health and social work activities (section Q); Arts, entertainment and recreation (section R)

Source: Eurostat (2013).

Table 2. Characteristics of employment for KIS, non-KIS and non-service activities.

Characteristics	KIS	Non-KIS	Non-services
Gender:			
Men	46.35	46.62	80.71
Women	53.65	53.38	19.9
Age:			
16–24	5.04	8.22	5.91
25–34	26.75	27.82	26.74
35–44	29.25	29.03	31.43
45–54	25.98	23.22	22.48
55 and above	12.98	11.71	13.44
Marital status:			
Single	41.75	43.00	35.77
Married	58.25	57.00	64.23

(Continued)

Table 2. (Continued)

Characteristics	KIS	Non-KIS	Non-services
Nationality:			
Spanish	94.31	79.46	85.46
Foreign	5.69	20.54	14.54
Education:			
Primary	15.53	49.91	53.73
Secondary	20.95	28.90	21.66
Tertiary	63.52	21.19	24.61
Employment status:			
Employer	2.77	7.53	6.50
Self-employed	6.39	13.37	14.13
Employed	90.84	79.10	79.37
Occupations:			
Directors	4.61	12.26	6.53
Professionals	36.80	1.84	4.51
Technicians and associated professionals	20.47	8.30	9.14
Administrative	12.36	9.37	5.06
Service and commercial workers	16.41	30.29	1.02
Agriculture qualified and assimilated workers	0.48	0.95	7.36
Construction workers, excluding electricians	2.20	5.50	36.48
Machinery, plant and assembly operators	1.11	9.21	17.05
Basic occupations	5.56	22.29	12.85
Duration of contract:			
Less than 1 year	13.06	19.02	17.13
From 1 to 3 years	15.59	18.14	13.71
From 3 to 5 years	11.26	14.44	12.01
More than 5 years	60.09	48.39	57.15
Workday:			
Full time	87.40	79.74	94.66
Part time	12.60	20.26	5.34
Willingness to engage in part-time employment:			
No	5.66	10.84	2.16
Yes	94.34	89.16	97.84
Labour contract:			
Indefinite	77.80	75.02	71.46
Temporary	22.20	24.98	28.54

Source: EPA, second quarter of 2010.

higher concentrations of non-manual occupations with elevated qualifications (professionals and support technicians). These qualification differences translate to a greater frequency in KIS employment of labour tenure of more than 5 years, although the trends are not generally conclusive. Part-time employment is particularly common in non-KIS

Table 3. Differences in the characteristics of women and men engaged in KIS, non-KIS and non-service activities.

Characteristics	KIS	Non-KIS	Non-services
Age:			
16–24	107.68	115.32	87.40
25–34	102.46	117.28	117.11
35–44	103.41	101.17	96.04
45–54	101.10	87.36	101.11
55 and above	83.89	79.11	80.93
Marital status:			
Single	99.40	113.22	104.95
Married	100.43	91.13	97.28
Nationality:			
Spanish	101.10	88.53	105.17
Foreign	83.55	163.25	71.50
Education:			
Primary	84.99	97.57	77.31
Secondary	88.90	100.31	108.30
Tertiary	108.23	105.52	148.82
Employment status:			
Employer	46.61	49.00	55.87
Self-employed	64.02	67.68	103.67
Employed	105.57	114.29	103.32
Occupations:			
Directors	45.55	58.77	82.99
Professionals	110.27	90.04	150.87
Technicians and associated professionals	91.17	68.68	271.77
Administrative	168.11	160.38	635.18
Services and commercial workers	115.57	173.28	451.43
Agriculture, both qualified and assimilated workers	12.91	4.16	120.66
Construction workers, excluding electricians	8.05	9.48	26.02
Machinery, plant and assembly operators	14.22	6.49	88.49
Basic occupations	100.45	245.23	132.04
Duration of contract:			
Less than 1 year	114.89	121.96	93.89
From 1 to 3 years	116.94	144.59	102.93
From 3 to 5 years	116.64	136.83	126.41
More than 5 years	90.61	73.83	95.90
Workday:			
Full time	88.89	74.22	86.19
Part time	246.21	416.13	588.74
Willingness to engage in part-time employment:			
No	229.26	369.67	300.43
Yes	95.53	87.47	96.83
Labour contract:			
Indefinite	91.99	92.99	107.47
Temporary	135.03	125.03	82.24

Source: EPA, second quarter of 2010.

activities (20%), although it is also involuntary to a greater degree and exhibits a lesser presence in non-tertiary activities (5%). Finally, lower rates of fixed-term contracts can be seen in KIS employment, whereas greater rates can be seen in primary and secondary activity employment.

To summarize, KIS activities integrate notably female-based employment with a greater presence of individuals having Spanish nationality and higher educational levels. KIS activities are concentrated in occupations with a greater qualification level and better working conditions (lower rates of temporary and part-time work, a higher proportion of salaried workers and greater stability in the labour relationship).

