

EMPLOYMENT OPPORTUNITIES IN SPAIN: GENDER DIFFERENCES BY EDUCATION AND ICT USAGE

GÓMEZ, Nuria
TOBARRA, María-Ángeles
LÓPEZ, Luis-Antonio

Abstract

Education is a main determinant of employment, but not in isolation. Information and Communication Technologies (ICT) skills have become a key element to facilitate employment opportunities. The growth in female educational attainment and ICT use is closing the gender divide and favouring female employment. We present evidence on this for the Spanish labour market using: a) a dynamic labour demand function; and b) analyzing the main factors explaining probabilities of finding a job based on traditional characteristics that affect employability and others related to ICT use. We develop this analysis for total population and distinguishing men and women using a Heckman model.

Keywords: Digital gender divide, Information and communication technologies (ICT), Education, Labour demand

JEL Codes: J16; J23; I24

1. Introduction

Strong support from central and regional governments currently exists to spread the use of new technologies in households. This paper focuses on the effect of the generalization of new technologies in residential use as a basic complement of education and on the ability of the members of the household to find and keep a job. A positive relationship between basic ICT skills and ability to find a job is expected, based on an argument equivalent to the one that explains the well supported positive relationship between education and the probability of finding a job. This is due to the fact that the generalization of the use of new technologies pushes private and public employers to require greater knowledge from their potential employees.

The article delves further into the empirical foundations of this relationship and proposes a two pronged approach to analyse it. The first approach performs an analysis of the relationship between ICT and labour, distinguishing between female and male workers by industry. In a second approach, we estimate a model aimed at explaining the probabilities of an individual finding employment depending on her individuals' characteristics generally accepted as employability determinants, such as education levels or gender, and other characteristics linked to basic computer literacy. Evidence of the two way reinforcement among education attainment and ICT use has been discussed by previous literature (see Campbell, 2001), and both elements effect on labour outcomes, mainly wages, analysed (see Borghans and ter Weel, 2005). We

refocus this perspective by analysing the importance of these on the probability of finding a job and a differential in the impact of these factors on employment outcome depending on the individual's gender. The use of new technologies has transformed the role of labour within the productive process and we find two main reasons that could lead to the use of ICT having a stronger positive effect on women's employability with respect to men. In some ways, it could be argued that the use of new technologies reduces the physical strength requirements for most tasks, with a potential positive effect on women labour demand (see Stanworth, 2002). On the other hand, the use of new technologies boosts labour networks and the execution of multiple tasks, leading to a labour organization that better matches women's specific characteristics. We use data of the Survey on ICT Equipment and Use in households (*Encuesta sobre Equipamiento y Uso de las TIC en los Hogares*), SICTH onward, available from 2002, however we avoid the effect of the crisis by considering data until the last pre-crisis period, 2006.

The proposed analysis does not have precedent in Spanish literature, even though some papers have been published on the relationship between technology and employment, our analysis is innovative in a number of issues. We provide evidence on the relation between increasing technology and the share of female employment at industry level. The sectors that introduce computers and other technology at a faster rate seem to increasingly hire women. This is particularly interesting in terms of reducing the economic and social gender gap and would suggest new technologies contribute to develop sectors with a traditionally strong female presence as well as allowing female workers to enter occupations previously restricted to them. From the individual perspective, our study works with household data to approach individual basic ICT literacy and computer facilities and analyse its effects on the probabilities of finding a job. We likewise consider that, as is the case for education and training, ICT skills exert a differential effect on men and women. The magnitude of this effect is of great interest for active unemployment programs, both for new entrants in the labour market and, particularly, for those older individuals who have been laid off and want to return to work. We perform the analysis using a Heckman model that controls for the difference between those individuals not working because they do not participate in the labour market and those individuals willing to participate in the labour market who, however, cannot find a job.

The paper is organised as follows: Section II reviews the related literature, Section III introduces a sectoral analysis of job demand differences per gender, Section IV explains the theoretical model and discusses the data, Section V shows and discusses the results and, finally, Section VI provides a summary of our findings and our conclusions.

2. Previous Literature on ICT and Employability

ICT and general access and use of technology are assumed to be highly positive for both individuals and economies in generating productivity gains and increasing

income. There is extensive literature on the digital divide and how the gap in opportunities for individuals, firms, industries or regions to access ICT (and related technologies) can influence their economic and social status (Campbell, 2001; Fink and Kenny, 2003). In the same way that the digital divide between countries is a source of preoccupation for researchers and policy makers, the digital gender divide¹, or gap in ICT use between men and women, is starting to receive a similar attention (Castaño, 2005; Fink and Kenny, 2003, Korupp and Szydlik, 2005; Gargallo-Castel, Esteban-Salvador and Pérez-Sanz, 2010; Cantos, 2013). While ICT use can impact a number of economic and social aspects, its effect on labour market gender differences is still in need of further research. Several channels are possible: ICT use can improve access to some occupations previously restricted to male workers (as men were traditionally the first to use new technologies), can combine favourably with other female characteristics (such as net working), and it promotes teleworking (that allows for better work-life balance), and online job searching, etc.

Our aim is to provide a complete analysis of the relationship between ICT and labour market outcome. In order to do so we propose a double approach, combining the sectoral and the individual perspective. We now review previous literature on both approaches.

Within the first approach, we perform a sectoral analysis of the relationship between employment and technology from a gender perspective for the Spanish labour market. The impact of technology on employment has been analysed from different perspectives, both theoretical and empirical. However it is not possible to find generally accepted conclusions, since the effect depends on other aspects, including firm strategies, applied economic policies, productive structure characteristics or the nature of labour relations (Castells, 1998). The technology appropriation mechanism, depending on whether the technological effort is performed by a sector or acquired in the market, is likewise one of the factors that affect the relationship (Calderón *et al.* 2009).

The type of innovation, process or product, further conditions the effect on employment, but the direction is undefined (OECD, 1996). Firms that introduce process innovations improve their productivity, but at the expense of reducing its own direct employment. On the other hand, the introduction of new products allows firms to employ new workers, but it does not necessarily lead to increasing productivity. Moreover, changes in production organization have allowed many industrial firms to move workers to the service sector. These processes that combine employment destruction together with employment creation are the ones that make it difficult for researchers to obtain conclusive results (Castaño, 1994).

The relationship between innovation and worker qualification level is not clearer. In some cases, technology entails task simplification and responsibility reduction, leading to worker disqualification. In other situations, innovations require highly qualified workers, able to handle new techniques and adapt to changes. Worker acquired knowledge has a positive effect on productivity since it allows workers to make a

¹ Two types of digital divide can be distinguished (Gargallo-Castel *et al.*, 2010, p. 121): First digital divide (related to the gap in access) and second digital divide (gap in quantity and access of ICT use).

better use of installed technology. In this sense, ILO (2001) admits that ICT introduction has a stronger effect on qualified employment, since these technologies develop: net work, hierarchy reduction, workers responsibility and remuneration according to performance. ICT introduction leads to the appearance and disappearance of some occupations and these changes modify employment structure.

The effect of technology on labour has been analysed for the Spanish economy from other perspective. García, Henández and López (2002) find a negative, though small, effect of process innovation on employment and a positive effect of knowledge stock, for the period 1991 to 1998. Llorca and Gil (2002) conclude that process innovations have a stronger positive effect on employment than product ones. Finally, Aguirregabiria and Alonso-Borrego (2000) estimate the impact of technology on labour qualification for Spanish industrial sectors between 1986 and 1991. They differentiate between research and development (RD) expenditure and investment in technological capital, and find that both variables reveal a positive relationship between innovation and qualified employment, although it is stronger for technological capital. Empirical works on the aforementioned questions for industries and firms analyses achieve mixed results.

In relation to its differential effect on female compared to male employment, computerization has been linked to an increase of qualified employment in Spain (see Castaño (2005) for service sectors analysis). The introduction of this kind of technologies tends to destroy industrial direct employment, mainly male, and to create indirect work in service sectors, where women are mainly located. Section 3 develops a model to analyse the effect of technology introduction on employment and consider the differences in terms of gender.

