ICT Diffusion, Working Conditions, and Job Satisfaction

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Abstract

This paper examines how digitization has affected wages, working conditions, and job satisfaction. Using French employer-employee data and an instrumental variable approach, we find that ICT adoption improves wages and working conditions, particularly through greater flexibility and physical comfort. However, in the private sector, it also increases work intensity. ICT diffusion has been associated with an overall rise in job satisfaction, mainly driven by better working conditions. This generates "rents" that accrue to workers in ICT-intensive occupations, who enjoy higher wages, improved working conditions, and ultimately higher job satisfaction.

Keywords: Digitalization; Polarization; Working conditions; Well-Being at Work; Job Satisfaction

JEL codes: J3; J81; O33; I31; J28

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1 Introduction

Technology continuously modifies work arrangements, wages, and well-being at work. Over the last decades, the main technical transformation has been digitization, i.e. the wide diffusion of information and communication technologies at the workplace. A very large economic literature has studied the impact of this transformation on productivity and the structure of jobs and wages. Before 2020, during the late 1990s and the early 2000s, digital transformation has been shown to create a massive trend of job polarization at the extremes of the wage distribution , with progressive replacement of programmable routine jobs (middle-class workers) by computers and robots. (Autor et al., 2006, 2003; Goos and Manning, 2007; Acemoglu and Autor, 2011;Ottaviano et al., 2013; Autor et al., 2014; Moreno-Galbis and Sopraseuth, 2014; Harrigan et al., 2021; Autor et al., 2008; Ottaviano and Peri, 2012; Goos et al., 2014). With the Covid-19 pandemic, distant communication technology has allowed the massive extension of work-from-home arrangements. Currently, the explosion of artificial intelligence has started a massive overhaul of our work practices, in all areas of the economy. To date, most efforts have been dedicated to understanding the material impact of these changes. Few studies have addressed their consequences on non-pecuniary aspects of jobs, such as working hours, autonomy, flexibility, and work intensity, and on subjective well-being at work.

In this paper, we focus on the pre-Covid period, when ICT technology became omnipresent. We study the impact of digitization on the different drivers of well-being at work and job satisfaction. We draw a picture of the aggregate transformation of the labor market, under these transformations, in terms of ICT intensity, wage structure, non-pecuniary working conditions, and job satisfaction. We first describe these trends and then use econometric identification strategies to assess the causal impact of ICT diffusion on the other evolutions.

We rely on matched employer-employee data for the period 2013–2019 in France. This enables us to implement an instrumental variable strategy, exploiting firm-level variation in ICT adoption to identify its impact on workers' wages and working conditions. Our identifying assumption is that a firm's ICT adoption rate captures an 'intention to treat,' while the intensity of ICT adoption by workers reflects actual treatment take-up. This approach allows us to estimate the causal effect of ICT adoption on wages and working conditions, as well as job satisfaction.

We first document how firm-level ICT adoption influences wages and working conditions, controlling for detailed occupation, employer, and worker characteristics that could

affect these outcomes. To measure working conditions, we rely on a composite indicator encompassing a wide range of factors such as learning opportunities, autonomy, support, stability, physical comfort, physical safety, psychological integrity, adherence to standard working hours, work-life balance, flexibility, and work intensity. We also analyze the effect of ICT on each component separately. Between 2013 and 2019, the proportion of workers using ICT increased by 26 percentage points in our data. Using firm ICT adoption rates as an instrument for a worker's use of ICT, we find that ICT adoption significantly improves both workers' hourly wages and overall working conditions. The improvement in working conditions has been driven by better physical comfort, adherence to standard working hours, and greater job flexibility. However, in the private sector, ICT adoption has also been associated with a more constrained work pace.

More specifically, we find that a 10-percentage point increase in the time spent using ICT during the workday increases hourly wages by 7.1% and working conditions by 0.12 standard deviations. These improvements are not solely driven by workers reallocating across jobs. We obtain similar results when accounting for individual fixed effects and individual*establishment fixed effects, relying on within-individual and within-establishment variations.