Table 3 analyses the existence of differences in the characteristics set forth above between women and men that work in the KIS, the non-KIS and the non-service sectors. The table shows the frequency of each category for women if we make the frequency of men equal to 100. Ignoring minor differences, the following important facts can be deduced:

1. For both service-sector groups (KIS and non-KIS), women are more common than men in younger groups. This trend becomes less clear in the case of non-tertiary activities.
2. Fewer immigrant women than men are seen, particularly in KIS and in non-tertiary activities.
3. For all sector groups, women with university degrees are more common than men, with the difference being particularly strong in non-tertiary activities.
4. Women surpass men in their relative presence as salaried employees, whereas they are less common in self-employed categories and particularly in the employer category.
5. The 'chief executive' occupation always exhibits a clear dominance by men.
6. In apparent contradiction to our observations related to educational levels, occupations with a greater relative presence of women are those in 'administrative', 'service worker' and 'basic occupations', even within KIS, which has an occupational structure focused on qualified non-manual tasks.
7. Manual occupations are clearly biased towards men.
8. Qualified non-manual occupations exhibit diverse trends, but women surpass men in these tasks only in non-tertiary activities.
9. Women predominate in working relationships of shorter duration.
10. Women have a majority presence in part-time employment.
11. Women also have a majority presence in temporary employment, except in non-service activities.

The results of this preliminary descriptive analysis point to a relevant but contradictory outcome. First, KIS activities yield better results in terms of employment quality because more qualified positions, fewer part-time jobs, fewer temporary contracts and higher labour stability are observed. Second, women contribute to KIS labour performance based on personal characteristics that are superior to those of men. In this sense it should be remembered that female employees engaging in KIS activities are younger, are less likely to be of foreign nationality and hold higher educational qualifications than

Table 4. Monthly net salary in euros for different activity sectors.

Mean WN	Total	Men	Women	Gross difference (men–women)	% over W (women)
Total:	**1420.9**	**1567.1**	**1249.0**	**318.1**	**25.5**
Services	1433.1	1636.7	1265.6	371.0	29.3
Non-services	1421.1	1478.2	1209.0	269.2	22.3
KIS	1628.6	1782.8	1488.2	294.6	19.8
Non-KIS	1079.4	1325.9	911.3	414.6	45.5

Source: ECV, pool 2009–2012.

men. But third, women benefit from characteristics that define KIS employment quality to a much lesser degree than men do. So, it is remarkable how many more women face part-time and temporary contracts than men.

Only those activities that are not related to services improve the disadvantageous status of women. We thus find that, a priori, despite their peculiarities and special relations to technology and the knowledge community, KIS activities reproduce trends of gender allocation that are similar to those observed across the entire employment population.

In now focusing our analysis on wages (Table 4), we find that mean service-sector wages differ little from the mean for the entire economy and from wages outside the tertiary sector. However, when looking at differentiation by gender, women earn verifiably higher mean monthly salaries in net terms when they are employed in KIS activities (1488.2 euros, mean per month).

The GPG differs from one labour location to the next. The greatest difference in gross and relative terms is found in non-KIS sectors (with 414.6 euros, mean per month, which represents 45.5% of the mean salary of a woman hired in that sector). Conversely, the smallest absolute differences are found in non-service activities (with 269.2 euros, mean per month) and in relative terms in KIS, where the GPG represents 19.8% of the mean female monthly salary.

4. GPG, the tertiary sector and KIS

The objective of this study is to analyse the salary differences between men and women, and to determine the effect of the service sector and in particular KIS. To this end, and based on the GPG findings, two analyses were carried out: the first identified factors (characteristics versus differential treatment) that contribute to the GPG, and the second identified the nature of salary differences between women and men throughout the salary distribution.

Characteristics or differential treatment: Explicative components of the labour gap by gender

Regarding the first analysis, we used the Oaxaca–Blinder decomposition (Neumark, 1988; Oaxaca & Ransom, 1994) to determine the proportion of salary differences that

either can be explained or cannot be explained by differences in characteristics between men and women. According to this methodology, we first estimate a series of salary equations with which to predict the salary (in logarithms) of men and women as a function of their personal and labour characteristics.

$$\ln W_H = \beta_0 + \beta_1 X_1 + \mu \tag{1}$$

$$\ln W_M = \beta_0 + \beta_1 X_1 + \mu \tag{2}$$

Using these equations, we determine how men's and women's labour characteristics are remunerated (or given a value) in the labour market through the estimation of the coefficient β_1. For example, people with a higher education tend to earn a salary, in mean terms, higher than that of less-educated workers. Therefore, higher education is a personal characteristic that is remunerated positively, and consequently, in the estimations, it obtains a positive associated ß coefficient. Following the above-mentioned authors, one possible differentiation of the previous salary equations is as follows:

$$\ln W_H - \ln W_M = \left(\overline{X_H} - \overline{X_M} \right)' \hat{\beta}_H + \overline{X_M}' \left(\widehat{\beta_M} - \widehat{\beta_H} \right) \tag{3}$$

where:

(a) $\left(\overline{X_H} - \overline{X_M} \right)' \hat{\beta}_H$ is the 'explained' component due to the different talents to be remunerated associated with the different groups. In this case, men's and women's different labour and personal characteristics are a basis for their unequal salaries.

(b) $\overline{X_M}' \left(\widehat{\beta_M} - \widehat{\beta_H} \right)$ is the 'unexplained' part of the estimation, which is not based on unequal characteristics and could be described as salary discrimination or different salary treatment without justification. In other words, given equal characteristics, salaries or salary treatment are not the same by gender.