We now turn to the individual outcome perspective. Extensive research into the effect of qualification can be found among the studies that analyse the relationship between an individual's characteristics and her labour outcome. Education is a main determinant and as such it has received major attention in applied studies. The most examined relationship is the one between education and earnings, where the positive relation is well proven (see, for example, Caparrós *et al.*, 2010, or Fabra and Camisón, 2009, for the Spanish case). Within this topic it is interesting to review the gender differences in returns to education in term of earnings, where higher schooling coefficients are found for females, as is the case for Dougherty (2005) results and for his detailed literature revision on the topic, where he finds a similar result for 24 out of 27 reviewed papers. The author explains the higher coefficient of positive side-benefits of schooling for females, as reducing the male-female wage differential 'attributable to factors such as discrimination, tastes and circumstances' (*Ibid.*: p. 980). Among the papers devoted to the analysis of employment probabilities and education a sophisticated dynamic model has been proposed by Eckstein and Lifshitz (2011), which find that years of schooling is the main factor behind the improvement in female employment rates. This result is also found where more specific information on individual abilities is considered. In this line, a positive relationship between individual's skills and labour market outcomes, finding a job and earning a higher

salary, appear in Vignoles, De Coulon and Marcenaro-Gutierrez (2011) for the United Kingdom or Albert Verdú, Toharia Cortés and Davia Rodríguez (2008) for Spain (focusing on young individuals). Both studies also differentiate the value of that effect depending on the individual's gender; we will develop a similar analysis in our application. Finally, the effect of education on gender equality was analysed by Caprile and Serrano (2001) for 12 European countries, where a positive relationship was found among education level and employment equality that is likewise shaped by institutions.

Among the articles that investigate other determinants that, together with education, explain individual employment propensity, we find that they mainly seek to analyse the efficiency of job training programs as active labour market policies, as in Andrén and Andrén (2006) or Card *et al.* (2011). Andrén and Andrén analyse the effect of vocational training offered by the Sweden government on individual employability whereas Card *et al.* consider a training program focused on low income youths with less than secondary education in the Dominican Republic. Common controls in this type of studies are gender, education level, age or place of residence. Generally, findings point to a positive relationship between probability of finding a job and being a man, having a higher education level and other factors related to training.

Our paper contributes to the topic by considering the importance of familiarity with ICT to the individual's probability of finding a job. We are not aware of any empirical work on this specific topic to date. Different papers on ICT provide several focuses, such as the effect of ICT on job characteristics or wage structure, as in Krueger (1993), Bresnahan (1999), or DiNardo and Pischke (1997). These papers find a positive relationship amongst the use of new technologies and wage improvements, which indicates higher productivity for workers that use them. Our research analyses whether workers that are familiar with ICT are also more attractive for employers and, as a consequence, have higher probabilities of finding a job. Papers on this relationship are less common. Among those, employment opportunities for individuals taking specialised ICT training courses are more popular in literature, but that is not the case for basic ICT skills, those skills that are nowadays mainly learned without formal training and consist of the execution of tasks useful for a wide range of jobs. Walton, *et al.* (2009) examines ICT skills and employment in the context of a transitioning economy and delves into the ICT level required to increase employment probabilities. They find that even 'simply using technologies in an occasional, exploratory way could have some positive effect on employability' (*Ibid.*: p.8).

The relationship between ICT and gender characteristics of a job has been previously discussed in the literature. Castaño *et al.* (1999) considers that the use of ICT has, among its most remarkable effects, the potential: a) To reduce the importance of physical or manual effort and to lower physical risk; b) To reduce direct employment (traditionally male) and increase indirect one (traditionally female); c) To increase the qualification requirements, a clear advantage for Spanish women who are increasingly qualified; d) To allow for more flexible work schedules, together with a generalization of work from home, which favors women incorporation to the labour

market; e) To help the generalization of networks, allowing delocalization and promoting collaborative work, which is positive for women; f) To increase labour growth in service sectors (both qualified and nonqualified) and to reduce it in industrial ones, where the first is traditionally female and the second male. From the empirical perspective, Moore *et al.* (2008) analyse this topic by gathering information from female ICT professionals in the UK and conclude that a 'future demand for 'soft' styles of management, for hybrid workers working with people as well as with technical skills, and for communication skills in ICT user support work' is expected, which points to opportunities to work improving for women with ICT skills (*Ibid.*: p. 538). In our application, we investigate the relationship between ICT basic skills returns and probabilities of finding a job and look for a differential effect for males and females.

3. Technology, Employment and Women

During our period of study (1995-2006), a significant increase in the number of women entering the labour market (2,800,000 women for 2,400,000 men) took place. We here discuss the employment structure in Spain focusing on gender differences and develop the model to explain changes that occurred during the period. The characteristics of that female labour are described in Table 1. In the main, female workers are employed in Trade, Manufactures, Health, Business services, Education, Hotels and restaurants, Domestic services and Public sector. Compared to their male counterparts, higher percentages of women work in Health, Education, Trade, Hotels and restaurants and Domestic services, while they are underrepresented in Building, Manufactures, and Transport and communications, which can be considered as 'male' industries.

When focusing on the education level obtained, female workers show an overall higher percentage of upper secondary qualifications and university and doctorate degrees. This is consistent with a dual labour market for women: low-qualification (temporary, low-wage) jobs and high-qualification (service, medium-high wage) jobs. This last type will include most women employed in Health and Education, where they are the majority, but also for the few women working in Electricity, gas and water, Building, Transport and communications, and Finance. In order to reach better jobs and to enter 'male' sectors, women need higher qualifications. Traditional 'female' sectors such as Health (where there are three female workers for each male) and Education (women almost double men) require university degrees or upper secondary qualifications to a great extent. On the other hand, other 'female' sectors, such as Domestic services (9:1 ratio of female/male), and sectors with a large number of female workers, such as Hotels and restaurants, require lower qualifications but labour and work conditions are usually far worse. Another important aspect in terms of education attainment is age. Younger female workers are more qualified than their male counterparts up to 45 years old, while the share of male workers with upper secondary qualifications and university and doctorate degrees is higher compared to women for workers over 45. The younger generation of women entering the labour market in the last 25 years is highly qualified to a greater extent than men.

Table 1: Labour force by industry, sex and education level in Spain, 2003

	Thousand people										% per education level							
	Total		Primary + no education		Compulsory secondary		Upper secondary		University + doctorate		Primary + no educat.		Compulsory secondary		Upper secondary		University + doctorate	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
TOTAL	11199.1	7622.9	2595.0	1297.6	3586.1	2017.8	2162.5	1676.7	2855.5	2630.8	23.2	17.0	32.0	26.5	19.3	22.0	25.5	34.5
A Agriculture	723.6	338.3	360.2	175.7	243.4	114.0	73.2	30.1	46.9	18.5	49.8	51.9	33.6	33.7	10.1	8.9	6.5	5.5
B Fishing	45.0	8.2	14.6	3.8	20.5	2.4	4.6	0.7	5.4	1.3	32.5	46.3	45.5	28.7	10.2	8.5	11.9	16.2
C Extractive	61.2	5.3	15.5	0.4	25.5	0.3	10.9	1.8	9.4	2.7	25.4	7.6	41.6	5.7	17.8	34.3	15.3	51.9
D Manufactures	2351.7	849.1	509.4	138.1	846.3	314.7	446.1	169.7	549.9	226.6	21.7	16.3	36.0	37.1	19.0	20.0	23.4	26.7
E Electrit., gas and water	87.2	17.0	16.8	1.2	21.0	2.2	16.0	3.7	33.4	9.9	19.3	6.9	24.1	13.0	18.4	21.8	38.3	58.5
F Building	2054.7	125.7	675.4	12.4	870.2	28.4	272.6	35.7	236.6	49.3	32.9	9.9	42.4	22.6	13.3	28.4	11.5	39.2
G Trade and repair	1500.9	1375.1	312.7	223.9	522.7	487.8	380.4	359.4	285.2	303.9	20.8	16.3	34.8	35.5	25.3	26.1	19.0	22.1
H Hotels and restaurants	573.9	620.2	154.2	163.2	228.2	253.7	116.1	124.6	75.6	78.7	26.9	26.3	39.8	40.9	20.2	20.1	13.2	12.7
I Transport and commun.	851.8	232.3	201.4	12.7	287.5	39.1	190.7	75.5	172.2	105.1	23.6	5.5	33.8	16.8	22.4	32.5	20.2	45.2
J Finance	260.3	154.8	8.5	7.0	31.5	13.8	90.5	47.0	129.8	86.9	3.3	4.5	12.1	8.9	34.8	30.4	49.9	56.2
K Business services	739.8	748.3	60.3	118.2	124.8	163.5	149.1	161.8	405.6	304.9	8.2	15.8	16.9	21.9	20.2	21.6	54.8	40.8
L Public sector	713.9	462.7	92.3	36.1	144.6	70.1	209.6	123.8	267.4	232.6	12.9	7.8	20.3	15.1	29.4	26.8	37.5	50.3
M Education	358.3	646.6	12.0	31.1	17.0	36.1	27.6	56.4	301.8	523.0	3.3	4.8	4.7	5.6	7.7	8.7	84.2	80.9
N Health	271.1	789.3	20.6	70.4	32.3	106.5	43.0	197.9	175.4	414.6	7.6	8.9	11.9	13.5	15.9	25.1	64.7	52.5
O Other social services	354.4	398.1	69.0	48.8	96.0	104.0	81.2	120.4	108.2	125.0	19.5	12.3	27.1	26.1	22.9	30.2	30.5	31.4
P Domestic services	50.9	439.4	23.8	170.6	16.4	155.9	7.9	79.6	2.8	33.4	46.8	38.8	32.3	35.5	15.5	18.1	5.5	7.6
Left his last job 3 or more years ago	72.8	192.5	29.0	49.1	22.1	70.5	13.2	42.4	8.6	30.4	39.8	25.5	30.4	36.6	18.1	22.0	11.8	15.8
Looking for first job	127.1	219.3	19.6	34.8	36.3	55.1	30.1	46.2	41.1	83.2	15.4	15.9	28.6	25.1	23.7	21.1	32.3	37.9

