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Giorgio Cutuli

Alessio Tomelleri

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Giorgio Cutuli
University of Trento
g.cutuli@unitn.it

Alessio Tomelleri
FBK-IRVAPP
atomelleri@irvapp.it

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Research Institute for the Evaluation of Public Policies
Bruno Kessler Foundation
Vicolo dalla Piccola 2, 38122 Trento (Italy)

Phone: (+39) 0461.314209
Fax: (+39) 0461.314240

E-mail: info@irvapp.it
Website: http://irvapp.fbk.eu

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Returns to ICT Skills Use and Labour Market Institutions

Giorgio Cutuli and Alessio Tomelleri

Abstract

This paper analyses the moderating role of institutional factors on returns to ICT skill usage among different groups of workers in eight European labour markets. Using PIAAC data, it leverages the 'institutional salience' of contractual status to analyse the returns on the use of ICT-related skills in the workplace, allowing for heterogeneous wage effects at the micro level among workers holding permanent and temporary contracts. It extends the analysis by considering how gaps in ICT wage premiums mirror the compositional differences in national-specific trade union densities among contractual groups. Wage premiums associated with ICT usage are not defined univocally by task content or demand-supply dynamics for specific occupations. Net of occupation and industry, the results show different returns between labour market segments and according to national-specific trade union densities of temporary and permanent workers, providing a test of how the consequence of technological change are shaped by institutional and regulative cleavages.

JEL-Code: J2, E24, O30, J50

Keywords: ICT skills, wage premiums, European labour markets, temporary contracts, trade unions

1 Introduction

The socio-economic literature of the last two decades has repeatedly underlined that the spread of new technologies, taking the shape of robotisation and digitalisation of production and organisational processes, tends to come with relevant spill-overs in the labour market. This favours structural trends such as dynamics of occupational polarisation or occupational upgrading. Accordingly, technical change has been considered a significant driver of changes in the returns to education, employment and wage prospects of distinct segments of the workforce (Autor et al., 2003; Goos et al., 2014; Haslberger, 2021; Oesch and Rodríguez Menés, 2011). From an economic perspective, the extent to which these macro-level changes affect economic inequality and become relevant from a social stratification standpoint is largely dependent on the dynamics of aggregate demand for specific occupations. Changes in demand are indeed associated with a shortage or redundancy of workforce with high/low educational and skill endowments and, relatedly, with increasing educational gradients in employment opportunities, wage levels and income stability among different groups whose skills and tasks are more or less complementary to technological advancements (Acemoglu, 1998, 2002; Goldin and Katz, 2007; de Vries et al., 2020; Hershbein and Kahn, 2018). Yet, although these trends have been empirically registered in most industrialised and developed countries, they have been proven to take place at different paces and with different magnitudes in distinct national contexts.

Especially in the sociological literature, cross-country divergences in this regard have been traced back to heterogeneity in institutional factors. At odds with economic theories of skill-based or routine-based technical change, which tend to see technological innovation mainly as an exogenous factor with seemingly deterministic consequences for group-level inequalities, the recent empirical evidence points in the direction of possible context-specific effects (Oesch and Piccitto, 2019; Klenert et al., 2020; Barbieri et al., 2021; Kristal and Edler, 2021; Minardi et al. 2023). This variation suggests that factors such as labour market regulations and wage-setting institutions play the role of moderators with respect to market-driven mechanisms associated with technological change (Oesch and Menes, 2011; Meyer and Biegert, 2019; Wang, 2020). In fact, from a cross-country comparative perspective, the most pronounced direct effects of technological/digital changes have been observed in flexible and relatively unregulated labour markets such as the US (Acemoglu and Restrepo, 2020; Berger and Engzell, 2022). More broadly, some degree of heterogeneity of technology in local labour markets tends to appear at the regional level, within countries, in response to the level of institutional constraints (Parolin, 2021).

Alongside other institutional elements such as employment protection legislation, wage setting and compositional differences in national/local workforces, the presence and action of trade unions have been found to prevent technological advancements from spurring consequential occupational and structural changes (Kristal and Cohen, 2017; Kristal and Edler, 2021). Overall, unemployment elasticity tends to be higher in contexts with weaker trade unions, confirming their function as buffers (or even shelters) against the possible imbalances in demand and supply dynamics fostered by technical and organisational changes. Still, trade union settings can be expected to affect group-specific employment opportunities (among educational, occupational or cohort-based groups) as well (Parolin, 2021). In the same vein, recent contributions have documented how technologically induced changes in labour demand for specific occupations tend to respond to the strength, density and internal composition of trade unions (Haapanala et al., 2022). Evidence and research on distributive effects (i.e. group-level heterogeneity) on the role of trade unions as mediators of technical change nonetheless remains underdeveloped. More nuanced views suggest possible insider-outsider dynamics that may come into play as a by-product of trade union strategies and constituencies, with heterogeneous efficacy of trade union agency in favouring employment and wage prospects among incumbents and outsiders, between prime-age workers and younger counterparts or between educational and skill groups (Bessinger and Baudy, 2015; Mosimann Pontusson, 2017; Dauth et al., 2021; Haapanala et al., 2022).

2 Contribution: ICT skill usage and institutional cleavages

Building on this stream of socio-economic literature and focusing on the West European labour markets, the main aim of this contribution is to test the role of institutional factors in shaping group-specific returns to technological workforce skills. More specifically, we look at the wage premium associated with the on-the-job usage of skills in the domain of information, communication and technology (ICT). Apart from their actual and growing diffusion and demand, ICT skills (and ICT skill requirements) are analytically interesting for at least two reasons. First, these skills consist of a set of computer-based competencies that, in line with the skill-based technical change perspective, are largely complementary to a broad set of technological innovations (Acemoglu and Autor, 2011). Second, with respect to the trends of robotisation, whose consequences have been extensively investigated in recent years, ICT adoption is less bound to the industrial production domain and can affect technical and organisational processes in a broader set of occupations and industries.

We first look at country-level differences of digital skills in the workplace, their distribution across occupational groups and workforce segments, and their implications for employability from a micro-level perspective. We find a significant and negative association between current or past usage of ICT skills and subsequent exposure to unemployment and inactivity. We then turn to our main focus, testing for a net role of ICT usage in shaping micro-level income capacity and highlighting the role of institutional factors in affecting ICT-related wage premiums.

It can be argued that three main features distinguish our contribution from previous relevant studies of group-specific returns to technological change. First, we rely on the micro-level consequences of demand-driven individual skill usage rather than investigating the aggregate change in the wage distribution stemming from an exogenous variation in exposure to a given technology in a particular context. Second, we investigate the role played by institutional factors as moderators of the effect of (demand-driven) digital skill usage. We allow for different wage effects among workers with distinct contractual arrangements (temporary and permanent workers), leveraging the 'institutional salience' of contractual status in the Western European labour market. Third, we perform a macro-level comparison, focusing on national-specific trade union settings and testing the extent to which gaps in ICT wage premiums between temporary and permanent workers mirror compositional differences in trade union densities among contractual groups.

In doing so, we contribute to a rich stream of socio-economic literature documenting how the distinction between temporary and permanent employment, far from being a mere normative and regulative fact, represents a significant stratifier of labour market advantages as well a relevant institutional dimension of labour market dualisation in contemporary European labour markets (DiPrete et al., 2006; Barbieri and Cutuli, 2016; Bentolila et al., 2019; Passaretta and Wolbers, 2019; Tomelleri, 2021; Fauser and Gebel, 2023). Nonetheless, delving into trade union representation dynamics and discussing alternative scenarios in terms of the extent and drivers of contractual segmentation (e.g. Lindvall and Rueda, 2014; Thelen, 2014; Benassi and Vlandas, 2016; Carver and Doellcast, 2021; Meardi et al., 2021) is beyond the scope of this contribution. The specific focus on contractual distinctions in skill usage premiums and their interplay with national trade union features are rather consistent with two findings emerging from the literature on firm-sponsored learning opportunities and returns to skill development. The first is related to the presence of gaps in exposure to sponsored learning opportunities and the provision of formal training in favour of permanent workers (Fouarge et al., 2012; Cutuli and Guetto, 2013; Cabrales et al., 2017; Ferreira et al., 2018), with dualistic settings in terms of labour market regulations being particularly affected by a retrenchment of (potential) training provision (Bratti et al., 2018;

Bentolila et al., 2019). The second one is linked to recent findings showing significant differences in returns to training/skills between contractual groups, suggesting that even in the presence of equal exposure to training and potentially comparable skills, temporary workers tend not to be in a position to take full advantage of their competencies. In addition, trade unions seem to have a role in shaping wage returns for permanent and temporary workers differently: even if workforce representation in the workplace promotes learning opportunities regardless of contractual status, trade union coverage at the national level is more beneficial to permanent workers (Adolfsson et al., 2022). If the first aim of this contribution is to add to this stream of literature, a second goal is to test more broadly for the institutional conditionality of the consequences of technological change. We argue that to the extent that ICT wage premiums are not primarily shaped by the task contents of the jobs nor by occupational-specific market-driven demand and supply mechanisms, alternative institutional settings (country-level labour market regulation, characteristics of national industrial relations, wage-setting schemes) can play a relevant part in addressing the socio-economic consequences of technical advancements.