To estimate this decomposition, we consider the bias selection correction by applying the Heckman filter (1979), which establishes a different weight for men and women as a function of the probability of participating in the labour market and, therefore, of obtaining salaried employment. The filter simply assigns a weight to each group to correct the possible selection bias for each collective group being analysed. In our case, when applying the filter, we have considered the differentiation in the sample between active and inactive people.

Table 5 gathers the results of applying the Oaxaca–Blinder decomposition to the entire economy, to the service sector and to all other non-tertiary activities. In this study, the dependent variable denotes net monthly salary levels in natural logarithms.[3] The explanatory variables considered gather both personal variables (age, age squared, marital status, offspring, nationality and education level) and labour variables (duration of contract, duration of workday, supervisory work, manual occupation, workplace size) along with some control variables (whether the residential nucleus is very populated, whether the region exhibits salaries above the national mean, and whether the sampling

Table 5. Oaxaca–Blinder salary decomposition: total, services and non-services.

	Total			Services			Non-services		
	Coef.	Sig.	%	Coef.	Sig.	%	Coef.	Sig.	%
Salary decomposition:									
LWN – Men	7.284	0.000 ***		7.312	0.000 ***		7.238	0.000 ***	
LWN – Women	7.032	0.000 ***		7.037	0.000 ***		6.998	0.000 ***	
Difference	0.252	0.000 ***		0.275	0.000 ***		0.240	0.000 ***	
Explained	0.085	0.000 ***	33.6	0.123	0.000 ***	44.8	0.026	0.021 **	10.7
Not explained	0.167	0.000 ***	66.4	0.152	0.000 ***	55.2	0.214	0.000 ***	89.3
Contribution of the explained component:									
Age	0.011	0.000 ***		0.011	0.000 ***		0.022	0.001 ***	
Age^2	−0.006	0.000 ***		−0.006	0.002 ***		−0.014	0.019 **	
Married	0.002	0.000 ***		0.002	0.000 ***		0.003	0.005 ***	
Home with independent offspring	−0.001	0.032 **		−0.001	0.001 ***		0.000	0.285	
Foreign	0.000	0.480		0.001	0.018 **		−0.004	0.007 ***	
Higher education	−0.019	0.000 ***		−0.008	0.000 ***		−0.020	0.000 ***	
Temporary contract	0.005	0.000 ***		0.010	0.000 ***		0.001	0.691	
Partial workday	0.103	0.000 ***		0.098	0.000 ***		0.085	0.000 ***	
Supervisory work	0.017	0.000 ***		0.018	0.000 ***		0.013	0.000 ***	
Non-manual occupation	−0.031	0.000 ***		−0.009	0.000 ***		−0.054	0.000 ***	
Size of the business (fewer than ten employees)	0.007	0.000 ***		0.008	0.000 ***		−0.002	0.116	
Resident of a very populated city	−0.001	0.008 ***		0.000	0.411		−0.001	0.054 *	
Resident of a region with salaries above the mean	−0.002	0.000 ***		−0.001	0.005 ***		−0.003	0.068 *	
2010	0.000	0.796		0.000	0.567		0.000	0.839	
2011	0.000	0.941		0.000	0.789		0.000	0.593	
2012	0.000	0.308		0.000	0.555		0.000	0.659	
Constant	0.000	0.000 ***		0.000	0.000 ***		0.000	0.000 ***	
N sample observations	36,721			26,626			10,035		

Source: ECV, pool 2009–2012 (authors' elaboration). *** significant to 99%; ** significant to 95%; * significant to 90%.

years of the data pool are transversal). All these variables attempt to measure the principal characteristics remunerated in the jobs; however, they also measure issues related to labour and family balance that may influence job selection and therefore salary. We are thus primarily concerned with variables such as the presence of dependent offspring in the home and holding a part-time job.[4] Including the part-time variable is fundamental when analysing monthly salary because it allows for better controlling of the mean salary differences estimated in the model. In the Spanish case, the part-time variable is even more necessary given the strong link between women and part-time employment.

The first section of Table 5 confirms that, independent of the activity sector observed, women earn lower salaries than men (according to the natural logarithm, women reach approximate values of seven, whereas men surpass this figure), but, again, it is the service sector in which women receive higher net mean salaries (7.037). In addition, when estimating the existing GPG, no excessively relevant differences are obtained in absolute terms (0.252 for total employment, 0.275 for services and 0.240 for all other non-tertiary activities). The decomposition of these differences shows that the greater proportion is unexplained by the characteristics, and thus, on occasion, they relate to differential or potentially discriminatory treatment. It is therefore accurate to confirm that the unexplained component is lower in the case of service-sector employment (55.2%). This fact, among other factors, such as the existence of a greater mean remuneration or more adequate labour characteristics, could explain the greater female placement in service activities.

The remainder of Table 5 reveals considered variable contributions to the explained component, estimated via Oaxaca–Blinder decomposition. From this observation, we can conclude that higher educational levels and non-manual occupations are characteristics that contribute to reducing the salary differences between men and women. Conversely, the factor that contributes to a greater degree to supporting a GPG is the greater involvement of women with generally less-remunerated part-time employment. To a lesser degree, other variables that increase the GPG include age and supervisory work.