Source: INE, EPA. Average for 2003

Table 2: ICT use by gender, age, education level and relation to labour market in Spain, 2004-2011

	% people using a computer in the last 3 months			% people using Internet in the last 3 months			% people doing on-line shopping in the last 3 months		
	2004	2006	2011	2004	2006	2011	2004	2006	2011
All	49.0	54.0	69.3	40.4	47.9	67.1	5.5	10.1	18.9
Men	54.0	57.9	72.0	44.9	51.5	69.8	7.2	12.2	21.4
Women	44.1	50.1	66.5	35.9	44.2	64.4	3.8	8.1	16.4
16 to 24 years old	82.7	86.6	95.5	75.5	82.8	95.0	6.3	13.1	21.7
25 to 34 years old	67.0	72.6	89.5	57.6	66.7	87.8	10.1	16.9	30.2
35 to 44 years old	55.7	63.6	81.6	43.9	54.3	79.0	6.7	12.4	23.4
45 to 54 years old	40.4	47.5	68.0	29.7	39.6	65.1	4.1	7.6	16.2
55 to 64 years old	20.6	23.3	41.3	13.7	17.9	37.7	1.5	3.9	9.2
65 to 74 years old	5.5	7.5	16.9	3.0	5.0	15.6	0.2	0.6	3.0
Illiterate	0.1	1.8	4.7	0.1	0.0	2.2	0.0	0.0	0.0
Primary Education	11.5	15.8	30.3	6.7	11.9	27.6	0.3	0.7	2.9
Compulsory Secondary Edct.	37.3	45.0	65.9	26.4	37.1	62.7	2.0	4.3	10.8
Upper Secondary Edct.	72.4	75.5	85.5	61.2	66.7	83.3	6.9	13.7	21.7
Higher Vocational Edct.	78.9	80.4	92.7	64.7	71.5	90.5	9.1	14.8	30.5
University and Doctorate	89.6	91.2	95.7	83.1	87.9	95.1	16.5	26.9	39.6
Other Education	27.2	15.2	36.4	26.1	15.2	36.4	0.0	0.0	0.0
Employed	61.7	67.0	83.3	50.3	59.7	81.1	7.9	13.8	25.8
Unemployed	43.2	46.9	68.2	37.4	40.8	65.0	2.8	6.9	12.5
Students	95.4	97.1	99.1	89.9	94.7	99.2	7.5	15.1	25.4
Housewife	14.7	20.3	32.6	9.1	14.5	29.4	0.7	1.7	5.8
Pensioner	8.7	10.4	23.4	5.9	7.3	21.8	0.6	1.1	3.9

Source: INE, Survey of ICT equipment and use in households

We have explained this ‘education level’ variable by industry and gender as the use of ICT is highly related to education attainment as well as age. This is shown by the Survey on ICT Equipment and Use in Households (INE, see below) and summarised in Table 2. ICT use increases with the level of education and decreases with age for both men and women. Even though men use ICT more than women as a whole, the gap is quickly decreasing, particularly for younger individuals.

Using these data, we will try to shed some light on two possible hypotheses. At industry level, we would expect female workers to be increasingly employed in sectors where ICT are highly used. At an individual level, women should be better equipped to find a job when they are knowledgeable and capable of using ICT. We seek to explain in turn the theory behind the equations employed to test these hypotheses in the following subsections.

Analysis by Industry.

This section considers the theoretical models that develop both the sectoral and the individual models to analyse the relationship between ICT and employment. We start by developing the sectoral analysis. We therefore pursue two different empirical approaches. In the first, we follow Hubert and Pain (1999) and Piva and Vivarelli (2003), and estimate a dynamic labour demand function from a production function using sectoral and aggregated data. The second line estimates an equation to determine those factors that explain the differences in the percentage of men and women by sectors, as in Kongar (2005). This author focuses on the effects of trade openness on female labour, while we concentrate on the effect of technology and ICT.

In theoretical terms, the equation to be estimated is developed from a profit maximizing firm first order condition in perfect competence, so that marginal product for each factor equals its real price. Piva and Vivarelli (2003) start from a CES production function as $Y = A[(\beta K)^{-\rho} + (\alpha N)^{-\rho}]^{(1/\rho)}$ where Y is production, K is capital stock, N is employment, A reflects Hicks’ neutral technical change, α and β are technical parameters and $0 < \rho < 1$. The following expression is obtained by solving the first order condition (amount of labour that maximizes profits), taking logs and rearranging terms:

$$n = y + \sigma w - (1 - \sigma) \ln \alpha \quad (1)$$

where $\sigma = 1/1 - \rho$ is the capital labour substitution elasticity.

This is a static or long-run relationship among the considered variables, which can be augmented by adding variables that represent technology introduction. In doing so, we will be analysing whether the use of technology (that can be measured in a number of ways: RD expenditure, capital stock, RD stock, RD results such as patents, etc) increases or decreases employment. While we expect a positive sign for output (the greater production, the more employment is required) and negative for wage (the cost of hiring workers), the results for technology variables are far less clear and require empirical analysis. However expression (1) precludes the existence of dynamic relationships among these variables. The above expression can dynamise panel data as shown by Piva and

Vivarelli (2003) or Cadarso, Gómez, López and Tobarra. (2008), where the studies aimed to analyse the effect of technological improvements or organizational changes due to production defragmentation respectively. Following these authors, our equation will be transformed as:

$$n_{it} = \alpha_0 n_{it-1} + \alpha_1 y_{it} + \alpha_2 w_{it} + \alpha_3 inno_{it} + (\varepsilon_i + u_{it}) \quad (2)$$

for $i = 1, \dots, N$ sectors and $t = 1, \dots, T$ years or periods, where lower case letters represent logs, n is employment, y is production or value added, w is labour cost, $inno$ represents the different technological variables that may be introduced in the equation. u represents sector specific effects that remain in time, and ε is the residual in econometric terms.

The second proposed empirical line seeks to identify factors that explain differences in the women to men ratio of employees per activity sector, where the proposed estimation is based on the following equation:

$$\% \text{ Employed Women}_{it} = \alpha_0 (\% \text{ Employed Women})_{it-1} + \beta X'_{it} + \varepsilon_i \quad (3)$$

where X matrix includes variables that are expected to influence that rate, including the generally required qualification in a sector, its trade openness, its competence degree, technology use, etc.