3 Analytical strategy and preview of results

Informed by this theoretical background, in this paper, we investigate a specific correlate of technological advancements in the labour market, namely, the usage of ICT in the workplace. We first apply a set of nested regression models, and we document the tendency of individuals/groups with prior experience in ICT use to show higher chances of remaining in employment and, on average, benefitting from a net wage premium associated with technological skills. We then look at the role of temporary employment in moderating ICT wage premiums and examine the gradient of this moderation effect according to different constituencies of national trade unions among temporary and permanent workers. We do not focus on micro-level return to skill endowments in themselves, but we consider the actual use of ICT at work (that we conceive of largely as demand driven) to allow for heterogeneity across firms and productive contexts more or less keen on requiring the workforce to engage with ICT for productive or organisational reasons.

Before looking at the distributive effects of different ICT premiums among distinct contractual groups, we ascertain the direction of the relationship between individual ICT usage and wage levels to prevent reverse causality issues from blurring our line of reasoning. Even if analytically problematic, the presence of endogeneity in the association between ICT and wage would nonetheless be informative from a theoretical standpoint. At the micro level, it would indicate supply-side self-selection into relatively ICT-intensive firms. At the macro level, it would suggest that ICT diffusion in specific firms could play a role in increasing wage inequality trends within the same occupational groups or widening wage cleavages between permanent and temporary segments to the extent that the firm-level implementation of ICT is negatively associated with the share of non-standard employment (Cetrulo et al., 2019).

More broadly, some confounding factors may influence the use of ICT skills at work while affecting micro-level income capacity. This dynamic would occur to the extent that highly productive firms are more likely to invest in ICT. It is reasonable to think that, on average, these firms tend to (i) require more ICT use at work and/or (ii) pay higher wages and provide higher ICT returns than less productive/innovative firms. Similarly, firms with better managerial quality are more likely to adopt ICT technologies in organizational processes and are potentially keen on providing the workforce with higher wages for the same reasons. To overcome issues stemming from unobserved context-specific/between-firm heterogeneity, we adopt a two-stage regression procedure using a shift-share instrumental variable on the use of ICT skills at work. More specifically, in the same spirit as Cette et al. (2022) – but slightly differently – we instrument the leave-one-out mean of ICT work within a sector, firm size and ISCO code, leaving out the values of the variable for all workers employed in the same country as individual *i*. In the same vein, we build a second instrument as the mean of ICT skill use at work within a country, industry and ISCO, leaving out firms of size classes greater than the one considered for individual *i*.[1] Because these instruments vary at the sector, firm size and ISCO cell level, their effects must be intended at this level of aggregation. This is a necessary compromise since we have no firm-specific information at hand in the PIAAC dataset. Therefore, our instruments represent the finest-grade tools for capturing this kind of endogeneity. The results allowing for purely exogenous variation indicate a net positive effect of the ICT measure, even if slightly smaller for the first instrument, allowing the use of the variable in its original form in the subsequent (core) part of the analysis.

After controlling for sociodemographic and structural variables (gender, education, linear and quadratic labour market experience, public/private sector, industry and occupation), according to our most detailed model specification, we find a net ICT coefficient ranging between 4-6 of the hourly wage. Interestingly, despite the specificities of national contexts from institutional and occupational structure standpoints, net of the abovementioned potential confounders, returns on ICT skill use are found to be similar across countries. Notably, the estimations remain fairly stable and statistically significant even when individual abilities and competencies – captured here by the level of numeracy, literacy and, where available, problem solving – are accounted for. We

[1] A more detailed discussion of the strength, validity and test of the instruments is provided in the appendix.

derive from this the indication that our measure of ICT use, while located at the micro level, is not intended merely as a proxy for a worker's individual technical/informatics skill endowment but rather as a measure of the ICT activities required and implemented in the production/business context in which the worker is involved. Incidentally, exposure to ICT use within the occupational structure is shaped according to institutional and productive national characteristics; consequently, the ICT distributions by ISCO are more compressed in countries such as Denmark and less compressed (i.e. more unequal) in settings like Italy and Spain. This piece of evidence can certainly be traced back to distinct occupational structures and different institutional configurations of vocational and training systems. In this analytical context, it suggests that ICT use can have a role in influencing the magnitude and trends of between-group inequality in distinct labour markets. In terms of occupational groups, we find that returns on ICT usage are relatively more pronounced in manual occupations (ISCO groups 7–9), where ICT use tends to be less prevalent, even if differences in wage premiums among broad occupational groups appear hardly statistically significant. Using quantile regression approaches, net returns on ICT usage are found to be relatively stable along the wage distribution as well. Even allowing for group-level stepwise interactions, they appear substantially homogeneous across cohort, tenure, availability of on-the-job training and gender. The employment feature with the strongest stratifying effect on returns on ICT use is the individual contractual arrangement, with significantly lower returns for those holding temporary positions. Still, the contractual cleavage varies across countries as the use of ICT for temporary contracts does not translate into wage premiums in contexts where union coverage is particularly skewed in favour of permanent workers.

Thus, the overall picture emerging from the analysis is consistent with the presence of diffused wage effects of ICT use, largely independent of individual, sectoral and occupational (macro) group characteristics. These findings come with two sets of indications. First, they have possible meso and macro policy implications in terms of incentives for the digitisation of production processes and innovation in the business organisation since the characteristics of firms and, more broadly, a local occupational structure favouring the adoption of technology can contribute to shaping trends of wage inequality between and within countries (OECD, 2021). Second, they have implications for the debates concerning the interplay between social stratification, between-group inequalities and labour market dualisation both at the national level and for studies pursuing a comparative approach.

4 Data and methods

4.1 Data

The Program for the International Assessment of Adult Competencies (PIAAC) is a large-scale international study of some key adult cognitive and workplace skills well known in the literature. The study is designed to assess adult skills over a broad range of abilities, from simple reading and numerical calculations to complex digital problem solving. These abilities are measured and collected along with sociodemographic information and relevant information on the use of ICT skills at work. Respondents not familiar with computers are given a paper-and-pencil version of the questionnaire (see figure 1). Among the databases collecting data on wages and skills, PIAAC is undoubtedly the one that best captures the on-the-job ICT skills use and is best suited to answer our research question. The main limitation concerns its cross-sectional dimension, which, given its nature as a survey, is compensated by the large set of variables gathered in over 40 countries.[2] Our main variable of interest, *ictwork*, is an index that measures the use of ICT skills at work and is derived from seven items in the background questionnaire. The seven questions capture the frequency of the use of particular ICT skills for specific tasks in the respondents' last job, namely, email, internet as a tool for understanding job-related issues, internet to sell/buy products/services or banking, spreadsheet software like Excel, word processor and the use of a programming language. The variable is a compound index derived by the Organization for Economic Cooperation and Development (OECD) that ranges from 0 to 6 and summarises the seven abovementioned items.[3]

The sample is restricted to non-students since including the reported earnings and employment status of students would likely obscure the impact of skills on labour market outcomes. There is no restriction based on age as the sample includes people aged between 16 and 65 years. The self-employed are excluded because their earnings may be unreliable and may not accurately reflect returns on education and skills. To decrease the number of missing *ictwork* items, we assign a value equal to 80% of the minimum value of *ictwork* to those who decided to answer the paper-based questionnaire and those who failed the Computer Based Assessment (CBA) stage 1 (cf. figure 1). By the same logic, we assign 90% of the minimum value of *ictwork* to those people who failed CBA stage 2. Although these thresholds are arbitrary, it is reasonable to assume that people who were not able to deal with the basic questions of stage 1 use their ICT

[2] Despite the presence of some relevant longitudinal follow-ups. See https://www.oecd.org/skills/piaac/events/.