The presence of offspring in the home does not offer a very high coefficient, but when it is significant, it shows a negative sign. Therefore, there are fewer pay differences between salaried men and women with children than among other workers. Alternatively, women with children receive more equal pay compared to men with children.

In the case of the tertiary sector, the trend in salary differences is based on the same characteristics, although with a lower intensity. Once again, it stands out that part-time employment is the labour characteristic that establishes the greatest pay differences by gender. Possibly due to the productive nature of the sector, non-manual occupations show a lower impact on the determination of a GPG within the service sector.

Table 6 presents the Oaxaca–Blinder composition, but differentiates between the KIS sector and all other service sectors, which are denominated as non-KIS sectors. As with the previous estimations, there remain salary differences in favour of men. However, in absolute terms, the salary differences estimated between women and men are higher outside of KIS (0.226 for KIS versus a difference of 0.349 for non-KIS employment). These differences are explained by the presence of different characteristics between men and women in 40.9% of the KIS sector and 50.1% in the non-KIS sector. The rest of the

Table 6. Oaxaca–Blinder salary decomposition, KIS and non KIS.

	KIS				non-KIS			
	Coef.	Sig.		%	Coef.	Sig.		%
Salary decomposition:								
LWN – Men	7,456	0,000	***		7,118	0,000	***	
LWN – Women	7,230	0,000	***		6,769	0,000	***	
Difference	0,226	0,000	***		0,349	0,000	***	
Explained	0,093	0,000	***	40.9	0,175	0,000	***	50.1
Not explained	0,134	0,000	***	59.1	0,174	0,000	***	49.9
Explained component contributions:								
Age	0,019	0,000	***		0,009	0,074	*	
Age²	-0,013	0,001	***		-0,008	0,070	*	
Married	0,001	0,060	*		0,001	0,050	*	
Home with dependent offspring	-0,001	0,061	*		-0,001	0,023	**	
Foreign	0,000	0,332			0,003	0,009	***	
Higher education	-0,011	0,000	***		0,002	0,046	**	
Temporary contract	0,012	0,000	***		0,008	0,000	***	
Partial workday	0,068	0,000	***		0,118	0,000	***	
Supervisory work	0,022	0,000	***		0,022	0,000	***	
Non-manual occupation	-0,006	0,000	***		0,010	0,000	***	
Size of the business (fewer than ten employees)	0,001	0,427			0,011	0,000	***	
Resident of a very populated city	0,000	0,330			0,000	0,743		
Resident of a region with salaries above the mean	-0,001	0,028	**		-0,001	0,113		
2010	0,000	0,948			0,000	0,612		
2011	0,000	0,469			0,000	0,826		
2012	0,001	0,278			0,000	0,884		
Constant	0,000	0,000	***		0,000	0,000	***	
N sample observations	18.128				8.498			

Source: ECV, pool 2009–2012 (authors' elaboration). *** significant to 99%;** significant to 95%;* significant to 90%.
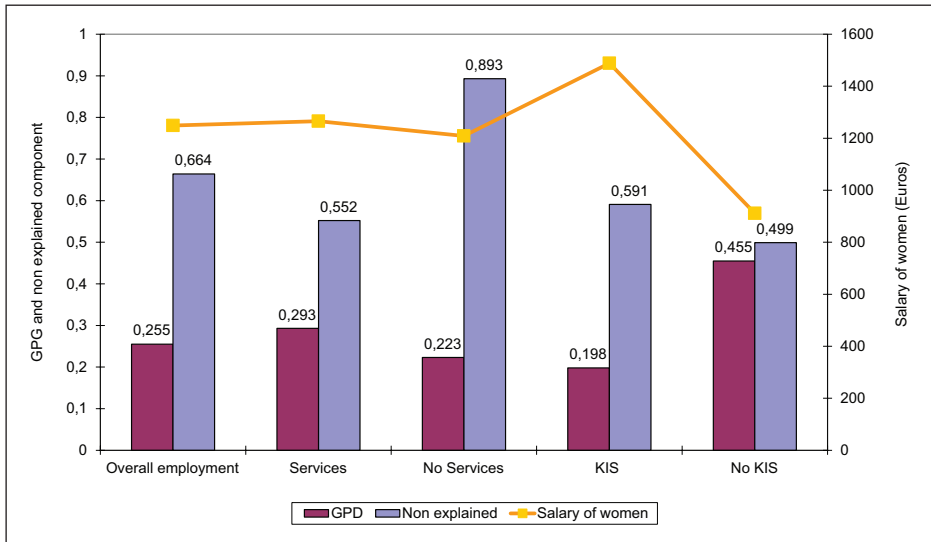
Figure 2. Summary of results: women's salary, GPG and unexplained components defined by sector.
Source: ECV (authors' elaboration).

salary gap by gender (59.1% and 49.9%, respectively) can be attributed to the presence of unexplained differential or potentially discriminatory treatment, which, in this case, is greater for the KIS case.

The variables that are the basis for the previous differences in the KIS case are the unequal contributions of age, the presence of a temporary contract, involvement in part-time work and development of non-manual tasks. The lesser relative presence of part-time employment within KIS may be one of the reasons why this characteristic loses relevance and reduces its contribution to explaining the GPG. Again, having a higher education contributes to reducing differences related to gender, with age becoming an additional part of the picture. The level of education loses some of its intensity relative to the general case given that, within KIS, there is more hiring of individuals with higher education, establishing a priori a more homogeneous group. The remuneration of education compensates for differences in GPG and in activities where such education levels are uneven. This shows that education, as defined at the start of this article, may promote female employability and gender equality.