This equation resembles the relative labour demand equations used to explain changes in employment structure in terms of qualified and unqualified labour. Empirical literature here finds that technological innovation pushes labour demand qualification, as in Berman, Bound, and Griliches (1993), Machin and Van Reenen (1998) or Aguirregabiria and Alonso-Borrego (2001) for Spanish data.

We also consider a differenced estimation of the previous expression, as in Kongar (2005):

$$\Delta(\% \text{ Employed Women}_{it}) = \beta \Delta X'_{it} + \varepsilon_i \quad (4)$$

The differenced estimation can explain the effect in terms of percentage variation of employed women in a sector of a percentage variation of the considered explanatory variables.

As regards the data used, most are provided by the Spanish National Statistics Institute (INE in Spanish): employment disaggregated by gender and activity sector (and by achieved education to build the education variable ‘% employed with secondary or above studies’, included in X) comes from the *Active Population Survey* (EPA in Spanish), mean monthly earnings by gender and sector come from the Survey on Industry and Services wages and from the *Structural Wages Survey*, these data have been deflated. The output (gross value added or GVA), the GVA deflator used, and profits relative to value added (‘gross operating surplus and mixed revenue EBE / GVA’) by industry were taken from National Accounting. Expenditure on RD comes from *RD Activities Statistic* (also deflated). The source for the capital variables is ‘Capital stock and services in Spain 1964-2003. New methodology’, by IVIE and BBVA Foundation (it is calculated using

two variables; ‘Productive capital stock, office machinery and computational equipment (thousand € 1995) / total employed’ and ‘Any other capital/ employees’ for each sector).

The use of ICT and employment opportunities

We will now search for the adequate model to analyse the topic of interest from the individual’s perspective, that is, whether familiarity with ICT, together with other personal characteristics, helps the probability of finding a job.

In order to analyse the effect of the education level and the use of new technologies on the probability of finding a job for any individual and, subsequently, to analyse whether such effect differs for men and women, we propose to work with the following standard labour economics model:

$$pr(y_i = 1) = \beta' X_i + \alpha' ICT_i + \mu_i \quad (5)$$

where the dependent variable measures the probability of a person being employed, X is the vector of the personal characteristics, ICT contains information on the degree of individual familiarization with the use of information and communication technologies and μ is the error term. The dependent variable $Pr(y_i = 1)$ is nonobservable; however it is possible to observe the dichotomy variable y_i that takes value 1 if the individual is employed and value 0 if not.

Although there are many attributes that affect individual employability, we shall concentrate on those that are collected in the SICTH database. This database gathers information on individual, general characteristics that are considered to have a strong impact on individual employability (referred to as ‘general’ in this paper), and included in X , together with other specific information pieces, which we named ‘ICT specific’, that collect information on the degree of familiarization of the individual with ICT and expressed as such in Equation 5.

The individual’s education level and gender are included in the general group. The education level indicates the educational degree achieved and, relating to it, individual productivity. Human capital theory points to education level as a determinant of worker productivity. Main stream economics consider the higher the education level the worthier the individual’s contribution to the production process is; what this implies for our study is that firms consider more educated workers as more appealing to contract. The parameter on individual gender will show whether there is discrimination in the labour market: if two individuals, with a similar education level, and different gender, could have different possibilities of finding a job.

The hypothesis regarding the ‘ICT specific’ variables is that familiarity with basic ICT skills aids job finding, so that those individuals that have those skills will find a job more easily. According to the aforementioned human capital model, the use of ICT potentially improves work quality, which has been found in empirical studies to have a positive effect on wages (Krueger, 1993; Bresnahan, 1999; or DiNardo and Pischke, 1997). For the same reason, and from a labour demand perspective, the quick and general spread of these technologies in the Spanish production system leads employers to look for workers able to work with them. Investment in ICT out of total nonresidential Spanish investment rose from 22% in 1995 to 34% in year 2000 (Gómez, López and Tobarra, 2006).

This model might be impeded with sample selection problems if the whole of the population is considered to estimate Equation 5. That would mean ignoring the bias produced by the personal decision of whether or not to participate in the labour market. The decision to participate must be considered prior to the one of working. The lack of this previous analysis causes a problem of omitted variables, leading to biased estimators (see Mohanty, 2001).

To analyse the effect of the considered characteristics on the possibility of an individual finding a job, we must focus on those individuals that have decided to participate in the labour market, that is, on active individuals. Active individuals include those that are not working but want to find a job and those that already have one. Nonactive individuals include, according to INE, those that do not look for a job as they are studying, doing household chores, are retired or early retirees, receive financial help but do not practice any economic activity or, finally, for other reasons.

The chosen model takes into account the decision sequence explained in the previous paragraph. The value for the ‘employability’ variable can only be monitored for active individuals, which is reflected in the model by the use of two equations, one to reflect the individual’s employability and a further one, her participation in the labour market. In line with Heckman (1979) terminology, we use the term ‘substantial equation’ for the first one and ‘selection equation’ for the second. The substantial equation has already been discussed; via the second equation, the model considers that the individual’s decision to participate in the labour market depends on her personal characteristics and interpretation of her possibilities of finding a job.

The expression in Equation 5 shows whether better education or the familiarization with use of new technologies helps to find a job. This issue raises two further questions: 1) Does education improve the possibility of finding a job equally for men and women?, and 2) what happens in the case of the capability of using ICT? To answer these questions we must redefine each group in Equation 5 as:

$$pr(y_i^M = 1) = \beta_M' X_i^M + \alpha_M' TIC_i^M + \mu_i \quad (6)$$

$$pr(y_i^H = 1) = \beta_H' X_i^H + \alpha_H' TIC_i^H + \mu_i \quad (6')$$

In relation to the survey used, SICTH, it provides information about the extent to which individuals are familiar with ICT, information that we will use to analyse the possible link between this familiarization and the possibilities of the individual being employed. In the survey, there are seven variables that provide information on ICT use in households: whether the household has a computer, whether the household has access to Internet, whether the individual has used the computer in the last three months, whether the individual has accessed Internet in the last three months, whether the individual has taken a computer course (all the previous are binomial variables), the frequency of computer use (with four possible ranges), and, finally, the frequency of Internet access (idem). All the previous variables only provide us a partial view of the degree of familiarization that individuals have with new technologies: the parameters obtained for all variables, in the empirical application, would need to point in the same direction, in order for us to consider that our results are consistent and satisfactory.

Some other variables have been obtained from SICTH, including the individual gender, her qualification level available (illiterate, basic education, compulsory secondary education, upper secondary, nonprofessional higher education, university education) that, for some estimates, have been aggregated to four levels, (illiterate, low level education, medium level education and high level education), and for some others have been transformed in a dichotomy variable with value 1 when the individual had an education level higher than the mean (high-school), and 0 when education level was equal or lower than the mean. Other included variables are the individual age and whether they live in a provincial capital, a large municipality or a small one (variable resulting from the aggregation of the 5 levels shown in the survey). We have also included in the dataset a measure of the percentage of people employed in the province by gender for each province and year, taken from the Active Population Survey, [Encuesta de Población Activa in Spanish], which is also published by INE. The survey is available from 2002 to 2006, however the period considered covers only 2003-2006 due to changes in the survey structure.

4. Empirical Application and Comments

This section sets out and comments the results for both approaches. From the sectoral perspective, as a high rate of female employment created in the last years is qualified employment², our base hypothesis points to a positive effect of technology on the percentage of employed women. This effect would be more difficult to establish if, instead of focusing on the employment level, our research focused on wage differences (as is the case with most papers on qualified relative demand) due to the important wage discrimination still affecting Spanish female workers.

Fig. 1 shows how office machinery and computing equipment stock per employee has increased in all sectors, yet its growth is stronger in Electrical, electronic and optical equipment and in service sectors. When we compare these sectors with the ones where women have been predominantly concentrated, we observe a coincidence between periods of greater investment in office machinery and computing equipment with periods of both stronger periods of female employment, and an increase in the concentration of women, mainly in service sectors.