Second, we find that workers positively value increases in both wages and working conditions. Specifically, a 1 SD increase in log hourly income increases job satisfaction by 0.07 SD and a 1 SD increase in working conditions increases job satisfaction by 0.40 SD. Combining these effects with the 2SLS estimates of the effect of ICT on wages and working conditions, we estimate that a 1 SD increase in the time spent using ICT during the workday increased job satisfaction by 0.30 SD. To test whether ICT diffusion could have affected workers' job satisfaction through other channels, we also directly estimate the relationship between ICT use and workers' job satisfaction controlling for worker's wages and working conditions. We find that most of the positive relationship between ICT diffusion and workers' job satisfaction is driven by the indirect effect of ICT through higher wages and improved working conditions. Specifically, 95% of the positive relationship between ICT adoption and job satisfaction is attributed to the indirect effect of ICT through wages and working conditions. Of this indirect effect, 8% is attributed to the indirect impact of ICT through better wages, and 92% to the indirect effect through improved working conditions. These results thus suggest that most of the effect of ICT on workers' job satisfaction comes from better working conditions.

These findings support the existence of rents associated with ICT adoption, where work-

ers in more ICT-intensive firms receive higher wages and enjoy better working conditions, which in turn enhance job satisfaction. While previous literature has primarily focused on the wage effects of ICT adoption, it may have overlooked the broader impact of ICT on inequalities.

Literature

This paper contributes to several strands of literature. First, we integrate the effects of ICT diffusion on working conditions and job satisfaction into the extensive and expanding literature that examines the connection between ICT diffusion, employment shifts, and wage dynamics (e.g. Autor et al., 2003; Goos and Manning, 2007; Goos et al., 2009; Michaels et al., 2014; Frey and Osborne, 2017; Arntz et al., 2016). Only recently has the influence of technology use on employees' working conditions become a focus of research. ICT has been shown to improve communication among workers (Hart and Moore, 2005; Dessein and Santos, 2006; Cremer et al., 2007), reduce information asymmetries (Jensen and Meckling, 1992), and increase productivity (see Institute for Prospective Technological Studies, 2013 technical report for a literature review). At the same time, ICT has been found to affect autonomy, lengthen working hours, worsen work-life balance, and increase work intensity (BBloom et al., 2014, Martin and Omrani, 2015; Martin, 2017; Menon et al., 2020; Gihleb et al., 2020; Caselli et al., 2021), with negative consequences for health and well-being (see for instance Schwabe and Castellacci, 2020; Gunadi and Ryu, 2021; Bolli and Pusterla, 2022; Lordan and Stringer, 2022; Kortmann et al., 2022; Haepp, 2021; Eurofound and ILO, 2017 report or Martin and Hauret, 2022 for a review). Our paper takes a broader perspective by considering multiple components of working conditions together, suggesting that ICT diffusion has been associated with an overall improvement in working conditions.[1] Unlike previous studies, our paper also relies on matched employer-employee data, allowing us to control for both individual and employer characteristics and to develop an instrumental strategy using firm-level ICT adoption, thereby improving causal inference in this literature.

Second, our paper relates to the literature on the determinants of job satisfaction. Previous studies on workers' preferences regarding job attributes do not consider ICT intensity, with the exception of Bolli and Pusterla (2022). Using Swiss data, Bolli and Pusterla estimate a positive association between digitization and job satisfaction. A key contribution of our paper is to show that workers' job satisfaction positively correlates with ICT adoption,

[1]Some papers take a perspective of multiple components of working conditions as we do here (e.g. Askenazy and Caroli, 2010; Green et al., 2013; Osterman, 2013; Antón et al., 2023; Duhautois et al., 2022).

mainly due to its positive effect on wages and working conditions.

Finally, our paper contributes to the debate on occupational rents. Both survey data (e.g., Hamermesh, 1999; Pierce, 2001; Maestas et al., 2023) and experimental studies (e.g., Mas and Pallais, 2017; Wiswall and Zafar, 2018) suggest that higher wages may serve as compensation for unfavorable job amenities. However, Clark et al. (2024) provides evidence of an unequal distribution of both wages and non-pecuniary job amenities across occupations, with some occupations offering both higher wages and better working conditions —consistent with the existence of occupational rents. They further argue that the distribution of job satisfaction across occupations is even more unequal than that of wages. Our study is the first to demonstrate that these disparities in wages, working conditions, and job satisfaction across occupations —as well as the presence of occupational rents in certain jobs —are, at least in part, driven by ICT adoption. More broadly, this study is the first to consider the overall consequences of ICT adoption on the distribution of wages, working conditions and job satisfaction together, as well as its related impacts on employment dynamics across these three dimensions.