Figure 2 summarizes the principal results. It shows, for each sector definition, women's monthly salaries, the existing GPG expressed as parts per unit with respect to men's salaries and the portion of this pay gap unexplained by characteristics (differential or potentially discriminatory treatment), also in parts per unit. Thus, while services overall do not substantially raise women's salaries (i.e. salaries similar to those of the entire employment pool and a similar pay gap), the KIS sector is associated with higher salaries for women and a smaller GPG. However, female employment linked to KIS exhibits an unexplained component of the GPG greater than that of the entire employment pool and

the tertiary employment group. Therefore, even though women in KIS activities show lower salary differences in absolute terms, their 'discriminatory' treatment is important, and we cannot establish that KIS is an ideal labour sector for female employment.

The glass ceiling: Salary differences throughout the salary distribution

With the intent of exploring the GPG in greater depth, we have extended the object of this study to the set of salary distributions. Our objective is now to verify whether salary differences and the explanatory components we have found for women are replicated along the entire salary distribution or whether, on the contrary, there are unequal conditions between women when differentiating by salary levels, which would show the existence of a glass ceiling (i.e. a situation in which pay gaps are greater at the higher end of the distribution) or a sticky floor (situations in which the remuneration level hardly increases when moving up the distribution). In general, women tend to exhibit a less sharp salary distribution, which is more displaced to the left than that of men. This shows not only that mean female salaries are lower than men's but also that there is a greater salary differentiation at higher levels of the salary distribution. In contrast to the appropriated estimations, this tends to indicate the existence of a glass ceiling.

To approach this issue, we developed a salary decomposition along the distribution that is similar to those developed previously, now applied to the salary quantiles. Specifically, the estimation methodology followed was developed by Melly (2006), who established the following decomposition:

$$\hat{q}_1(\theta) - \hat{q}_0(\theta) = [\hat{q}_1(\theta) - \hat{q}_c(\theta)] + [\hat{q}_c(\theta) - \hat{q}_0(\theta)] \qquad (4)$$

where:

(a) The first term of the equation shows the explained component of salary differences, and in this case, for each quantile.
(b) The second term reflects the unexplained component of salary differences, again for each quantile analysed. This term is estimated based on the counterfactual quantilic distribution θ, which is observed when people are not subject to differential treatment or the quantilic unconditioned distribution.

Figure 3 gathers the values that result from applying such a decomposition to the analysed sector spheres. As shown in the figure, in all cases there is a glass ceiling, which is something that tends to define the Spanish economy (see Carrasco et al., 2011; De la Rica et al., 2010; Dolado & Llorens, 2004; Gardeazábal & Ugidos, 2005). For activities that fall outside the service sector, the glass ceiling is clearly higher. More relevant to the objectives of this study, if we compare the results obtained for the specific case of KIS and non-KIS, we observe that, although KIS closely reproduce the situation observed for the entire employment pool, in non-KIS the glass ceiling seems to disappear when we see a small reduction in pay gaps in absolute terms for the higher salary groups and in the importance of unexplained factors when moving up the salary distribution.
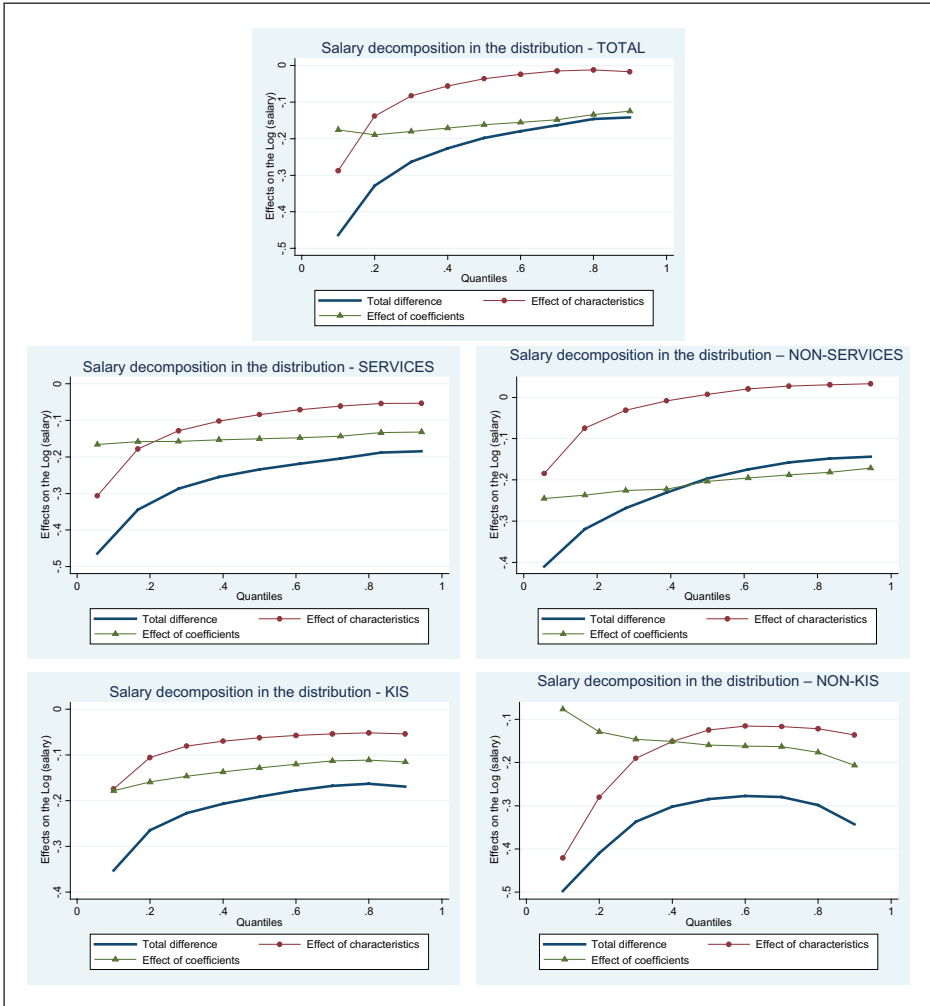
Figure 3. Salary decomposition by quantiles.
Source: authors' elaboration based on data from the ECV, pool 2009–2012.