[3] For further information, please check the related OECD documentation listed in the references.

skills at work rarely or not at all. Similarly, people who could pass stage 1 but failed stage 2 are likely able to conduct basic operations but cannot cope with more sophisticated tasks. Our dependent variable is the logarithm of hourly wages (including bonuses), and it is regressed on several structural and individual characteristics, such as occupation classification (ISCO one digit), industry, public/private sector, education (ISCED, six levels), firm size, type of contract, gender, experience, tenure, on-the-job training, birth cohort, numeracy, literacy and problem solving (if possible). Another key variable is the permanent-temporary union coverage rate, which has been merged at the country level using the OECD/AIAS database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (ICTWSS). The database provides comprehensive and comparable information on the evolving nature and scope of collective bargaining in OECD and EU countries. This database is used to compute the ratio between the coverage rate of permanent and temporary employment. We restrict our analysis to the most representative labour markets at the European level from both a structural and an institutional standpoint. We must also consider the availability of wage data and the size of country-level data to obtain a reliable model specification. The final sample consists of eight countries: Denmark, France, Ireland, Italy, the Netherlands, Poland, Spain and the United Kingdom (see table 1). Unfortunately, we had to exclude Germany because of a lack of availability of income data. Nevertheless, our sample accounts for approximately 70% of the combined gross domestic product of the 27 EU member states and the UK and for one-fifth of their workforce.[4] Descriptive statistics are presented in table 1 for the entire sample and in tables 9 and 10 by country and contract, respectively.[5] The final sample consists of 19,955 observations distributed among the eight largest economies in Europe, not taking into account Germany because of the unavailability of data.

[4] Source: OECD and Eurostat.

[5] To facilitate reading, the last two tables are moved to the appendix.

Figure 1: PIAAC Assessment Design

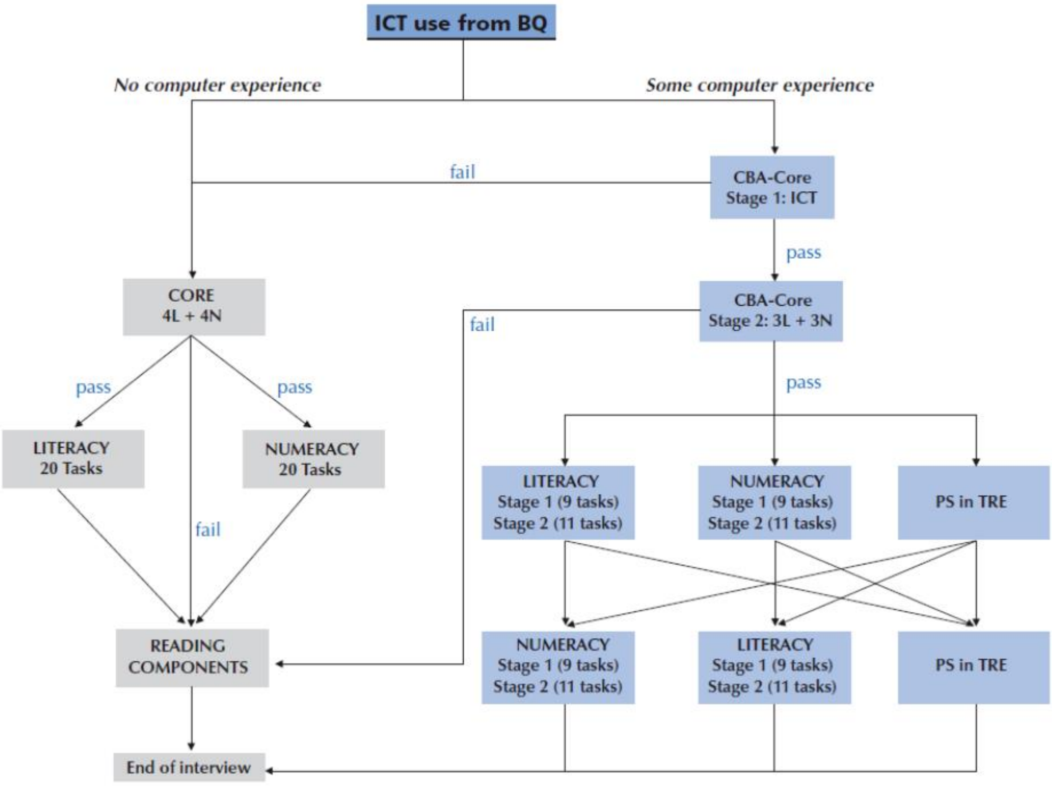


Table 1: Descriptive statistics

	Mean	Median	SD	N
ln(hourly wage)	3.14	2.80	1.17	19,955
gender	0.53	1.00	0.50	19,955
age	40.36	40.00	11.94	19,955
experience	18.95	18.00	12.08	19,955
tenure	10.58	7.00	9.94	19,944
ictwork	1.82	1.76	1.11	19,955
numeracy*	279.22	282.15	48.21	19,955
literacy*	282.90	286.25	43.81	19,955
problem solving*	289.54	291.33	39.15	12,085

*For the three domains assessed, proficiency is considered a continuum of ability represented on a 500-point scale.

Table 2 shows the differences in the average levels of *ictwork* among countries. Although country differences seem relatively small, especially for ISCO levels up to 5 (i.e. managers, professionals, technicians and associate professionals, clerical support workers and service and sales workers), Italy, Poland and Spain show a lower average of *ictwork* for ISCO 7 and 8 (i.e. plant and machine operators and elementary occupations). In general, the distribution of average ICT skills among the countries analysed reveals a gradual decrease as one moves towards less skilled jobs. This is certainly expected considering that the highest categories of ISCO represent relatively lower-skilled occupations.

Table 2: Average ictwork level by occupation and country

ISCO 08	**DK**	**ES**	**FR**	**IE**	**IT**	**NL**	**PL**	**UK**	**Total**
0	1.99		1.81	2.17	1.95	1.51	1.35	2.25	1.84
1	2.77	2.63	2.45	2.44	2.29	2.49	2.50	2.67	2.57
2	2.19	2.06	2.15	2.18	1.99	2.24	2.02	2.33	2.18
3	2.28	1.97	1.81	2.24	2.28	2.02	1.97	2.25	2.09
4	2.26	2.05	1.91	2.22	2.02	2.10	1.86	2.22	2.10
5	1.29	1.08	1.03	0.99	1.01	1.43	1.09	1.24	1.18
6	1.17	0.47	0.80	0.51	0.69	1.23	0.81	1.16	0.91
7	1.12	1.03	0.73	1.44	0.83	1.10	0.47	1.42	0.95
8	0.89	0.74	0.56	1.09	0.42	0.80	0.49	0.64	0.67
9	0.75	0.30	0.55	0.80	0.56	0.79	0.32	0.85	0.62
Total	1.92	1.68	1.67	1.90	1.74	1.96	1.47	2.02	1.82
N	3,741	1,544	2,768	2,027	1,177	2,545	2,537	3,556	19,895

The trade union density rates are reported in table 3. We built our ratio as the share of the union density rate for temporary workers over the union density rate for workers with permanent contracts. Data for Poland and Ireland are available only for the year 2016.

Table 3: Union density ratio for temporary/permanent workers by country

Country	Reference year	UD temp. workers	UD perm. workers	Ratio
Denmark	2014	58.7	75.1	0.78
France	2013	2.9	12.8	0.23
Ireland	2016	26.3	30.1	0.87
Italy	2012	31.8	39.3	0.81
Netherlands	2011	9.0	21.0	0.43
Poland	2016	6.2	16.4	0.38
Spain	2010	11.4	20.6	0.55
UK	2013	14.3	26.4	0.54

4.2 Model

To analyse the returns on ICT usage, we use a linear probability model (LPM) and a Mincer earnings function with various specifications. We estimate nested models for the Mincer function, plugging in additional covariates and interactions to check if the coefficient of interest changes in significance and magnitude.