The remainder of the article is organized as follows: Section 2 describes the data; Section 3 the empirical strategy, Section 4 presents the estimates of the effects of ICT on wages, working conditions, and job satisfaction. Section 5 concludes.

2 Data

2.1 The Working Conditions Survey

The Working Conditions Survey is an annual representative sample of around 25,000 employed workers in France. It is conducted by the *Direction de l'Animation de la Recherche, des Études et des Statistiques* (DARES) in collaboration with the *Institut National pour la Statistiques des Etudes Economiques* (INSEE). Since 2013, this survey has been conducted every three years.

The survey provides a comprehensive description of work, its organization and its conditions in various dimensions: work organization, cooperation, conflicts, schedules, physical efforts or risks, safety, hardship and work rhythms. In addition, the survey reports information on the socio-demographic characteristics of individuals (gender, age, education, marital status, children, type of employment contract) as well as information on their monthly wages and number of hours worked.

In 2013 and 2019, the survey also included information on the use of information and communication technologies by workers. More specifically, workers were asked how many weekly minutes they spent using at least one of the following IT tools: a computer, laptop, professional email address, internet and intranet. We convert this variable to compute the number of daily hours an individual uses these technologies. We then define our ICT indicator as the proportion of daily working during which the individual uses ICT. The proportion of workers who use ICT at all in our data increases from 73.4% in 2013 to 100% in 2019. Among the workers who report hours spent working with ICTs, the average intensity increased from 37% of total working time using ICT in 2013 to 53% in 2019. Not only did a larger share of individuals use ICT in 2019 compared to 2013, but they also used ICTs more intensively.

About 50% of the interviewed workers were surveyed in both 2013 and 2019 (panel dimension), for a total of 25,000 observations. Table 1 compares the characteristics of the entire employee sample with the panel sample. We drop workers from the agricultural sector and those living outside mainland France. Women account for 56% of our sample, 63% hold a diploma higher than or equivalent to the French Baccalauréat (end of high school), and around 81% work full-time.

Although some differences emerge between the two samples, with the panel sample being slightly older, the characteristics of the two samples are virtually the same. Since 2013, the Working Conditions Survey has also included a matched employer-employee database, linking employer survey responses with worker information. Approximately 47% of the initial employee dataset has been matched to employer survey responses, for a total of 23,800 observations. For these 23,800 observations, we therefore have information on both the employer and the employee.

Table 1 additionally compares the characteristics of the merged employer-employee sample with those of the initial employee sample and the panel employee sample. There are slightly fewer women in the merged employer-employee sample, a higher proportion of full-time workers, and fewer immigrants. However, the samples remain remarkably comparable overall.

The merged employer-employee dataset contains about 13,788 establishments (observed either in 2013 or in 2019). On average, we observe 3.4 employees per establishment in this sample (see Appendix Table A.1 for the distribution of employees per establishment). Most employers responded to the survey in only one wave. Only 1,926 establishments appear in both 2013 and 2019.

Table 1: Summary Statistics for Initial Employee, Panel and Merged Samples (in 2013 and 2019)

	Initial employee sample			Panel sample			Merged sample		
	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Male	50,313	0.44	0.50	25,078	0.43	0.50	23,867	0.43	0.49
Age	50,309	43.91	10.62	25,075	44.60	9.38	23,865	43.85	10.43
No Diploma	50,242	0.06	0.24	25,052	0.05	0.22	23,852	0.06	0.23
CEP, Brevet	50,242	0.07	0.25	25,052	0.05	0.22	23,852	0.06	0.24
CAP, BEP	50,242	0.25	0.43	25,052	0.25	0.43	23,852	0.25	0.43
Baccalaureate	50,242	0.18	0.38	25,052	0.18	0.39	23,852	0.18	0.38
BAC+2	50,242	0.15	0.36	25,052	0.17	0.37	23,852	0.15	0.36
BAC+3 ou BAC+4	50,242	0.16	0.36	25,052	0.17	0.37	23,852	0.16	0.37
BAC+4 or more	50,242	0.14	0.34	25,052	0.14	0.34	23,852	0.14	0.35
In couple	50,308	0.77	0.42	25,074	0.79	0.41	23,865	0.77	0.42
Has children	50,313	0.60	0.49	25,078	0.66	0.47	23,867	0.61	0.49
Immigrant	50,313	0.09	0.29	25,078	0.07	0.25	23,867	0.08	0.27
Full-time worker	50,074	0.81	0.39	24,986	0.81	0.39	23,848	0.83	0.38
ICT	45,334	0.44	0.39	22,534	0.46	0.38	21,818	0.45	0.39

Notes: Working conditions survey, 2013, 2019, including public and non-farm private sectors.