Figure 4 shows the percentage represented by the unexplained component of pay-gap decomposition. This figure allows one to better identify the presence of important discriminatory or unexplained treatment at higher salary ranges for all the cases analysed. In relative or percentage terms, such 'discrimination' occurs mainly in the context of non-tertiary activities. More importantly, KIS do not offer better results than the rest of the service sector or than non-KIS services. Therefore, the service sector may favour female employment (in this case, due to the reduction of the glass ceiling), but KIS as a labour sector are not especially attractive for female employment.

While the absolute GPG level is reduced for the entire distribution of the KIS sector, at higher salary levels differential treatment continues to be relevant, denoting the
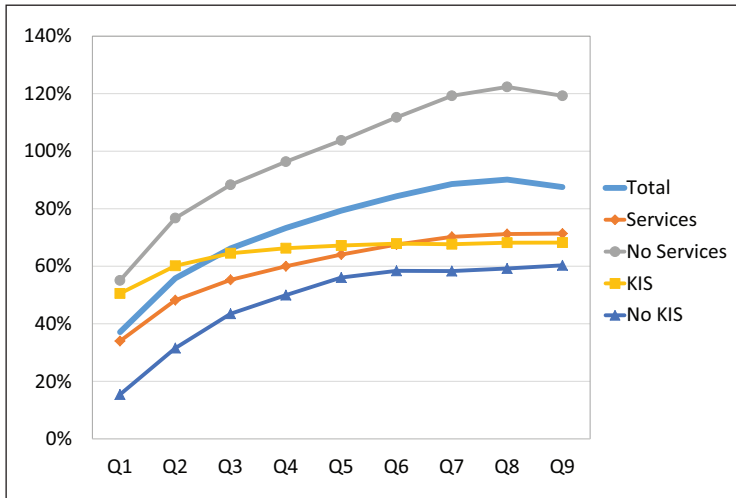
Figure 4. Salary decomposition by quantiles: percentage that represents the unexplained component.
Source: authors' elaboration based on data from the ECV, pool 2009–2012.

persistence of discrimination in higher salary groups along with the presence of a glass ceiling. Thus, the hypothesis that the KIS sector is a favourable labour destination for women is less accurate in view of these new results. From the perspective of wage discrimination, although the KIS glass ceiling is not as high as it was, it is still there.

5. Conclusions

The service sector, specifically the KIS sector, is favourable for female hiring, where there are certain labour conditions that a priori are favourable for the reduction of GPGs. This article has analysed the salary gap between men and women as a measure of such labour differences by gender in different sectorial groups. Similarly, using the Oaxaca–Blinder decomposition, we have estimated which part of the salary gap may be explained by existing different workplace-decision characteristics between men and women, and the elements of those differences that cannot be explained and are instead associated with patterns of differential treatment or potential discrimination.

The results show that, while the service sector is more favourable to women in terms of salary levels, since women earn higher mean salaries, and less discrimination occurs in relation to trends in non-service sectors, this trend cannot be clearly established for KIS. Rather, while women employed in this sector do earn higher salaries and experience lower salary differences in relation to the remainder of activities, discrimination and differential treatment persist and continue to be as influential as in non-KIS sectors and in the tertiary employment sector overall.

Similarly, it has been verified that education and performing a non-manual occupation are labour factors related to the existence of a smaller GPG. Education, or having a higher education, is established in current economic literature as a fundamental tool to

avoid labour segregation and, therefore, salary discrimination (Iglesias & Llorente, 2008). In the opposite situation, working part-time is found to determine the presence of significant pay gaps, possibly due to women's greater involvement in this type of work.

Finally, the GPG along the entire salary distribution has been analysed through salary decomposition by quantiles. The presence of a glass ceiling, based on the presence of larger salary differences together with a greater weight of the unexplained component within the higher salary ranges, tends to be the norm in each and every sector analysed. However, within the service sector, the glass ceiling is not as decisive in relative terms as it is in all other non-tertiary activities. Unfortunately, within KIS, salary differences persist in higher salary ranges, a situation that defines the presence of a glass ceiling.

