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New technology and old institutions: An empirical analysis of the skill-biased demand for older workers in Europe

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ABSTRACT

Using panel data from nine European countries over the period 1970 to 2007, we examine the impact of information and communication technology (ICT) on the demand for older workers (aged 50 and over). We find evidence of a decrease in demand for older workers in the 1970s and 1980s. It can be argued that the impact of ICT on demand for older workers is skill-biased. However, the skill-biased demand for older workers is mainly reflected in the skill-biased changes in employment shares rather than relative wages. There is some evidence of a gradual deskilling of older workers. We find that labour market institutions such as the national minimum wage, social pacts on wage issues and union density mostly benefit skilled older workers, while coordination of wage setting, extension of collective agreements, social pacts on pensions and centralisation of wage bargaining can alleviate the adverse effects of skill-biased technological change.

1. Introduction

A number of existing studies have attempted to identify the determinants of the skilled-unskilled wage premium. Some studies have focused on the role of technology or skill-biased technological change (SBTC), especially the impact of information communication technology (ICT) (e.g., see Acemoglu, 1998 and Mallick and Sousa, 2017).[1] Using firm and industry level data, it has been argued that improvements in ICT have allowed highly skilled workers to earn higher wages (e.g., see Autor et al., 1998).[2] Skill, or educational attainment, is only one dimension of worker characteristics that influence their ability to adapt to new technology. Other dimensions include gender and age. However, few studies have focused on these aspects. Exceptions include Card and Lemieux (2001) who argue that the well-known increase in the skill premium for college-educated workers in the US in the 1980 s was concentrated in younger age cohorts and could be attributed to a low supply of graduates relative to previous cohorts. In a more recent study, Daveri and Maliranta (2007) consider the links amongst age, seniority, wages and information technology.[3]

The focus of this paper is on the age dimension, in particular, the demand for workers aged 50 and over in Europe. We discuss the complementarities between human capital and technology, where technology is represented by capital accumulation in the form of ICT. Human capital theory (Becker, 1964; Mincer, 1974) suggests that the decision to invest in human capital is based on cost-benefit considerations for both employers and employees. In relation to new technology, human capital theory predicts that lower levels of learning ability contribute to lower productivity in the workplace. It is generally believed that learning ability declines after a certain age and it can therefore be argued that the effectiveness of human capital investment (in terms of the potential gains to the employer from higher produc-

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[1] The literature on the determinants of skilled-unskilled wage inequality is rapidly growing. Some recent empirical studies have started to focus on the role of non-market factors. For example, using data on 43 US industries from 1968 to 2012, Kristal and Cohen (2016) argue that a decline in unionization and the real value of the minimum wage can also account for a significant proportion of skilled-unskilled wage inequality in the US. Other related studies, such as Kawaguchi and Mori (2014), aim to explain rising wage inequality by focusing on supply side factors. Using micro data from some European countries, Garnero et al. (2014) examine the impact of the minimum wage and collective bargaining on wage inequality.

[2] In a very interesting recent study, using decomposition techniques, Marouani and Nilsson (2016) provide evidence of skill-biased technological change in Malaysia in recent years.

[3] Messinis and Ahmed (2013) use a new measure of human capital that also takes education, cognitive skill, life expectancy and the use of ICT into account.

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tivity and the worker from higher earnings) declines with age. This is likely to lead to both lower offers of human capital investment in older workers and less incentive for them to accept any offers that come their way (O'Mahony and Peng, 2009; Carmichael and Ercolani, 2014).[4] Caselli (1999) shows that a biased technology revolution affects wage inequality if the workforce is heterogeneous in training cost. Lower levels of learning ability may also raise the cost of human capital investment in older workers, in terms of time and effort, which could have an additional negative impact on the motivation to invest in such human capital. Hence, human capital investment (training) theory suggests a negative relationship between the demand for labour for older workers and new technology.

While this paper focuses on the impact of ICT on demand for older workers in some European countries, related studies have also considered the more general issue of the impact of improvement in technology on employment. For example, using panel data for the UK manufacturing sector over the 1976–1982 period, Van Reenen (1997) finds that technological innovation has a positive impact on employment. A similar positive link between innovation (usually measured by R & D spending) and employment is found by Piva and Vivarelli (2005) and Hall et al. (2008) in Italy, Lachenmaier and Rottmann (2011) in Germany, Mitra and Jha (2015) in India, and Ciriaci et al. (2016) in Spain. Disaggregated studies that deal with the impact of technology on employment produced mixed results. For example, while focusing on the UK, Greenhalgh et al. (2001) find that the positive impact of R & D on employment was limited to high-tech industries. However, Lachenmaier and Rottmann (2011) did not find any significant sectoral heterogeneity between high-tech and non-high-tech sectors. Using time series data on 677 European companies over the 1990–2008 period, Bogliacino et al. (2012) find that the job creation effect of R & D spending was present only in the services and high-tech manufacturing sectors.