The employer survey contains information on general establishment characteristics, workforce management, work organization, and employee representation. In particular, in both 2013 and 2019, employers were asked about the share of workers who use the internet in the workplace. The response options were: "not using it", "less than 10%", "10-50%", "50% and more" and "I do not know". We use this information to construct our two instruments for worker's ICT use. The first instrument equals 1 if the establishment reports that between 10% and 50% of workers use the internet, and the second equals 1 if more than 50% of workers in the establishment use the internet. It is important to note that this measure of ICT adoption rate at the establishment level is based on employer responses, which consider the entire workforce of the establishment. Therefore, the fact that we do not observe all employees per establishment does not pose an issue.

The share of establishments where none of their employees use ICT is extremely low in both 2013 and 2019. The share of establishments where fewer than 10% (but more than 0) of the workforce uses ICT declined from 14% in 2013 to 11% in 2019. We also find a reduction in the share of establishments where between 10% and 50% of their employees

use ICT. Conversely, the share of establishment where more than 50% of their employees use ICT increased, from 56% in 2013 to 62% in 2019 (see Figure A.1 in Appendix).

2.2 Wages, Working Conditions and Job Satisfaction

Working Conditions. Numerous measures of working conditions were collected in the WCS data. Previous studies on the effect of ICT on working conditions have usually relied on a subset of them. In this study, we adopt a more comprehensive approach and explore the impact of ICT on a broad range of working conditions. We follow the Eurofound convention (see Eurofound, 2015 and Eurofound and ILO, 2017) and define twelve non-pecuniary working conditions: learning, autonomy, support, stability, physical comfort, physical safety, psychological safety, standard working hours, not working on the weekend, work-life balance, flexibility and an unconstrained work pace. All of these are reported in both 2013 and 2019.

1. **Learning.** is the mean of four variables: (i) an indicator variable set to 1 if the individual reports learning new skills on the job, (ii) an indicator for access to sufficient and appropriate training, (iii) a discrete variable equal to 0, 1/3, 2/3, and 1, reflecting improved prospects for career advancement and (iv) a similarly defined discrete variable signifying opportunities for professional skill development.

2. **Autonomy.** is the mean of (i) an indicator for the ability to choose methods to accomplish work objectives, (ii) an indicator equal to 1 if there is no immediate dependence on the work of one or more colleagues, (iii) a discrete variable ranging from 0 to 1 (i.e., 0, 1/3, 2/3, and 1), where higher values represent less adherence to orders, (iv) a discrete variable ranging from 0 to 1 indicating the degree to which work rhythm is influenced by external client demands.

3. **Support.** is the mean of three indicators equal to 1 if the individual declares receiving support from (i) colleagues, (ii) from their manager, and (iii) for having the opportunity to cooperate with others.

4. **Stability.** is the mean of (i) an indicator equal to 1 if the individual believes that they have a low probability of losing their job in the next six months, (ii) a discrete variable equal to 0, 1/6, 2/6, 3/6, 4/6, 5/6 and 1, where 0 corresponds to the situation of working without a contract and 1 corresponds to a permanent contract or civil service

position, and (iii) a continuous variable which measures seniority and is normalized between 0 and 1.

5. **Physical comfort.** captures the absence of physical uncomfortable movements or gestures at work. It is the mean of six indicator variables that take the value 1 if (i) the worker does not work in painful positions, (ii) does not stand up for long periods, (iii) does not need to walk extensively, (iv) does not move heavy loads, (v) does not perform painful or tiring movements, and (vi) does not continuously repeat the same series of gestures or operations.

6. **Physical safety.** captures lower physical risks at work. It is the mean of four indicator variables that are equal to 0 when the individual is exposed to the corresponding physical risk and equal to 1 when the individual is not exposed. These physical risks include: (i) vibrations, (ii) smoke, (iii) exposure to chemical products, and (iv) traffic accidents.