In sum, although the KIS sector has improved certain aspects of women's salary equality in relation to men, it does not constitute a working environment that is free from wage discrimination. The basis for this finding can be found in the fact that within ICTs, which are strongly linked with developing KIS, freedom from salary discrimination cannot be found (Llorente et al., 2013). This fact points to a need for future research to further investigate the more favourable aspects that reduce the pay gap within the KIS sector. With the intent of developing future economic policies, our study points to the need to equalize the participation of men and women in part-time employment, to continue to promote education and to support the growth of the service sector.

Our findings on ICT and service activities for the KIS sector do not confirm conjectures presented in previous studies regarding the sector's potential capacity to promote gendered income equality. We present two potential reasons for this outcome. On the one hand, ICTs, although they are increasing women's wages somewhat, reproduce gender inequalities similar to those found in other sectors. While women's wages may be relatively higher in this sector, gender differences and processes of discrimination in this sector differ only slightly from the national norm. Second, while ICTs expand employment opportunities for women, they are likely unable to modify 'existing gendered structures in the workplace' as a central explanatory factor influencing female labour trends in the KIS sector. Therefore, the KIS sector has improved the status of women in the workplace but has largely reproduced existing gender inequality patterns.

Furthermore, the results clearly illustrate the pivotal explanatory role that education plays in increasing gender equality in the workplace. Confirming the previous results noted in the literature, investments in education most effectively allow women to overcome obstacles to labour participation and to secure economic resources similar to those enjoyed by men. In light of this outcome, we believe that the results of our analysis in terms of gender equality would have proven more significant if we had limited our study to an examination of KIS sectors associated with higher-education requirements. Thus, our findings must also be evaluated considering that our definition of the KIS sector includes several different activities in terms of qualifications.

Our findings inform economic policies focusing on gender equality in two ways. First, it is necessary to stimulate women's investment in education and to more specifically discourage gender segregation regarding forms of education that are pursued by women and men in Spain. Second, quota policies may be implemented to mitigate and eventually remove existing gender structures in workplaces and in the most technologically advanced service sectors. Encouraging women to participate more in decision-making processes

within companies may help alter gender-biased structures and procedures operating in the labour market.

Both of these strategies must guide gender-related labour policies, particularly in labour markets such as those of Spain, where gender inequality is higher and more persistent than in neighbouring countries. Our analysis results show that it is not feasible to passively trust gendered labour-inequality correction mechanisms of the Spanish services sector, and even for sectors most associated with ICTs. More active measures may focus on educational choices made by women and on their participation in business decisions.

Acknowledgements

Funding

Notes

1. This term refers to the unadjusted gender pay gap (GPG), estimated by Eurostat as the difference between men's net mean salaries per hour compared to women's over the men's value. For more details, consult Eurostat's methodology online (metadata).
2. This period was the last available at the time this article was written; however, it is also the period that has a homogeneous definition of activities based on CNAE-09. The data shown have been established as the mean annual figures for the years analysed.
3. We consider the monthly salary, not the hourly salary, because monthly salary is more decisive for labour and family balance and because, when studying different sectors, the sharpest differences occur in the monthly measure instead of in the hourly measure.
4. Although the ECV asks for the motives for part-timers, its information does not allow for identifying whether a respondent's labour situation is voluntary.

References

Akerlof G, Kranton R (2000) Economics and identity. *The Quarterly Journal of Economics* 115(3): 715–753.

Altonji J, Blank R (1999) *Race and gender in the labor market*. In: Ashenfelter O, Card D (eds) *Handbook of Labor Economics.* London: Elsevier, 3143–3259.

Arrow K (1973) The theory of discrimination. In: Ashenfelter OA, Rees A (eds) *Discrimination in Labor Markets*. Princeton, NJ: Princeton University Press, 3–33.

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

Becker G (1965) A theory of the allocation of time. *Economic Journal* 75(229): 493–517.

Bergmann B (1974) Occupational segregation, wages, and profits when employers discriminate by race and sex. *Eastern Economic Journal* 1(2): 103–110.

Bertrand M (2010) New perspectives on gender. In: Ashenfelter O, Card D (eds) *Handbook of Labor Economics*. London: Elsevier, vol. 4, part b: 1540–1590.

Boden M, Miles I (2000) *Services and the Knowledge-based Economy*. London: Continuum.

Carnoy M (2002) *Sustaining the New Economy: Work, family and community in the information age*. Cambridge, MA: Harvard University Press.

Carrasco R, Jimeno JF, Ortega AC (2011) Accounting for changes in the Spanish wage distribution: The role of employment composition effects. Working paper no. 1120, Banco de España. http://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosTrabajo/11/Fich/dt1120e.pdf.

Castaño C, Webster J (2011) Understanding women's presence in ICT: The life course perspective. *International Journal of Gender, Science and Technology* 3(2): 364–386.

Castaño C, Martín J, Vázquez S, Martínez JL (2010) Female executives and the glass ceiling in Spain. *International Labour Review* 149(3): 343–360.

Chen DHC (2004) Gender equality and economic development: The role for information and communication technologies. Policy research working paper no. 3285, The World Bank. http://info.worldbank.org/etools/docs/library/117321/35079_wps3285.pdf.