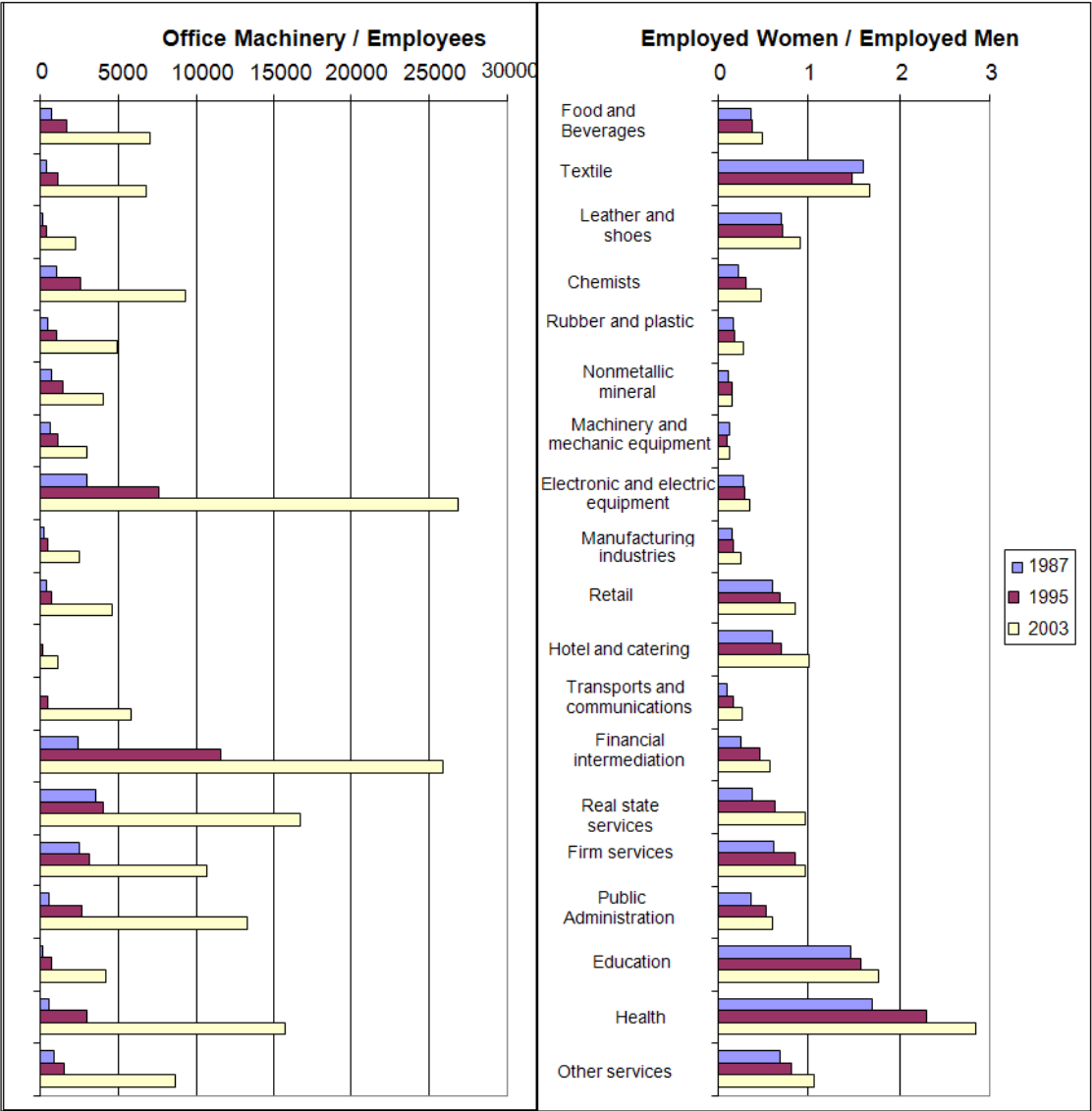
We perform two types of empirical estimations in order to analyse the sectoral relationship between technology and female sectoral employment, and the results are in Tables 3 and 4. Table 3 shows the estimation of labour demand for women (col. 1), men (col. 2) and relative labour demand (col. 3 and 4), following Equations 2 and 3 in text respectively. The estimation includes 24 industrial and service sectors where women are sufficiently represented, excluding education and health sectors, where there is no access to mean wages by gender.

In terms of the econometric technique, we use pooled OLS (within estimator). This estimation generates problems (due to the introduction of a lagged dependent variable among the regressors, as well as endogenous and predetermined variables). In a case such as this, we would prefer to employ an instrumental variable method, for example the difference (or even better, system) GMM technique. However, this requires a large

² According to Albert *et al* (2008), over 30% of women under 30 had a university degree in 2000, compared to 23% for men.

sample (particularly in cross terms), while we only have 24 sectors in our analysis. Furthermore, the validity of the GMM is dependent on first order autocorrelation. As we can see in the following tables, most of our regressions show no first order autocorrelation (AR (1)).

Fig. 1. Office Machinery and Computing equipment (thousand 1995 € per employee) and Employed women/ Employed men, selected activity sectors, 1987, 1995 and 2003)



Sources: INE and IVIE-FBBVA, own elaboration.

We find the expected signs for the standard labour demand equation terms: lag in the dependent variable, output and wage. However, wage is nonsignificant for female labour

demand. These variables indicate that there is a dynamic that determines the demand behavior in following years (lag in the dependent variable), output increases push labour requirements for firms in a similar way for men and women (this variable is significant in female and male regressions, but it is not in the relative labour demand expression), and how wage increases reduce labour demand although the coefficient appears as nonsignificant in two out of the three regressions. A relative wage variable has also been included in relative demand equations but it is nonsignificant in both cases. Our interest technological variable (RD expenditure/GVA) is nonsignificant in Columns 1 and 2; however it is interesting to note its positive sign for women and its negative one for men. When labour demand is estimated in relative terms the coefficient becomes significant (and positive) pointing to a positive relationship between technology and female labour demand in the analysed sectors. This appears to be the result of some type of substitution between male and female workers.

Table 3: Labour demand and relative demand, wage variables 1995-2003

Dependent variable	1. Employed women	2. Employed men	3. Employed women/ Employed men	4. Employed women/ Employed men
Dependent (t-1)	0.3756 (0.1102)***	0.6343 (0.0562)***	0.3185 (0.1375)**	0.3390 (0.1232)***
GVA	0.3359 (0.1348)***	0.2272 (0.0830)***	0.0507 (0.0753)	---
Wage	-0.3122 (0.2367)	-0.2127 (0.0991)**	0.0688 (0.1293)	---
RD/GVA	0.0281 (0.0264)	-0.0249 (0.0210)	0.0491 (0.0180)***	0.0604 (0.0155)***
Female Wage/ Male Wage	---	---	-0.3185 (0.2877)	-0.3232 (0.2702)
R ²	0.6205	0.6135	0.3671	0.3619
Wald (whole sig.)	66.35 [0.000]	202.6 [0.000]	78.42 [0.000]	76.20 [0.000]
AR (1)	1.457 [0.145]	0.291 [0.771]	1.026 [0.305]	0.749 [0.454]

Note: Within estimator; * for 10% significance, ** 5% and *** 1%. Temporal dummies in all estimations.

The results shown are calculated excluding sectors with strong female participation because of lack of wage data (as in Education, Health and Social Services). A new empirical application is proposed where all sectors are considered (disaggregated at 30), including primary, industrial and service sectors. The wage variable has been substituted by education, benefits and capital variables, more specifically Office machinery per employee that controls for the effect of the introduction of ICT on employment.

Table 4 shows main results of this analysis. The remaining standard variables, the lag and output, behave as in the previous expression. It is interesting to highlight the positive and significant effect of education on female employment (nonsignificant for men) and the negative effect (for both male and female) of capital per employee (where office machinery is not included). These results point towards mechanical capitalization having

a negative effect on employment, that is slightly stronger for women, and education having a positive effect on women. However, we also find that the Office machinery and computing equipment variable shows different patterns, negative and significant for men and positive, although nonsignificant for women. This pattern explains why when a relative demand equation is estimated, office machinery and computing equipment show a stronger positive link with relative female employment.

Finally, our results are consistent with the idea of a recent restructuring of employment, due to the massive introduction of ICT, that is particularly driving and advancing activity sectors with a strong female presence, as highlighted in previous studies for the Spanish (Castaño, 2005) and international (Weinberg, 2000) economies.