The LPM on the probability of being unemployed is expressed as:

$$Pr(Y=1|X) = \beta_0 + \beta_1 exp_i + \beta_2 exp_i^2 + \beta_3 \mathbf{ictwork}_i + \beta_4 gender_i + \beta_5 educ_i + $$
$$+ \beta lit + \beta num_i + \beta ps_i + \delta_c + \epsilon_{ic} \tag{1}$$

To obtain the wage effect of ICT skills, we estimate a Mincer earnings function (Mincer, 1970, 1974) that relates a person’s wages to that person’s education, experience, gender and structural variables such as occupation and industry. Our variable of interest is the measure of ICT skill usage at work (*ictwork*), as explained in the first part of this section. We then introduce literacy, numeracy and problem solving as proxies of individual abilities. Finally, we add the institutional covariate of the contract and its interaction.

The Mincer function is thus as follows:

$$w_{ics} = \beta_0 + \beta_1 exp_i + \beta_2 exp_i^2 + \beta_3 \textbf{ictwork}_i + \beta_4 gender_i + \beta_5 ISCO_i + \beta_6 private_i +$$
$$+\beta_7 educ_i + \beta_8 firmsize_i + \gamma_s + \delta_c + \beta lit_i + \beta num_i + \beta ps_i + \beta contract_i + \beta ictwork_i * contract_i + \epsilon_{ics} \quad (2)$$

$$w_{ics} = \beta_0 + \beta_1 exp_i + \beta_2 exp^2{}_i + \beta_3 \textbf{ictwork}_i + \beta_4 gender_i + \beta_5 ISCO_i + \beta_6 private_i +$$
$$+\beta_7 educ_i + \beta_8 firmsize_i + \gamma_s + \delta_c + \beta lit + \beta num_i + \beta ps_i + \beta contract_i + \beta ictwork_i * contract_i +$$
$$+\beta trad.un.den.ratio_c + \beta ictwork_i * contract_i * trad.un.den.ratio_c +$$
$$+\beta contract_i * trad.un.den.ratio_c + \beta ictwork_i * trad.un.den.ratio_c + \epsilon_{ics} \quad (3)$$

where w_{ics} refers to the logarithm of the hourly wage of individual *i*, in country *c*, working in sector *s*. *exp* is the reported experience in the labour market, *ictwork* is our variable of interest and measures the ICT skills gained in the current/previous job.[6] ISCO represents the occupational level at one digit, while *private* is a dummy that takes the value of 1 if the worker is employed in the public sector. *Educ* reports the highest level of formal education obtained (six ISCED categories) and *firmsize* the size class of the firm in which worker *i* is employed. γ_s and δ_c are sector and country fixed effects, respectively. In the second specification of model 2, we also add measures of literacy, numeracy and, where possible, problem solving as well as the type of contract (permanent or temporary). The third specification includes the trade union density ratio and its three-way interaction with contract and *ictwork.*

5 Empirical results and discussion

We begin the analysis of the PIAAC data by looking at how ICT skill use affects the probability of being employed. We then examine the wage returns and explore the moderating role of institutional factors either at the micro level – i.e. contractual arrangement (temporary or permanent workers) – or the macro level – i.e. trade union densities for distinct contractual groups. Table 4 shows the coefficients estimated on the dummy that identifies employment status (1 = unemployed; 0 = employed). For those in unemployment, the ICT measure refers to the last employment spell. Even controlling for individual skills, the ICT skills used at work decrease, on

[6] prviuos in case of a current unemployment spell in model number 1.

average, the probability of being unemployed by 2%. Although this might seem a negligible effect, we are also controlling for individual skills such as literacy and numeracy, and *ictwork* represents the use of ICT skills at work. At the country level, *ictwork* is always significant, ranging from 0.8% in France to 3% in Spain and 3.1% in Poland.

Table 4: Probability of being unemployed

	(1)	(2)	(3)	(4)	(5)
	Total	Denmark	France	Ireland	Italy
ictwork	-0.020***	-0.012***	-0.008*	-0.020***	-0.020***
	(0.001)	(0.003)	(0.004)	(0.004)	(0.005)
N	26,488	4586	3469	2836	1967
Adj R^2	0.050	0.030	0.033	0.059	0.066
	(1)	(6)	(7)	(8)	(9)
	Total	Netherlands	Poland	Spain	UK
ictwork	-0.020***	-0.008*	-0.031***	-0.030***	-0.012***
	(0.001)	(0.003)	(0.004)	(0.00s7)	(0.003)
N	26,488	3223	3568	2335	4504
Adj R^2	0.050	0.013	0.065	0.101	0.044

Robust standard errors in parentheses. | * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In general, individuals/groups with prior experience in ICT use demonstrate lower risks of unemployment, confirming demand-side preferences for skilled labour in contemporary labour markets and mid-term micro-level risks stemming from underinvestment in sponsored or self-promoted human capital development.

Moving to ICT returns, table 5 shows the nested specifications of the model illustrated in section 4.2, starting with the basic one (1), adding literacy and numeracy (2), literacy and numeracy and, where possible, problem solving (2b) and, further, the type of contract (3). For the sake of clarity, we also add the two shift-share IV model estimates illustrated in section 3 and developed in the appendix. Column (4a) reports the instrument excluding the country of individual *i* and column (4b) the one that leaves out the firm size class of individual *i*. All model specifications allow for country, sector and ISCO fixed effects. The results show that the ITC skills acquired at the workplace are significantly and positively correlated with hourly wages: one additional point in the *ictwork* index increases the hourly salary by 5–6%. Considering additional factors that may lead to an increase in hourly wages does not change the sign and magnitude of the returns on the use of ICT skills at work: the coefficient remains fairly stable in all specifications. Even if we look at the *ictwork* coefficients estimated in the IV setting, the results appear substantially unchanged and not statistically different from the estimates of model 3. In other words, possible unobserved factors do not seem to play a major part in affecting returns on ITC skills (columns 4a and 4b vs. all the OLS specifications). The coefficient estimated using the first instrument reduces the returns by one percentage point, confirming the main result of model 3 at the 95% level of significance. The second instrument, at the 99% level of significance, does not provide any change in the coefficient.[7]

Table 5: Return to skills in terms of hourly wage

	(1)	(2)	(2b)	(3)	(4a)	(4b)
	baseline	lit_num	lit_num_ps	contract	IV	IV2
ictwork	0.06***	0.05***	0.05***	0.05***	0.04*	0.05**
	(0.00)	(0.00)	(0.01)	(0.00)	(0.02)	(0.02)
2.cntrct2				0.11***	0.12***	0.11***
				(0.01)	(0.01)	(0.01)
ISCO FE	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
N	19,874	19,874	12,063	19,463	19,463	19,463

[7] For the sake of clarity, the coefficient is slightly smaller than the OLS coefficient at the level of the third decimal.

r2	0.829	0.829	0.857	0.837	0.837	0.837

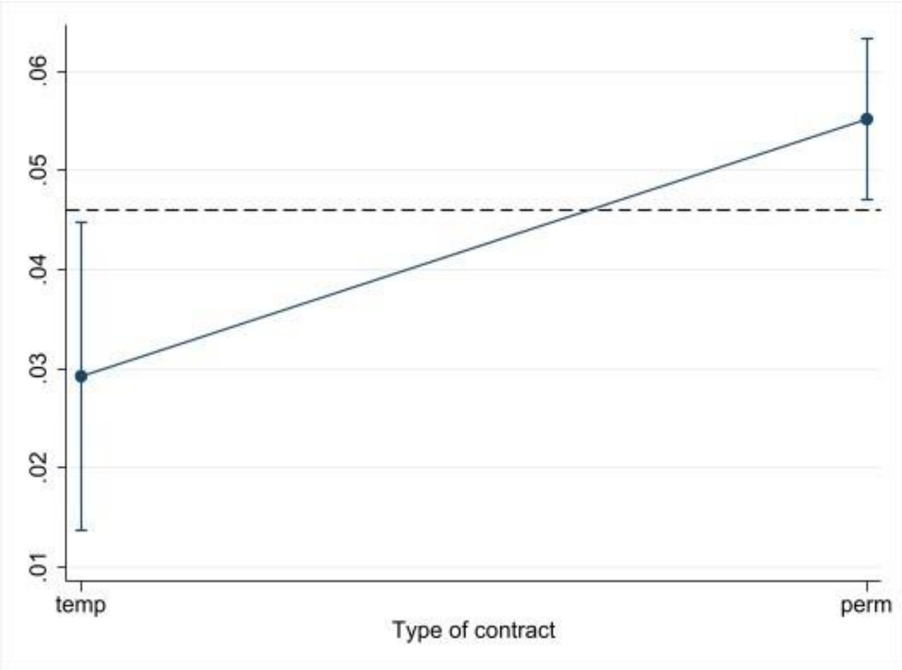
Standard errors in parentheses. | * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