Technology affects employment though process and product innovation. It is generally believed that process innovation has a negative effect on employment whereas product innovation is basically labour-friendly (Brouwer et al., 1993; Smolny, 1998). Using data from France, Germany, Spain and the UK over the 1998–2000 period, Harrison et al. (2014) found evidence of process innovation as well as product innovation effect on employment. However, Hall et al. (2008) and Lachenmaier and Rottmann (2011) failed to find the employment displacement effect of process innovation. Even though most new technologies are labour saving, improvement in technology has not resulted in large scale unemployment.

The initial labour-saving effect of process innovation can be counterbalanced by market compensation forces via new machines, new investments, decrease in prices and wages, and increase in income (Vivarelli, 2014). The possible labour-friendly impact of product innovation can also mitigate the negative effect of new technology on employment (Vivarelli and Pianta, 2000). The empirical evidence presented by Evangelista and Vezzani (2012) suggests that both technological and organizational innovation exert a positive impact on employment mainly by improving growth performances of the firms. They also find evidence of diminishing relevance of the labour displacing effect of the process innovation. Thus, the existing literature tends to support a positive link between new technology and employment, especially when R & D and/or production innovation are used as proxies for technological change and when high-tech sector become the focus of the study.

In some sectors, such as microelectronics and telecommunications where technology is skilled labour-friendly, improvement in ICT can be considered as product innovation. However, in the case of the manufacturing and services sector, improvement in ICT can be viewed as labour saving process innovation. The relationship between the ICT and employment is considerably more complex. The combined effect of process and product innovation can vary considerably across countries and sectors.

While the early studies focused on the quantitative aspect of the link between technology on employment, recent studies also consider the qualitative aspects in term of SBTC (Vivarelli, 2014). Several studies have reported that ICT and R & D investments contribute positively to the productivity and efficiency of firms (Acemoglu, 2015; Bonanno, 2016). The SBTC has shifted the demand for labour in favour of skilled workers thereby increasing the employment opportunities and wages of skilled workers (Acemoglu and Autor, 2011). At the same time, the past few decades have witnessed a rapid (and simultaneous) growth in both the highest- and lowest-skilled job. This phenomenon, which is also referred to as job polarization, is evident in the US (e.g., see Autor and Dorn, 2013; Autor, 2015), the UK (e.g., see Goos and Manning, 2007), Germany (e.g., Spitz-Oener 2006; Dustmann et al., 2009) and Sweden (e.g., Adermon and Gustavsson, 2015). Goos et al. (2014) and Michaels et al. (2014) find that the high- and low-paying occupations have expanded relative to middle-wage occupations in most European countries, suggesting that job polarization is pervasive across advanced economies.

The main explanation for the observed job polarization is that the new technologies are mainly designed towards replacing labour in routine tasks (Routine-biased technological change, RBTC) thereby decreasing the demand for middle-skilled "routine" cognitive and manual jobs. Workers with non-routine tasks lie at the two opposite ends of the skill distribution. For example, the professional speciality and manual personal services (Autor and Dorn, 2013).

In this paper, we attempt to test whether new technologies (especially the ICT) are complementary or substitute to the use of older workers within an industry. The SBTC hypothesis implies that employment (and therefore the earnings) of older workers decline as new technologies become available. However, the RBTC hypothesis highlights the advantages of older workers over the current technology. Older workers tend to have well developed job-specific abilities that help them apply the ICT to deal with non-routine tasks requiring situational adaptability and in-person interactions (Autor and Dorn, 2009). Accordingly, the older workers may gain employment in low-skill non-routine occupations within an industry.

It is commonly believed that learning ability deteriorates with age. However, the evidence is mixed (e.g., see Waldman and Avolio, 1986 and Wooden et al., 2001). If the new technology developed is codified in a standard way, then the lower learning ability of older workers might not be viewed as a serious obstacle to investment in human capital. The existing literature also suggests that different stages in the diffusion of technology can affect the demand for skilled workers. In some respects, ICT capital appears to become less complementary with skilled (or younger) workers over time. Chun (2003) argues for the need to distinguish between the short-run adoption effect that ICT has on the demand for skills and the long-run use effect, which may be considered as the "real" change in skill bias. Chun's analysis implies that, as new technology is fully implemented, firms can replace high-wage, highly educated workers with lower-paid older workers who are not highly educated. Ruiz-Arranz (2004) provides evidence of a decreasing contribution of ICT capital-skill complementarity to the growth of the skill premium in the US since the 1980s. More recent studies on job polarization, for example Michaels et al. (2014) and Goos et al. (2014), argue that ICT has led to an increase in demand for highly educated workers at the expense of middle-educated workers but demand for low-educated workers has scarcely been affected. Thus, a deskilling effect may replace the skill-biased demand for older workers at the late stage of the adoption process of new technology.

[4] It can also be argued that older workers will have fewer years left in the workforce and that makes learning new skills less attractive both to them and to employers. At the same time, older workers, due to their accumulated experience, can remain highly productive. However, without learning new skills, at some stage, experience would not be able to offset the lack of knowledge of new technology. Other related studies include Pianta (2005), Frey and Osborne (2013) and Brynjolfsson and McAfee (2014).