Table 4: Labour demand and relative demand, no wage variables, 1995-2003

Dependent variable	1. Employed women	2. Employed men	3. Employed women/ Employed men	4. Employed women/ Employed men
Dependent (t-1)	0.3977 (0.0811)***	0.5194 (0.0861)***	0.4866 (0.0635)***	---
GVA	0.2478 (0.0959)**	0.2116 (0.0468)***	-0.0713 (0.0435)	-0.0011 (0.0527)
Office Machinery/ Employee	0.0728 (0.0681)	-0.0315 (0.0167)*	0.0315 (0.0179)*	0.0724 (0.0342)**
Secondary Education	1.2459 (0.3599)***	0.2717 (0.1727)	-0.1023 (0.1452)	-0.0580 (0.1494)
Capital / Employee	-0.4324 (0.1497)***	-0.3116 (0.1127)***	-0.2024 (0.0735)***	-0.2052 (0.0845)**
EBE / GVA	-0.1033 (0.1694)	-0.0690 (0.0648)	-0.0226 (0.0778)	0.0606 (0.0673)
R ²	0.7258	0.8166	0.6476	0.1228
Wald (whole sig.)	220.1 [0.000]	782.1 [0.000]	566.4 [0.000]	12.33 [0.030]
AR (1)	2.221 [0.026]	2.127 [0.033]	0.679 [0.497]	-0.3379 [0.735]

Note: Within estimator; * for 10% significance, ** 5% and *** 1%. Temporal dummies in all estimations.

We now move to the application of our two stage Heckman model expressed in Equations 5, 6 and 6'. The application of the Heckman model requires, as commented in the theoretical model section, two different equations to be defined. The variables selected for the main equation are included in two groups. The first is the general group, which contains individual gender and the education level, both included as dichotomyc variables, with value 1 if the individual is a man and has an education level above medium level. The second group, the ICT one, includes all the variables regarding the use of the new technologies in SICTH: if there is a computer in the household, if the individual uses it, how frequently classified in two levels (very high for diary use and high when used weekly but not every day), if the household has Internet access, whether the individual accesses Internet and how frequently (as previous). According to this selection of variables, the 'base' individual is a woman, with an education level equal or below the mean and not familiar with the use of new technologies. The gender variable

coefficient reveals whether the individual would improve his possibilities of finding a job by being a man, whether the individual would improve her possibilities by improving her education level or becoming more familiar with ICT. A statistical description of these variables is shown in Table 5. The percentage of working men is around 24 percentage points higher than for women, and all technological variables also show higher values for men. Differences are higher in the “use” variables than in the “access” variables, and even more acute in the very high frequency variables. On the other side, the detailed education variables show a small but higher percentage of women that have achieved high education levels while the proportion is reversed for medium education levels. In low education levels percentages are again higher for women.

Table 5: Employability regression variables main statistics

	Total		Men		Women	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Working	0.449	0.497	0.581	0.493	0.344	0.475
Access to computer	0.445	0.497	0.474	0.499	0.422	0.494
Access to Internet	0.302	0.459	0.328	0.470	0.281	0.449
Uses Internet	0.373	0.483	0.427	0.495	0.330	0.470
Uses the computer	0.457	0.498	0.512	0.500	0.414	0.493
Computer course	0.351	0.477	0.350	0.477	0.353	0.478
Computer used very often	0.345	0.475	0.407	0.491	0.293	0.455
Computer used often	0.159	0.366	0.167	0.374	0.152	0.359
Internet access very often	0.239	0.427	0.295	0.456	0.191	0.393
Internet access often	0.174	0.379	0.186	0.389	0.165	0.371
Low education level	0.582	0.493	0.561	0.496	0.597	0.490
Medium education level	0.163	0.370	0.174	0.379	0.155	0.362
High education level	0.036	0.187	0.025	0.157	0.045	0.208

The variables included in the selection equation are those that are expected to affect the individual decision to participate or not in the labour market, and involve age, the squared age (to bring into play the fact that the individual’s possibilities to get a job increases with age until a threshold where it declines), gender, education level, the size of the town of residence and the employment rate for her gender and province. The positive relationship between labour market participation and education level has been found in empirical studies (see Hotchkiss, 2006 for US). Hotchkiss includes other variables that are found to be significant in order to explain differences in women participation rates, such as age (also in Fitzenberger, Schnabel and Wunderlich, 2004 for East Germany), civil state, race or macroeconomic unemployment rate. For Spain, Martínez-Granado

(2001) shows how women participation rates also depend on (expected) wage, on other income sources in the household and on the existence of children. The survey used in this paper does not contain information on those variables. Our analysis cannot consider such a wide range of individual characteristics and we therefore focus on those variables of interest that reflect the situation in the Spanish labour market that are included in our dataset.

The specifications used in this research are the result of a selection process. This process compares specifications with different variables selection in the main equation or the selection one, in order to try to improve (reducing its absolute value) the statistic ‘likelihood ratio’, which is shown in Table 6 as a measure of the suitability of the model. The database used in the empirical application combines data from the 2003, 2004, 2005 and 2006 survey, and temporal dummies have been included in all the regressions in order to control the possibility of structural change between years.

We start by analysing the effect of the general and ICT characteristics on the individuals’ employability, with no attention to gender, results shown in Table 6. We will also analyse whether the labour market values the personal characteristics for men and women in a different way, with the results being shown in Tables 7 and 8.

The results in Table 6 show how it is more difficult for women to find a job, according to the variable gender coefficient. The possibilities of finding a job are from 9 to 10% higher for men than for women, independently of the level of education or any other of the considered characteristics. The used dataset does not include information on the individual previous labour experience, occupation or profession that could explain the differences in the probabilities of a man and a woman finding a job, which could lead to explain part of this identified discrimination.

Table 6. Employability of ICT users. Pooled regression for males and females

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gender	0.08848 (0.000)***	0.09455 (0.000)***	0.09157 (0.000)***	0.10090 (0.000)***	0.10185 (0.000)***	0.09233 (0.000)***	0.10103 (0.000)***	0.09583 (0.000)***
High or above education	0.08497 (0.000)***	0.07966 (0.000)***	0.07569 (0.000)***	0.08216 (0.000)***	0.08251 (0.000)***	0.08229 (0.000)***	0.07281 (0.000)***	0.08459 (0.000)***
Access to computer		0.04210 (0.000)***						
Access to Internet			0.04594 (0.000)***					
Uses Internet				0.03602 (0.000)***				
Uses the computer					0.03642 (0.000)***			
Computer course						0.01315 (0.005)**		
Computer used very often							0.10640 (0.000)***	
Computer used often							0.03050 (0.000)***	
Internet access very often								0.07406 (0.000)***
Internet access often								0.03190 (0.000)***
No. of observations	77688	77688	77681	77669	77667	70237	69398	67445
Goodness	-50761.9	-50705.9	-50697.8	-50722.6	-50721.4	-42183.4	-41004.9	-39345.7

Note: All regressions include time dummies. * is for 10% significance level, ** for 5% and *** for 1%,

The importance of the education on the employability of the individuals can be observed in all the columns in Table 6. The coefficient shows that an individual with an education level above the mean, as well as those individuals that have finished the second stage of high-school, superior vocational education or university, have higher probabilities of finding a job than those individuals with only first stage of high-school or lower education completed. The probabilities of finding a job increase between 7 and 8% with the improvement in the education level, pointing to the capacity of the labour market to compensate the individual's training effort supporting the human capital effect.

The first column in Table 6 shows the results of a regression that only contains general variables. The following columns include the different ICT use variables. In general, we observe a positive coefficient in all the columns, pointing to individuals with familiarity to ICT having higher probabilities of finding a job, independently of gender or education level. The results show that employers consider familiarity with the use of computers as an incentive to hire a worker. Among these variables, the frequency of use of computers or Internet is the ones that show a higher coefficient. Computer and Internet access at home facilitates the acquisition of basic skills as accessing information through Internet, e-mails sending, word-processors or spreadsheets learning, all useful activities in most jobs, and our results show that these skills are also valuable for employers. We should also mention that Internet and computer users could benefit from higher improvements in job finding probabilities due to having skills in post searching or being able to improve their CV presentation (Campbell, 2001). The coefficients in the ICT variables show a high level of statistical significance (expressed as probability in the table).