To be valid, an instrumental variable must be correlated with the dependent variable only through the endogenous variable (exogeneity) and, therefore, uncorrelated with the error term. As regards our instrument, it reasonable to assume that the average ICT work level of workers in the same industry, size class and ISCO but employed in other countries does not affect the income of workers in the same industry-firm-size-employment cell working in the reference country of individual *i*. More likely, within that cell, there may be firms competing in the European market (especially the large ones), which may encourage the use of ICT in firms in the country under consideration but not an increase in the workers' wages. Regarding the second instrument, it is possible that our instrument is exogenous only when it leaves out the firm sizes that are, on average, more productive than the firm size for individual *i.* (i.e. in a higher size class). In this sense, the previous leave-one-out mechanism could be problematic. For example, when SMEs are left out as a size class in the instrument, they could react to an increase of *ictwork* of the 'others' by increasing their wages to keep the most skilled workers from leaving. This can happen since the 'other' category also features smaller firms operating in the same country sector and it is reasonable to assume that their productivity is lower as well. This is why our instrument leaves out firms that are on a size class higher than that of individual *i*. In addition, thanks to the inclusion of the sector, ISCO fixed effects in the regressions, the leave-one-out mean in the use of digital technologies solely measures the average practices in terms of these technologies in the sector, occupation and firm size considered for the first instrument and in the sector, occupation and country considered for the second one.

In summary, our instrument addresses the endogeneity problem by showing that: (i) if firm productivity can be a confounding factor, it goes in the same direction as *ictwork* (i.e. the IV coefficients have the same sign as the OLS ones) and (ii) it 'only' slightly decreases ICT returns. Thus, we are confident that what we have found so far will lead to, at worst, negligible overestimations of the returns on ICT skills.

Based on the previous analysis shown in table 5, column 3, we continue by interacting the contract with our variable of interest (the coefficients are shown in table 8, column 3b). The only factor affecting ICT returns seems to be the interaction with the contract type, providing evidence of a moderating role of institutions at the micro level.[8] To better understand the role played by the type of contract in shaping ICT returns, we computed the marginal effects reported in figure 2. The figure shows that temporary contracts are worse off than their permanent counterparts. *Ceteris paribus*, being in a permanent position increased the return on ICT skills by 3%. In this sense, the type of contract has a stronger stratifying effect on ICT returns, with lower returns for those holding a temporary position. The coefficients are presented in table 11.

Figure 2: Average marginal effects of ictwork by type of contract, all countries



Note: "temp" stands for temporary contract, and "perm" stands for permanent contract.

At this point, we are interested in determining whether the contractual gaps in the returns on ITC skills differ among the countries considered in the analysis. We begin by looking at model 3 at the country level; estimated coefficients are reported in the table below. Once individual characteristics, including individual ability, and structural variables such as sector and industry are controlled, the returns on ICT skill usage are similar across countries. Even though the point

[8] In the appendix, we exploit the interaction with other significant variables and the type of contract, finding no significant results.

estimate ranges from 4% for France to 8% for the UK, there seems to be no significant difference across European countries.

Table 6: Mincer earnings function on hourly wage by country (model 3)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Denmark	France	Ireland	Italy	Netherlands	Poland	Spain	UK
ictwork	0.05***	0.04***	0.07***	0.05**	0.07***	0.05***	0.06***	0.08***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
N	3745	2770	2030	1177	2545	2543	1544	3601
r2	0.28	0.42	0.18	0.37	0.35	0.34	0.36	0.38

Standard errors in parentheses. | * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As regards the interaction, for the sake of clarity, we directly report the average marginal effects of the contract on skills in table 7, while the table with the country-specific coefficients and the related graph are shown in the appendix (see table 11 and figure 5). Unlike in figure 2, here, wage returns are positive and reach statistical significance in all countries only for permanent workers. Therefore, it appears that the data do not allow for sufficiently large sample sizes to properly estimate, within each country, the contractual gradient in returns on ICT skill usage. Indeed, given the number of relevant covariates included in the model to isolate the effect of ICT skill usage (namely, individual characteristics, individual abilities and structural variables such as industry and private/public sector), the cell-specific size and variability inevitably decrease, expanding the confidence intervals. This holds true particularly for temporary workers, which are on average much less numerous than permanent ones.

Table 7: Average marginal effects of ictwork by type of contract

Country	Contract	dy/dx	std. err.	t	P>|t|	[95% conf.	interval]
DK	temporary	0.06	0.019	3.32	0.001	0.026	0.101
	permanent	0.04	0.007	5.74	0.000	0.026	0.054
FR	temporary	-0.02	0.024	-0.93	0.355	-0.069	0.025
	permanent	0.04	0.008	4.71	0.000	0.023	0.055

IE	temporary	0.03	0.020	1.48	0.138	-0.009	0.068
	permanent	0.08	0.019	4.35	0.000	0.046	0.121
IT	temporary	0.00	0.031	0.12	0.905	-0.058	0.065
	permanent	0.06	0.016	3.42	0.001	0.023	0.087
NL	temporary	0.05	0.030	1.55	0.120	-0.012	0.107
	permanent	0.06	0.011	5.68	0.000	0.042	0.087
PL	temporary	0.02	0.017	1.43	0.152	-0.009	0.057
	permanent	0.06	0.012	4.75	0.000	0.034	0.082
ES	temporary	0.05	0.028	1.70	0.089	-0.007	0.104
	permanent	0.05	0.013	4.12	0.000	0.028	0.080
UK	temporary	0.04	0.023	1.77	0.076	-0.004	0.087
	permanent	0.08	0.009	9.27	0.000	0.066	0.102

To confirm our argument pointing in the direction of insufficient statistical power, we re-estimated model 2 pooling countries and running the models separately for temporary and permanent workers, de facto allowing interactions between contracts and the entire vector of independent variables. Table 8 shows the results of this exercise in the last two columns, confirming that the returns on ICT skill usage for temporary workers are, on average, positive and significant but still 3% lower than those of permanent workers.

Table 8: Return to skills in terms of hourly wage (2)

	(3)	(3b)	(3c)	(3d)
	contract	contract*ictwork	temporary	permanent
ictwork	0.05***	0.03***	0.03**	0.06***
	(0.00)	(0.01)	(0.01)	(0.00)

contract	0.11***	0.08***		
	(0.01)	(0.02)		
2.cntrct2c.ictwork		0.03**		
		(0.01)		
ISCO FE	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Observations	19,463	19,463	3,424	16,039
Adj. R^2	0.84	0.83	0.78	0.84

