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Labor demand and ICT adoption in Spain



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ABSTRACT

Spain is delayed in adopting information and communication technologies (ICT) and its productivity per hour worked presents a downward trend since the mid-90s. In this paper we argue that these two facts are related. Using the EU KLEMS dataset we test the capital-skill complementarity hypothesis in a cross-section of sectors in Spain. We find that the substitutability between workers and ICT assets falls as worker skill level rises, and that this feature holds across all sectors. Furthermore, the ICT assets are complementary with skilled workers. The fraction of workers employed with medium and high skills across sectors rose by 21% and 12%, respectively, to the disadvantage of low skilled workers, due to an adjustment within sectors more than to a composition effect between sectors. Finally, using a regression analysis, we conclude that some labor market institutions are likely behind the evolution of sectorial productivity and ICT investment in Spain.

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1. Introduction

Information and communication technologies (ICT), which have spread more rapidly and bolstered productivity more effectively than earlier technologies, have had a definite impact on the economy. Numerous studies have pointed to the special role played by these assets in the recovery of productivity growth since the mid-1990s in the United States and some European countries. Such a change implies an active adaptation process, as worker skills are changed to suit the new technologies and firms reorganize, replacing unskilled workers with others whose training and experience are appropriate to the new context.

ICT-driven changes have intensified the need for a skilled workforce, increasing both the demand for and the productivity of qualified workers and causing a rise in the relative wage of this group, especially in ICT-intensive countries such as the US, the UK and Sweden (Acemoglu, 2003; Autor, 2002). The fact that the price and the cost of ICT assets have fallen steadily worldwide during the past two decades—more intensely if we take quality adjusted prices into account—suggests a complementary relationship between these assets and highly skilled workers. On the other hand, the weight of low-skilled workers, who tend to concentrate in sectors where computers and information systems are used less intensively, such as construction or seasonal activities, has diminished.

In Spain, the composition of labor demand has changed as the use of ICT has risen across sectors. Mas and Quesada (2006) have shown that human capital employment has been stronger, the higher the intensity ICT assets have been used in a sector. Spain has used ICT assets less intensively than other OECD economies. In this sense, Spain is a good case study to help understand the capital-skill complementarity hypothesis, as there are sharp contrasts between sectors. Our aim is to

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estimate for Spain the elasticities of substitution between inputs, including workers of different skill levels and different assets (ICT and non-ICT). Using the EU KLEMS database, we can perform this estimation for a decomposition of 24 productive sectors between 1980 and 2005, comprising industrial activities and market services. This period has witnessed the main process of growth in recent Spanish history: the transition to democracy after a long dictatorship with a tightly intervened economy, the openness following Spain's EEC entry, and some crucial reforms which allowed the fulfilment of the Maastricht criteria and the early adoption of the Euro in 1999. Due to the limitation of EU KLEMS data, the period under consideration, notwithstanding, excludes the great recession starting in 2008 and still ongoing.

We reach the following findings. First, we show that changes in hours worked were motivated by adjustments within sectors, rather than adjustments between sectors: the percentage of workers employed with medium and high skill rose by 21% and 12%, respectively, while the employment of low skilled workers fell by 33%. Second, the degree of substitutability between capital and labor is lower the higher the skill of workers is. Specifically, for low skilled workers, the elasticity of substitution was 2.07 with respect to communications equipment, 4.07 with respect to computer hardware, and 5.98 with respect to computer and software licenses. For the medium-skill workers, the results indicate complementarity with communication equipment (-2.17), but substitute with hardware and software in a similar magnitude to that of low skilled workers. And for the high-skill workers, we find them complementary with all ICT assets. On the other hand, the elasticity of substitution of non-ICT capital assets with all workers, regardless of skill level, was 2.00. Finally, we find that the ICT assets are complementary between them, and substitutive with the non-ICT assets.

To our knowledge, this is the first paper that tests the capital-skill complementarity hypothesis for sectors in Spain, controlling for workers education and capital assets embedding different technological progress. Our findings do not differ much from those estimated for other countries: skills complement technology. Yet, the Spanish case serves as an experiment to test whether this hypothesis depends on the ICT intensity: we take the few sectors that use ICT intensely as a treatment group and the low intensive users as a control group, and conclude that the capital-skill complementarity still holds. Hence, we endeavor in identifying those restrictions that reduce firms' incentives to adopt new technologies. Several labor market and goods market institutions are natural candidates to help explain the existence of barriers to technology adoption (Gust & Márquez, 2004).

A second (complementary) explanation deals with the transformation of the sectorial composition occurred after Spain became an EEC member in 1986, and the liberalization followed by the Single European Act in 1987. Trade policies can have important effects on efficiency, measured as total factor productivity (TFP), and can change incentives for both domestic savings and foreign investment. The Spanish economy specialized in non-tradable activities, such as construction, real estate services or tourism, barely exposed to international trade competition. Trade and foreign investment liberalization changed Spanish firms' incentives to incorporate technology and, thereby, reap the gains in productivity (Delgado, Fariñas, & Ruano, 2002). Growth accounting exercises (Mas & Quesada, 2006) find that the Spanish economy shows notable inefficiencies, with negative TFP growth during the period 1985–2004. The ICT intensive sectors, however, reversed such a trend since 2000, with an upsurge in labor productivity, albeit most of these intensive sectors are non-tradable activities.

In Section 5, using a regression analysis, we consider whether institutional transformations and higher openness can provide a ground for the particular evolution of TFP and ICT investment across sectors in Spain. We find significant correlation of both variables with some labor market institutions: employment protection, the particular dual structure of the Spanish labor market, and the degree of centralization of collective bargaining. Some other indicators concerning the facility to trade in international markets are found correlated with ICT investment, but not with TFP growth. The temporary rate (i.e. the ratio of the number of wage earners under a fixed-term contract relative to the total number of workers) increased 23 percentage points during the period we study. While these fixed-term contracts tend to be associated with low skilled workers, according to the regression results, the 23% increase produced a TFP deceleration of 1.84% and accounts for a reduction in the ICT investment share of 5.87%.

This paper is structured as follows. In Section 2 we study the relationship between ICT and human capital in Spain. Using simple techniques, we decompose the changes in the fraction of workers employed for each category in two sources: intersectional and intrasectional changes. In Section 3, we propose a translog costs function to estimate the functions of input demand and different elasticities. We describe the evolution of relative input prices. The econometric results of this estimation are presented in Section 4. In Section 5 we use a regression analysis to explore which institutional elements are likely behind sectorial TFP and ICT investment in Spain. Section 6 finally concludes.

2. ICT, productivity and education

Several studies which include those by Jorgenson (2001), Colecchia and Schreyer (2002), Stiroh (2002), and Timmer, Ypma, and van Ark (2003) have confirmed the following: first, ICT assets accumulation in the European Union economies and the US over the past thirty years has risen more sharply than non-ICT asset; second, productivity growth has increased in parallel with the rise in ICT use; and third, ICT accounts for a considerable fraction of growth in countries where the use of this technology is more intensive.

The technological progress embodied in these assets can help explain this relationship between productivity growth and the intensity of ICT use (Rodríguez-López & Torres, 2012). For instance, a computer is a means of technology adoption, which translates into higher productivity. On the other hand, technological progress that incorporates traditional non-ICT assets is rather limited relative to ICT ones (Cummins & Violante, 2002).

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