The results of the estimations are for two groups, differentiated according to gender; as expressed in Equations 6 and 6'.

When comparing results for men and women, it can be observed how, for both education and ICT familiarization, the coefficients for women are higher than the ones for men in most cases, pointing to a higher reward for women than for men in terms of endeavor to improve qualifications or knowledge about new technologies. Improvements in education levels increase the possibilities of finding a job by about 5% for men, and around 7% for women. A possible explanation is that women try to overcome a perceived discrimination problem in the labour market by being more motivated students than males, although we would need information on student grade attainment to prove this. The differential in the education coefficient supports the fact that education is the best way to ensure a job for a woman and point in the same direction than Dougherty (2005) for returns to schooling in the United States for females. Men have probabilities of finding a job in sectors that do not require high education levels, as in most industries or in building. Women are concentrated in sectors such as Education and Health that require high educational levels, whereas women with low education levels have difficulties in finding a job outside the Domestic Service sector. The different variables providing information on ICT familiarization reveal, in most cases, a higher coefficient for women, pointing to employers attaching a higher value to the use of ICT for women than for men, or, for the self-employed, familiarization with ICT making the likelihood of success greater for women than for men. Some other research also support the existence of a differential coefficient for men and women, as in Vignoles *et al.* (2011) and Albert Verdú *et al.* (2008), or in Friedlander, Greenberg and Robins (1997) for job training.

Table 7. Employability of ICT users. Results for women

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High or above education	0.07683 (0.000)***	0.07437 (0.000)***	0.07014 (0.000)***	0.06674 (0.000)***	0.07061 (0.000)***	0.06617 (0.000)***	0.04002 (0.000)***	0.05740 (0.000)***
Access to computer		0.02975 (0.000)***						
Access to Internet			0.04559 (0.000)***					
Uses Internet				0.02736 (0.000)***				
Uses the computer					0.01951 (0.007)*			
Computer course						0.01188 (0.068*)		
Computer used very often							0.12754 (0.000)***	
Computer used often							0.02945 (0.002)**	
Internet access very often								0.08473 (0.000)***
Internet access often								0.04169 (0.000)***
No. of observations	43385	43385	43383	43376	40364	43383	39894	38975
Goodness	-24645.0	24632.3	-24616.1	-24623.9	-20563.7	-24616.1	-19820.3	-19032.8

Note: See table 6.

Table 8. Employability of ICT users. Results for men

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High or above education	0.05552 (0.000)***	0.04907 (0.000)***	0.04702 (0.000)***	0.05244 (0.000)***	0.05220 (0.000)***	0.06040 (0.000)***	0.05539 (0.000)***	0.06127 (0.000)***
Access to computer		0.04075 (0.000)***						
Access to Internet			0.03513 (0.000)***					
Uses Internet				0.02498 (0.000)***				
Uses the computer					0.03243 (0.000)***			
Computer course						0.01058 (0.049)*		
Computer used very often							0.05368 (0.000)***	
Computer used often							0.01775 (0.022)**	
Internet access very often								0.03997 (0.000)***
Internet access often								0.00987 (0.187)
No. of observations	34303	34303	34298	34293	34293	29873	29504	28470
Goodness	-22849.6	-22802.9	-22816.1	-22834.3	-22827.3	-18930.9	-18579.1	-17888.6

Note: See table 6.

Table 9. Employability, detailed education level analysis, pooled regression for males and females

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gender	0.12298 (0.000)***	0.12744 (0.000)***	0.12374 (0.000)***	0.13609 (0.000)***	0.13766 (0.000)***	0.13812 (0.000)***	0.14541 (0.000)***	0.14575 (0.000)***
Low education level	0.15881 (0.000)***	0.14856 (0.000)***	0.14975 (0.000)***	0.15745 (0.000)***	0.15232 (0.000)***	0.20079 (0.000)***	0.19560 (0.000)***	0.20608 (0.000)***
Medium education level	0.17528 (0.000)***	0.17064 (0.000)***	0.16757 (0.000)***	0.18158 (0.000)***	0.17913 (0.000)***	0.21071 (0.000)***	0.21696 (0.000)***	0.22852 (0.000)***
High education level	0.21032 (0.000)***	0.20333 (0.000)***	0.19921 (0.000)***	0.21481 (0.000)***	0.21356 (0.000)***	0.25177 (0.000)***	0.24853 (0.000)***	0.26760 (0.000)***
Access to computer		0.04503 (0.000)***						
Access to Internet			0.04850 (0.000)***					
Uses Internet				0.04186 (0.000)***				
Uses the computer					0.04297 (0.000)***			
Computer course						0.01145 (0.049)**		
Computer used very often							0.12261 (0.000)***	
Computer used often							0.03730 (0.000)***	
Internet access very often								0.08737 (0.000)***
Internet access often								0.03849 (0.000)***
No. of observations	77562	77562	77555	77543	77541	70111	69272	67319
Goodness	-51354.8	-51307.7	-51301.7	-51314.7	-51312.7	-42840.0	-41689.3	-40039.6

Note: See table 6.

The interpretation of the positive differential coefficient for women for ICT variables will be carried out following Krueger's (1993) analysis of the use of ICT in US firms and its effect on wage structure. Krueger shows how women and highly qualified workers had higher probabilities of using computers in the work place than men and less qualified workers.

Table 9 shows a deeper analysis of the relationship between the education level and individual employability, with education classified down to four levels, so that it is possible to observe the coefficient for three of them. It is possible to observe that an individual's probabilities of finding a job improve with education level, the higher the education level the higher the probabilities. The ICT variables have a profile similar to the one found in previous tables.

Results also show that a more detailed analysis of education does not reduce the positive differential for men probabilities of finding a job, as shown in the positive coefficient of gender. The positive value in education and ICT variables points to the increase in education levels and office automation knowledge as the best ways to improve job finding probabilities.

5. Conclusions

This paper analyses how the use of new information and communication technologies has modified job opportunities in Spain. The debate regarding the effects of information society on the labour market focuses mainly on the whole of the labour market or labour disaggregated at different qualification levels. Our analysis starts with a general analysis to then delve further in a differentiated study for men and women.

The gender differential analysis is carried out from two different perspectives. In the first, we prepare a sectoral approach and investigate how the introduction of ICT and other capital investments in service and industrial sectors affects male and female employment rates differently. We find that sector mechanization has a negative effect on both men and women, while ICT investment has a negative effect for male workers but a positive effect for female ones, which we interpret in terms of ICT introduction involving the establishment of jobs in firm involving characteristics deemed to be traditional female roles, including teamwork and cooperation, and the creation of jobs that are related to administrative work, also commonly considered as being a traditionally female realm.

In the second stage, we explore how ICT affects employability and perform our analysis from the point of view of the labour supply. A two stage Heckman model is used to analyse the possibilities of finding a job focusing only on those individuals that have decided to participate in the labour market. We again find that both general education and basic ICT skills increase the probabilities of finding a job, and that is more so the case for women than for men, pointing to a higher value attached to education and the use of ICT for women than for men. This can be explained by the far-reaching spread of new technology implying the appearance of tasks that require coordination and communication and not physical strength, which are more appropriate for women. It also suggests that policies aimed at increasing educational levels and at spreading domestic use of new technologies must be backed in order to improve individual employability.