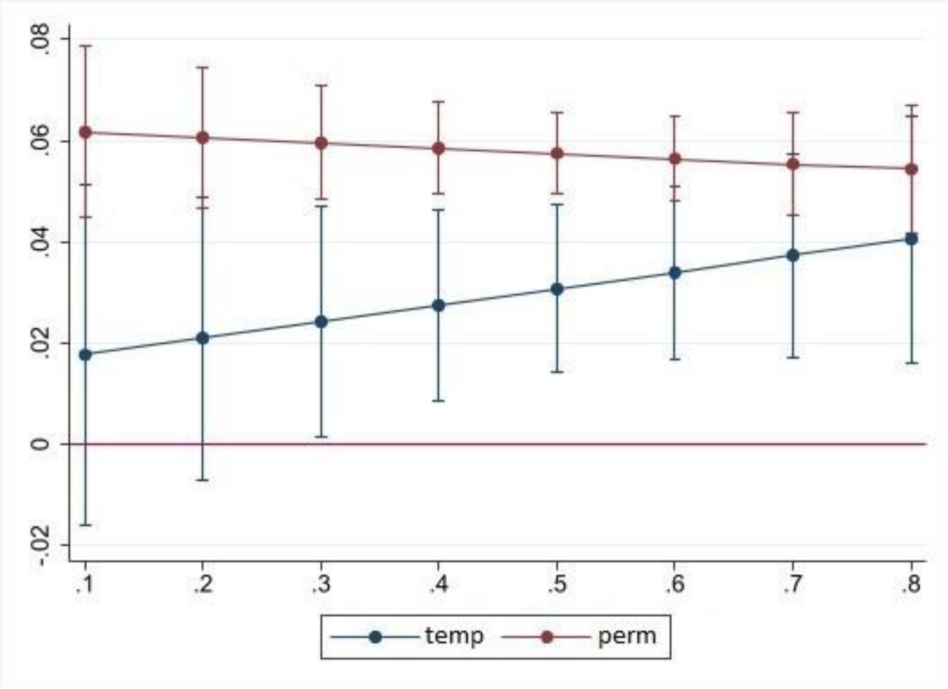
Robust standard errors in parentheses. |*** *p < 0.01*, ** *p < 0.05*, * *p < 0.1*.

Overall, the results are consistent with the idea of an institutional cleavage between contractual groups so that net of individual characteristics and skills, the contract has a stratifying effect within sectors and occupations characterised by relatively homogenous tasks performed by workers.

As mentioned in sections 1 and 2, the country-specific institutional context in general and the trade union setting in particular may play a crucial role in shaping the consequences of technological advancements. Since the abovementioned evidence points clearly in the direction of a contractual penalty in returns on ICT usage, to better gauge the role played by this institutional feature as a moderator of the effect of digital skill usage at the country level, we add to our model an interaction between contractual status and the country-contractual specific trade union density rates. The is to test the salience of the role of temporary employment in shaping ICT wage premiums, especially in contexts where union density is skewed in favour of permanent workers. More specifically, we allow for a three-way interaction among *ictwork*, contract type and the ratio between the union density rates for temporary workers and for permanent contracts. Thus, we focus on national-specific trade union settings to check the extent to which gaps in ICT wage premiums between temporary and permanent workers mirror compositional differences in trade union densities among contractual groups.

Figure 3 shows the wage returns to on the use of ICT skills at work for the two types of contracts along the gradient of the union density rate ratio between temporary and permanent workers. The figure shows that the returns to *ictwork* increase as the temporary contracts are unionised to a similar extent as permanent workers. As the ratio approaches 1 (i.e. the equilibrium between union density rates for temporary and permanent workers), the stratifying effect of the contract vanishes. On the other end of the spectrum, the relative underrepresentation of non-standard employment comes with a significant (or even complete) compression of the ICT skill wage premium. Notably, the contractual-specific returns on ICT do not seem to fit in a zero-sum scenario since the returns on skills for workers with permanent contracts are always statistically different from 0 and appear to be relatively stable, consistently higher and inelastic.

Figure 3: Average marginal effects of ictwork, type of contract and temporary/permanent density ratio (95% CI)



Note: Level 1 stands for temporary contract, and level 2 stands for permanent contract.

To be more precise, the smaller size for temporary contracts on the gradient scale does not allow us to be very accurate at the lower end of the gradient (0.1 and 0.2). However, the figure shows statistically significant different trends up to 0.5, that is, when the unionisation rate of workers on permanent contracts is twice as high as that of the temporary ones. Above this threshold, there appears to be no significant difference between the two groups, although the punctual estimates for temporary contracts are always smaller than those for permanent contracts.

In sum, workers with permanent contracts are always rewarded for ITC skill usage, whereas it is not the case for workers with temporary contracts, whose returns to skills use are conditional to relatively high levels of unionisation.

6 Conclusion

In this paper, we look at the wage premium associated with on-the-job usage of ICT skills and the role of institutional factors in shaping ICT-related wage dynamics. We were not primarily interested in the partial correlation of wages with educational endowments, industry, firm size, or even occupation and task content since we did not trace returns to digital skill usage back to demand dynamics relevant to specific occupations or specific task domains as per skill/routine bias technical change hypotheses. Additionally, we did not assume a deterministic relation between the ICT wage premiums on the one side and education or the task content of occupations on the other. Instead, we followed a growing socio-economic literature that connects cross-country divergences in returns on technology (variously defined in terms of robotisation, digitisation, etc.) not only to structural dynamics in the aggregate demand for specific occupations but largely to heterogeneity in institutional factors. In this paper, our specific focus has been on testing for a net role of ICT usage in shaping micro-level income capacity, highlighting the effect of the contractual divide on ICT-related wage premiums. In line with the idea of an interplay between technical requirements and possible insider-outsider dynamics, we framed temporary employment as a salient institutional dimension in the Western European labour market. We documented the existence of a contractual cleavage between temporary and permanent workers in returns on ICT skill use, with the contract being the main factor in moderating ICT returns among all individual and structural variables. Moving on to a macro-level comparison, we focused on national-specific trade union settings, looking at the extent to which gaps in ICT wage premiums between temporary and permanent workers mirror compositional differences in trade union densities among contractual groups. We found that the use of ICT does not translate into relevant wage premiums for workers with temporary contracts in contexts where union density is particularly skewed in favour of permanent workers. Roughly speaking, temporary workers' returns on the use of ICT skills grow as their unionisation approaches that of their permanent counterparts. This is not the case for regular contracts, which display stable rewards. Loosely speaking, for temporary workers to enjoy ICT-related wage premiums as their permanent counterparts do, high levels of unionisation of temporary workers are needed. However, when the two rates equalise, the returns tend to be similar, and the wage gap in the returns on ICT skill use fades away.

This contribution comes with some analytical and empirical shortcomings. Apart from the lack of a deeper analysis of trade union dynamics at different levels (industry, regional or firm level) due to the unavailability of contractual-specific data to be merged with ours, the primary limitation is the cross-sectional nature of the analysis and the relatively limited number of countries considered in the study. Both points may be addressed when the next PIIAC data is released, enabling a comparison of the results over time and the reliance on repeated country measures. A second issue is related to the specific institutional feature used to grasp the potential role played by dualisation and segmentation dynamics, here proxied by contract-specific trade union density rates. Another measure of institutional segmentation could have been EPL (as a ratio); however, because the data is derived from a cross-sectional form, we would have been forced to rely exclusively on country-specific cross-sectional levels of protection for distinct contractual groups, a practice increasingly criticised and progressively less frequent in socio-economic literature. We are nonetheless confident that our approach allowing for country-, industry- and occupation-specific fixed effects enabled us to focus with a reasonable degree of precision on our main variables of interest (i.e. individual contractual status and contractual dualisation in trade union dynamics) due to the centrality of institutional factors in general and industrial relations in particular in the debate on the macro- and micro-level spill-overs of technological change.

The pieces of evidence provided so far raise further questions and considerations worthy of being analysed in future contributions. A first point concerns the drivers and determinants of the underrepresentation and lack of participation of temporary workers in trade unions, a question that points to possible endogeneity issues, according to a demand-supply scheme shaping trade union membership: are temporary workers a less attractive target group for unions, or are they a selected group of workers whose contractual status entails little interest in union affiliation and lower usefulness of participation? Another aspect is related to a twofold broader interpretation of the findings. First, our results suggest that in shaping micro-level economic and occupational rewards, technical change will reasonably increase the role of meso factors such as firm characteristics (OECD, 2021) or, at the micro level, the influence of other job characteristics, including the control of information at the workplace, as recently proposed by some scholars (Kristal, 2020). Second, if it is certainly true that skill requirements associated with technological change have an asymmetrical impact on different groups in the labour market, these distributive effects do not necessarily hinge on occupational class or educational dimensions, as per skill bias and routine bias perspectives on technical change. We add to this literature, showing that ICT skill usage magnifies other cleavages within the workforce, such as the contractual one. If this holds true, it implies that technological advancements can significantly interplay with segmentation dynamics in national labour markets and with dualisation dynamics in trade union representation.