De la Rica S, Dolado JJ, Vegas R (2010) Performance pay and the gender wage gap: Evidence from Spain. IZA discussion paper no. 5032. http://ftp.iza.org/dp5032.pdf.

Dolado JJ, Llorens V (2004) Gender wage gaps by education in Spain: Glass floors vs. glass ceiling. CEMFI working paper no. 0403. ftp://ftp.cemfi.es/wp/04/0403.pdf.

Dolado JJ, Felgueroso F, Jimeno JF (2002) Recent trends in occupational segregation by gender: A look across the Atlantic. Documentos de trabajo de FEDEA 2002–11. http://documentos.fedea.net/pubs/dt/2002/dt-2002-11.pdf.

Dueñas D, Iglesias C, Llorente R (2014) Expulsion or confinement? A comparative perspective on occupational segregation by sex in Spain. *International Labour Review* 153(2): 311–336.

Eurostat (2013) Science, technology and innovation in Europe. Eurostat. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-GN-13–001/EN/KS-GN-13–001-EN.PDF.

Federal Glass Ceiling Commission (1995) *Good for Business: Making full use of the nation's human capital*. Washington, DC: US Department of Labor.

Fernández R (2007) Women, work and culture. *Journal of the European Economic Association* 5(2–3): 305–332.

Galor O, Weil D (1996) The gender gap, fertility and growth. *American Economic Review* 86(3): 374–387.

Gardeazábal J, Ugidos A (2005) Gender wage discrimination at quantiles. *Journal of Population Economics* 18(1): 165–179.

Goldin C (2006) The quiet revolution that transformed women's employment, education and family. *American Economic Review* 96(2): 1–21.

Hafkin NJ, Huyer S (2006) *Cinderella or Cyberella? Empowering women in the knowledge society*. West Hartford, CT: Kumarian Press.

Heckman J (1979) Sample selection bias as a specification error. *Econometrica* 47: 153–161.

Iglesias C, Llorente R (2008) Evolución reciente de la segregación laboral por género en España. Documento de trabajo no. 13/2008, Instituto de Análisis Económico y Social (IAES). http://www2.uah.es/iaes/publicaciones/DT_13_08.pdf.

Iglesias C, Llorente R, Cuadrado R (2003) Employment tertiarization and emerging new patterns of work: The Spanish case. *The Service Industries Journal* 23(3): 125–152.

Iglesias C, Llorente R, Dueñas D (2010) Job quality, job satisfaction and services in Spain. *Journal of Innovation Economics* 5: 147–168.

ILO (2001) *World Employment Report 2001*. Geneva: International Labour Organization.

Llorente R, Iglesias C, Dueñas D (2013) Do information and communication technologies improve the female labor situation? The impact of ICT on gender wage differences in Spain. In: Roselli J, Gulick E (eds) *Information and Communications Technology: New research*. New York, NY: Nova Publishers.

Melhem S, Morrell C, Tandon N (2009) Information and Communication Technologies for Women's Socioeconomic Empowerment. Working paper no. 176. The World Bank. http://elibrary.worldbank.org/doi/pdf/10.1596/978–0–8213–8133–5

Melly B (2006) Estimation of counterfactual distributions using quantile regression. *Review of Labor Economics* 68(4): 543–572.

Neumark D (1988) Employers' discriminatory behavior and the estimation of wage discrimination. *Journal of Human Resources* 23(3): 279–295.

Ng C, Mitter S (2005) *Gender and the Digital Economy: Perspectives from the developing world*. New Delhi: Sage.

Ngai R, Petrongolo B (2013) Gender gaps and the rise of the service economy. Discussion paper no. 1204. Centre for Economic Performance, London School of Economics and Political Science. http://eprints.lse.ac.uk/51538/1/dp1204.pdf.

Oaxaca RL, Ransom MR (1994) On discrimination and the decomposition of wage differentials. *Journal of Econometrics* 61(1): 5–21.

OECD (2007) ICTs and gender. *OECD Digital Economy Papers*, no. 129. OECD Publishing. http://www.oecd-ilibrary.org/docserver/download/5kz84nxcjc5l.pdf?expires=1429084883&id=id&accname=guest&checksum=3DEC7E65F995DB060DDC320FF5FB084B.

Phelps E (1972) The statistical theory of racism and sexism. *American Economic Review* 62(4): 659–661.

Rendall M (2010) Brain versus brawn: The realization of women's comparative advantage. Working paper no. 491, Department of Economics, University of Zurich.

Truss C, Conway E, d'Amato A, Kelly G, et al. (2012). Knowledge work: Gender-blind or gender-biased? *Work, Employment & Society* 26: 735–754.

Author biographies

Diego Dueñas-Fernández is an Assistant Professor in the Department of Economic Foundations of both the University of Alcalá (Spain) and the University of Valladolid (Spain). He is also a research member of the Economic and Social Analysis Institute (IAES).

Carlos Iglesias-Fernández is a Lecturer in the Department of Economics and Business of the University of Alcalá (Spain) and a senior researcher in the Economic and Social Analysis Institute (IAES) of the University of Alcalá.

Raquel Llorente-Heras is a Lecturer in the Department of Economic Analysis, Economic Theory and Economic History at the University Autónoma of Madrid (Spain) and a researcher in the Economic and Social Analysis Institute (IAES).