Bibliography

- Aguirregabiria, V., Alonso-Borrego, C. (2001). "Occupational Structure, Technological Innovation and Reorganization of Production," *Labour Economics*, Vol. 8 (1), pages 43-73.
- Albert Verdú C., Toharia Cortés, L., Davia Rodríguez, M.A. (2008). "To Find or Not To Find A First "Significant" Job," *Revista de Economía Aplicada*, Vol. 16 (46), pages 37-60.
- Andrén, T., Andrén, D. (2006). "Assessing the employment effects of vocational training," *Applied Economics*, Vol. 38, pages 2469-2486.
- Berman, E. Bound, J., Griliches, Z. (1994). "Changes in the Demand for Skilled Labor with U.S. Manufacturing: Evidence from the Annual Survey of Manufactures," *Quarterly Journal of Economics*, Vol. 109, pages 367-398.
- Bresnahan, T. F. (1999). "Computerisation and wage dispersion: An analytical reinterpretation," *The Economic Journal*, Vol. 109, pages F390-F415.
- Borghans, L., ter Weel, B. (2005). How computerization has changed the labour market: A review of the evidence and a new perspective. In *The economics of the digital society*, ed. Luc Soete and Bas ter Weel, pages 219-247. Cheltenham: Edward Elgar.
- Cadarso, M.A., Gómez, N. López, L.A., Tobarra, M.A. (2008). "The EU enlargement and the impact of outsourcing on industrial employment in Spain, 1993-2003," *Structural Change and Economic Dynamics*, Vol. 19 (1), pages 95-108.
- Calderón, M. J., Gómez, N., López, L.A., Tobarra, M.A. (2009). "Patentes, proximidad tecnológica y empleo industrial en Castilla-La Mancha," *Revista de Estudios Regionales*, Vol. 85, pages 197-219.
- Campbell, D. (2001). "Can the digital divide be contained?," *International Labour Review*, Vol.140, pages 119-141.
- Caparrós Ruiz, A., Navarro Gómez, L., Rueda Narváez, M. (2010). "Endogenous wage determinants and returns to education in Spain," *International Journal of Manpower*, Vol.31, pages 410-425.
- Caprile, M., Serrano Pascual, A. (2011). "The Move Towards the Knowledge-based Society: a Gender Approach," *Gender, Work and Organization*, Vol.18 (1), 48-72.
- Card, D., Ibarrán, P., Regalia, F., Rosas-Shady, D. and Soares, Y. (2011). "The labor market impacts of youth training in the Dominican Republic," *Journal of Labor Economics*, Vol.29, pages 267-300.
- Castaño, C. (1994). *Tecnología, empleo y trabajo en España*, Madrid, Alianza Editorial.
- Castaño, C. (2005). *Las mujeres y las tecnologías de la información*, Madrid, Alianza Editorial.
- Castaño, C.; Iglesias, C.; Mañas, E., Sánchez-Herrero, M. (1999). *Diferencia o discriminación*; Consejo Económico y Social; Madrid.
- Castells, M. (1998). "La estructura social de la era de la información: la sociedad red," Tezanos, J. F. y Sánchez Morales, R. (eds.) (1998). *Tecnología y sociedad en el nuevo siglo*, Madrid, Editorial Sistema, pages 11-29.
- DiNardo, J. E., Pischke, J. S. (1997). "The returns to computer use revisited: Have pencils changed the wage structure too?," *The Quarterly Journal of Economics*, Vol.112, pages 291-303.
- Dougherty, C. (2005). "Why Are the Returns to Schooling Higher for Women than for Men?," *The Journal of human resources*, Vol.40, pages 969-988.
- Eckstein, Z., Lifshitz, O. (2011). "Dynamic Female Labor Supply," *Econometrica*, Vol.79, pages 1675-1726.
- Fabra, M. E., Camisón, C. (2009). "Direct and indirect effects of education on job satisfaction: A structural equation model for the Spanish case," *Economics of Education Review*, Vol.28: 600-610.
- Fink, C., Kenny, C.J. (2007). "W(h)ither the digital divide?," *info*, Vol.5: 15-24.
- Fitzenberger, B., Schnabel, R., Wunderlich, G. (2004). "The gender gap in labor market participation and employment: A cohort analysis for West Germany," *Journal Population Economics*, Vol.17, pages 83-116.
- Friedlander, D., Greenberg, D., Robins, P. K. (1997). "Evaluating government training programs for the economically disadvantaged," *Journal of Economic Literature*, Vol.35, pages 1809-1955.

- García, J., Henández, P. J., López, Á. (2002). "An Investigation of the relationship between job characteristics and the gender wage gap," Working Paper, May Universidad Pompeu Fabra.
- Gómez, N., López, L.A., Tobarra M.A. (2006). "Difusion y absorcion de TIC en la industria española," *Economía Industrial*, Vol.360, pages 117-130.
- Gargallo-Castel, A., Esteban-Salvador, L., Pérez-Sanz, J. (2010). "Impact of gender in adopting and using ICTs in Spain," *Journal of Technology Management & Innovation*, Vol.5 (3), 120-128.
- Gómez, N., López, L.A., Tobarra M.A. (2006). "Difusion y absorcion de TIC en la industria española," *Economía Industrial*, Vol.360, pages 117-130.
- Heckman, J. (1979). "Sample selection bias as a specification error," *Econometrica*, Vol.47, pages 153–61.
- Hotchkiss, J.L. (2006). "Changes in Behavioral and Characteristic Determination of Female Labor Force Participation, 1975–2005," *Federal Reserve Bank of Atlanta Economic Review*, pages 1-20.
- Hubert, F., Pain, N. (2001). "Inward investment and technical progress in the United Kingdom manufacturing sector," *Scottish Journal of Political Economy*, Vol.48, pages 134-147.
- International Labour Organization 2001. World Employment Report 2001: *Life at work in the Information Economy*. Geneva: ILO
- IVIE (2006). "El stock y los servicios de capital en España 1964-2003. Nueva metodología," Fundación BBVA Disponible en línea en la dirección http://w3.grupobbva.com/TLFB/tlfb/TLFBIndex_pub.jsp.
- Kongar, E. (2005). "Importing Equality or Exporting Jobs? Competition and Gender Wage and Employment Differentials in U.S. Manufacturing," University of Utah Working Paper, n° 2005-13.
- Korupp, S., Szydlik, M. (2005). "Causes and trends of the digital divide," *European Sociological Review*, Vol.21, pages 409-22.
- Krueger, A. (1993). "How Computers Have Changed the Wage Structure: Evidence from Microdata, 1984-1989," *Quarterly Journal of Economics*, Vol.108, pages 33-60.
- Llorca, R., Gil, S. (2002). "Innovaciones de producto, innovaciones de proceso y empleo. El caso de España," *Economía Industrial*, Vol. 348 (VI), pages 119-126.
- Machin, S., Van Reenen, J. (1998). "Technology and Changes in Skill Structure: Evidence from Seven OECD Countries," *Quarterly Journal of Economics*, Vol. 113, pages 1215-1243.
- Martínez Cantos, J. L. (2013). "Habilidades digitales y brecha de género en Europa (2007-2011)," *Revista de Estudios Empresariales. Segunda época*, Vol.2/2013: 4-28.
- Martínez-Granado, M. (2001). "Oferta de trabajo femenina en España:un modelo empírico aplicado a mujeres casadas," *Cuadernos Económicos de I.C.E.*, N.º 66, pages 129-152.
- Mohanty, M.S. (2001). "Determination of Participation Decision, Hiring Decision, and Wages in a Double Selection Framework: Male-Female Wage Differentials in the U.S. Labor Market Revisited," *Contemporary Economic Policy*, Vol.19 (2), pages 197-212.
- Moore, K., Griffiths, M., Richardson, H., Adam, A. (2008). "Gendered Futures? Women, the ICT Workplace and Stories of the Future," *Gender, Work and Organization*, Vol.15 (5), 523 – 542.
- OECD (1996). *Technology, productivity and job creation*, Paris, OECD (2 vols).
- Piva, M., Vivarelli, M. (2003). "Innovation and employment: Evidence from Italian microdata," Discussion paper no. 730, IZA (Forschungsinstitut zur Zukunft der Arbeit, Institute for the Study of Labour).
- Stanworth, C. (2000). "Women and work in the information age," *Gender, work and organization*, Vol.7, pages 20-32.
- Vignoles, A., De Coulon, A., Marcenaro-Gutierrez, O. (2011). "The Value of Basic Skills in the British Labour Market," *Oxford Economic Papers*, Vol. 63, pages 27-48.
- Weinberg, B. A. (2000). "Computer use and the demand for female workers," *Industrial and Labor Relations Review*, Vol.53 (2), pages 290-308.
- Walton, R., Putnam, C., Johnson, E., Kolko, B. (2009). "Skills Are Not Binary: Nuances in the Relationship Between ICT Skills and Employability," *Information Technologies and International Development*, Vol.5, pages 1-18.