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Appendix

Endogeneity issues

To deal with the endogeneity problem mentioned in section 3, we built two instruments using a shift-share approach. The first instrument consists of the leave-one-out mean of *ictwork* within a sector, firm size and ISCO, leaving out the values of *ictwork* for workers employed in the same country as individual *i*. In other words, for each individual, our instrument represents the average level of ICT use of workers in the same sector, firm size and ISCO group in all the countries but excluding the average level of *ictwork* of individuals working in the same country as individual *i*. The rationale behind this analytical option is that the average ICT usage level in other countries within the same sector, occupation and firm size is correlated to the ICT usage of the *i*-th individual in country *j* but not directly to her/his income. More formally, the instrument is built as follows:

$$\overline{ictwork_{i,c,s,f,I}} = \frac{\sum ictwork_{j,s,f,I}}{N_{s,f,I}}$$
$$with \quad i \neq j$$

where the instrument for individual *i*, working in country *c* in sector *s*, employed in a firm of *f* dimensional size and occupied according to ISCO level *I*, is equal to the sector-, size- and ISCO-specific average of individuals *j* working in countries other than that of individual *i*. $N_{s,f,I}$ represents the number of *j* individuals of the sector-, size- and ISCO-specific cell.

In the same vein, we build a second instrument as the mean of ICT skill use at work within a country, industry and ISCO, leaving out firms in size classes higher than the one considered for individual *i*. The rationale is that ICT use in the same country, sector and ISCO but in the other size classes is correlated with the ICT use of other size classes but not with wages. This assumption holds only when the 'other' enterprises are the most productive (i.e. the largest ones). In fact, it is difficult for small enterprises to pay workers more if the 'others' make greater use of ICT. However, when the instrument leaves out SMEs, for example, it is still likely that those firms can decide to increase their wages to keep the most skilled workers from leaving. This is why we leave out firms in a higher size class than that of individual *i*. More formally, this translates as:

$$\overline{ictwork_{i,c,s,f,I}} = \frac{\sum ictwork_{j,c,s,I}}{N_{c,s,I}}$$
$$with \quad i \neq j \quad and \quad s_i <= s_j$$

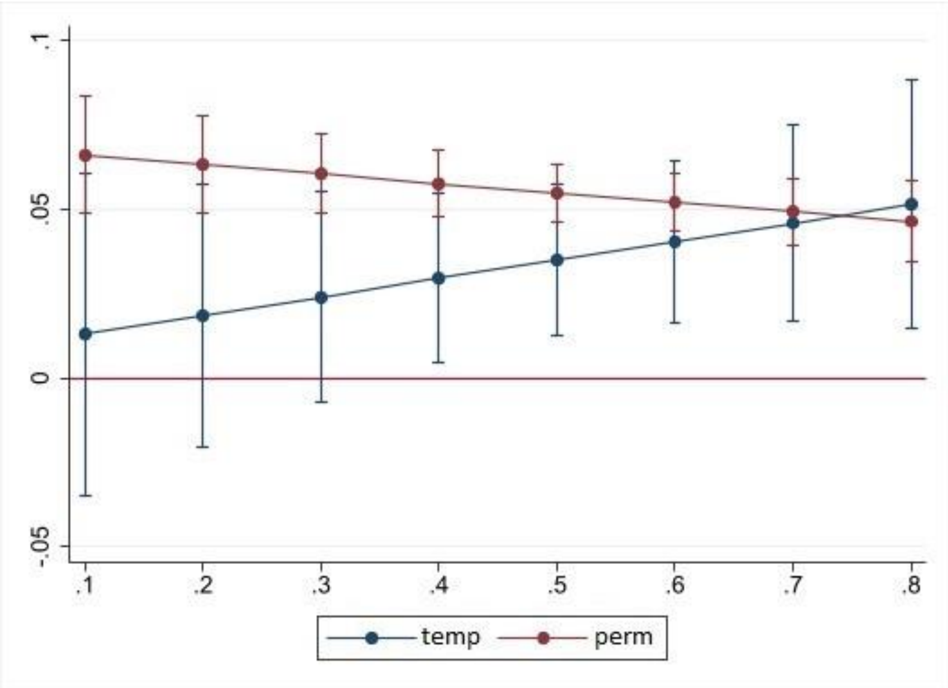
It is worth mentioning that these instruments vary at the sector, size and ISCO cell level, and their effects must thus be intended at this level of aggregation – a necessary compromise since the PIAAC contains no firm-specific information and our instruments are the finest-grade tools for capturing this kind of endogeneity.

Trade unions and stratification dynamics

In the data section, the reference year for some unionisation rates is 2016, that is, three years after the date of publication of the data and four after the administration of the survey. This is because values around 2013 were missing in the ICTWSS database. Although a one- to two-year lag may plausibly remain constant in terms of trade union representation, three years may already pose an issue. Therefore, we decided to carry out the same exercise excluding the two countries whose unionisation rates were from 2016, namely, Ireland and Poland. We present the results in the figure below.

Average marginal effects of *ictwork*, type of contract and temporary/permanent coverage ratio (95% CI)

(IE and PL excluded since data are from 2016)



Note: Level 1 stands for temporary contract, and level 2 stands for permanent contract.

Although the two groups are not significantly different, mainly due to the increased imprecision of the estimates, the main pattern described for the previous figure remains valid:

permanent contract workers are always rewarded for ITC skill usage – of course, as the variable is a ratio, the representation advantage of permanent workers over temporary workers decreases as it increases. Meanwhile, this is not the case for temporary contracts; however, they may not be rewarded at all if the unionisation levels of these contracts are very low.

Tables

Table 9: Descriptive statistics

	Mean	Median	SD	N	Mean	Median	SD	N
		DK				*ES*		
ln(hourly wage)	5.18	5.2	0.51	4,424	2.27	2.21	0.56	2,405
gender	0.51	1	0.5	7,191	0.51	1	0.5	5,945
age	44.17	46	14.61	7,191	40.17	40	13.56	5,945
experience	23.46	24	14.2	6,951	16.9	15	12.19	5,061
tenure	9.93	6	10.28	4,697	11.19	8	9.85	2,714
ictwork	1.76	1.7	1.17	5,163	1.41	1.34	1.22	2,735
numeracy	276.03	280.96	52.97	7,149	243.41	248.49	53.21	5,861
literacy	267.27	273.25	49.51	7,149	250	254.74	50.6	5,861
problem solving	280.03	282.49	42.15	5,984	.	.	.	0
		FR				*IE*		
ln(hourly wage)	2.55	2.5	0.47	3,742	2.82	2.83	0.82	2505
gender	0.51	1	0.5	6,959	0.54	1	0.5	5,631
age	41.84	43	14.27	6,959	40.65	40	13.12	5631
experience	20.46	20	13.28	6,156	18.04	16	11.75	5189
tenure	11.51	8	10.92	3,981	10.22	7	9.25	2735
ictwork	1.47	1.46	1.11	4,005	1.55	1.42	1.3	3,417
numeracy	256.39	261.56	56.86	6,873	258.17	261.97	53.03	5,611
literacy	263.59	268.45	49.16	6,873	269.1	273.03	46.87	5,611
problem solving	.	.	.	0	277.63	278.29	39.55	3,874

Continuation of table 1

	Mean	Median	SD	N	Mean	Median	SD	N
		IT				*NL*		
ln(hourly wage)	2.49	2.44	0.53	1,801	2.8	2.82	0.67	3,152
gender	0.52	1	0.5	4,555	0.51	1	0.5	5,085
age	42.55	43	13.26	4,555	42.01	43	14.29	5,086
experience	18.57	18	12.05	3,850	19.96	19	12.69	4,790
tenure	12.85	10	10.17	2,163	10.7	7	10.2	3,374
ictwork	1.58	1.57	1.27	2,246	1.87	1.85	1.01	3,480
numeracy	251.7	254.8	50.04	4,523	281.75	286.45	49.29	5,000
literacy	254.89	257.03	44.42	4,523	285.22	289.08	46.65	5,000
problem solving	.	.	.	0	286.12	288.33	41.15	4473
		PL				*UK*		
ln(hourly wage)	2.59	2.54	0.62	3,774	2.4	2.34	0.57	4583
gender	0.5	0	0.5	9,143	0.58	1	0.49	8,565
age	31.34	25	13.81	9,143	41.35	41	13.57	8565
experience	10.82	5	12.17	7,178	19.89	19	12.6	7973
tenure	6.41	3	8.14	4,252	9.71	7	8.96	4817
ictwork	1.18	1	1.19	4,639	1.82	1.83	1.18	5,045
numeracy	264.77	267.6	49.03	9,143	260.37	262.64	53.41	8,479
literacy	273.96	277.34	46.05	9,143	271.83	275.14	47.46	8,479
problem solving	279.84	281.66	45.75	5841	276.79	277.91	41.2	7,056

Table 10: Descriptive statistics by type of contract

	Temporary				Permanent			
	Mean	Median	SD	N	Mean	Median	SD	N
ln(hourly wage)	2.76	2.49	1.03	3,424	3.24	2.87	1.18	16,116
gender	0.55	1.00	0.50	3,424	0.52	1.00	0.50	16,116
age	32.91	29.00	11.99	3,424	42.13	42.00	11.17	16,116
experience	11.27	7.00	11.20	3,424	20.79	20.00	11.50	16,116
tenure	4.24	2.00	6.14	3,423	12.05	9.00	10.07	16,107
ictwork	1.53	1.44	1.10	3,424	1.89	1.87	1.10	16,116
numeracy*	271.18	273.44	49.79	3,424	280.96	284.10	47.70	16,116
literacy*	280.58	283.97	45.96	3,424	283.34	286.61	43.25	16,116
problem solving*	292.20	294.19	41.08	2,095	288.95	290.84	38.61	9,778

*: For the three domains assessed, proficiency is considered a continuum of ability represented as a 500-point scale.

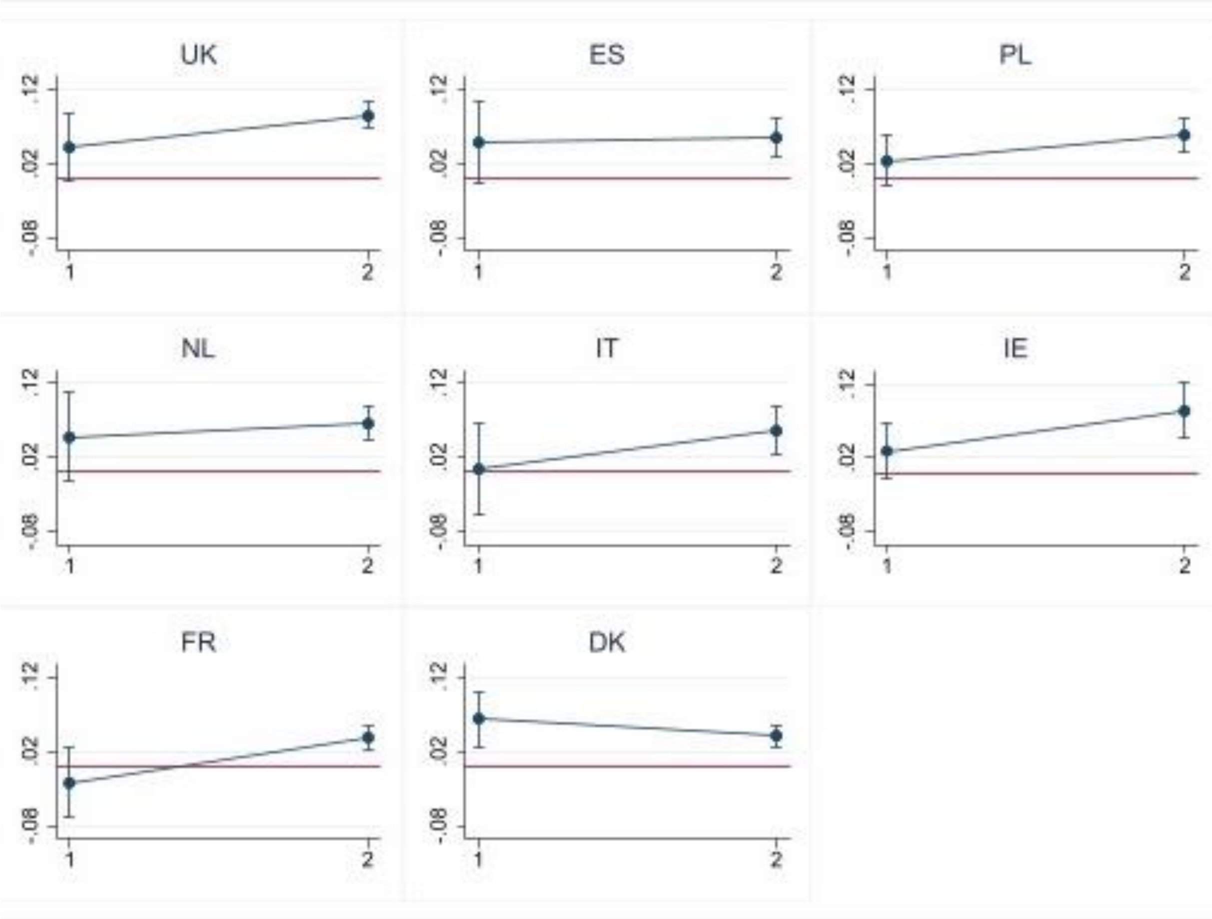
Table 11: Mincer earnings function on hourly wage by country (model 3b)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Denmark	France	Ireland	Italy	Netherlands	Poland	Spain	UK
ictwork	0.06**	-0.03	0.02	-0.01	0.04	0.02	0.04	0.04
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)
permanent	0.18***	0.07	-0.06	0.08	0.15*	0.08*	0.12*	-0.02
	(0.04)	(0.04)	(0.05)	(0.07)	(0.07)	(0.04)	(0.05)	(0.05)
permanent*	-0.03	0.06**	0.06*	0.05	0.02	0.04*	0.01	0.04
ictwork	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)
N	3720	2732	2016	1166	2509	2343	1483	3571
r2	0.31	0.44	0.18	0.38	0.36	0.37	0.42	0.39

Standard errors in parentheses. | * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

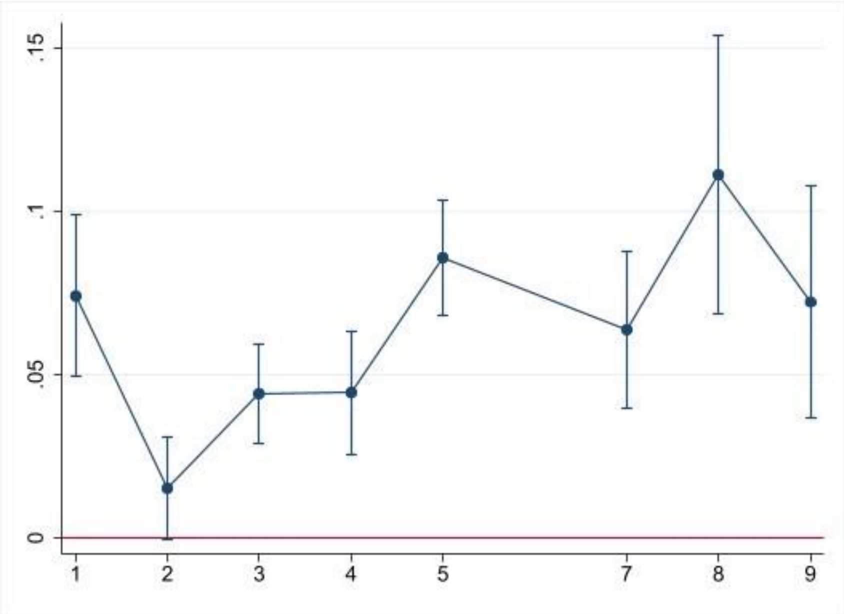
Figures

Figure 5: Average marginal effects of ictwork by type of contract and country



Note: Level 1 stands for temporary contract, and level 2 stands for permanent contract 5.

Figure 6: Average marginal effects of ictwork by ISCO major groups, all countries (95% CI)



Note: Agricultural occupations are excluded.