7. **Psychological safety.** measures the extent to which an individual's working conditions do not involve psychological stress. It is the mean of five variables: (i) a discrete variable capturing whether the individual has to do things they disapprove of (0=often, 1/3 and 2/3 for intermediate values and 1 never), (ii) a discrete variable capturing the absence of pressure at work (0=always, 1=never), and three indicator variables for the absence of tense interactions with (iii) clients, (iv) managers, and (v) colleagues.

8. **Standard hours.** is the mean of three discrete variables that takes the value 0, $\frac{1}{2}$ and 1 and summarizes whether an individual's job does not require working (i) in the evenings, (ii) at night, and (iii) early in the morning.

9. **Not working weekend.** is the mean of two discrete variables that takes the value 0, $\frac{1}{2}$ and 1 and summarizes whether an individuals' job does not require working on (i) Saturdays and (ii) Sundays.

10. **Flexibility.** is the mean of four variables: (i) an indicator variable for the individual's ability to take a break whenever they want during the day, and three discrete variables that takes value between 0 and 1, capturing whether (ii) the individual's working time is not monitored, (iii) the individual can organize their work time freely, and (iv) the individual can easily take 1-2 hours off during the day.

11. **Work-life balance.** is the mean of four discrete variables equal to 0, 1/3, 2/3, 1, where 1 corresponds to (i) no need to work overtime, (ii) no need to bring work home, (iii) no need to think about work outside of work hours and (iv) compatible work hours with family and social activities.

12. **Unconstrained work pace.** is the mean of four variables: (i) an indicator variable for whether the individual has enough time to do their job, and three discrete variables that takes value between 0 and 1, capturing whether (ii) the individual does not have to work at high speed, (iii) does not have strict deadlines and (iv) does not have to manage an excessive worload.

The higher the values of these indicators, the better the working conditions. The summary statistics and the correlation matrix for the 12 non-pecuniary working conditions are provided in the Appendix Tables A.2 and A.3. Overall there has been a small improvement in working conditions between 2013 and 2019, driven by the increases in learning and development, support, stability, physical comfort, physical risk, standard working hours, and unconstrained work pace. We also note that these 12 dimensions are not highly correlated: most of the correlations range between 0.1 and 0.2. The highest correlation is between physical comfort and physical risk (0.45). We summarize these non-pecuniary working conditions with a single variable and facilitate comparisons with wages, we also compute an unweighted mean of these twelve indicators, which we standardize to have a mean of 0 and a standard deviation of 1 ("Non-pecuniary index", NPI, see below).

Wages. The Working Condition Survey also collects information on workers' monthly wages. We use the weekly hours of work to define the hourly wage and adjust wages for CPI information between survey years (CPI reference year 2005).

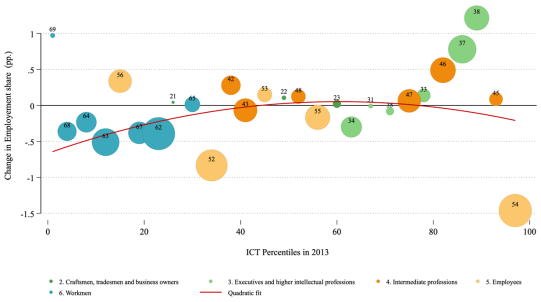
Job Satisfaction. Information on workers' job satisfaction was collected in 2019. Employees were asked "Over the course of your working life, please rate from 0 to 10 your level of agreement with the following statement: for the most part, I am satisfied with my professional life, where 0 means "not satisfied at all" and 10 "totally satisfied".

2.3 Stylized facts about ICT, wages, and working conditions

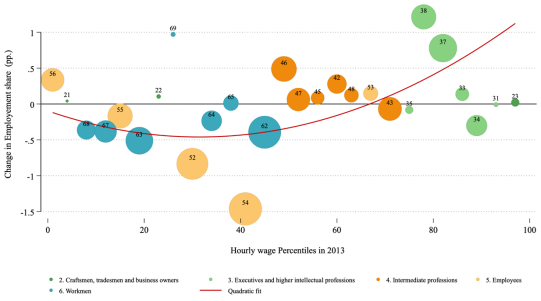
Figure 1 (Panel A) illustrates the growth in employment shares within ICT-intensive occupations in France between 2013 and 2019. As seen in many European countries, these

shifts on the French labor market have been accompanied by occupational upgrading (e.g., Reshef and Toubal, 2024; Eurofound, 2015 report; Arntz et al., 2022). Figure 1 (Panels B and C) show that the rise in employment shares in ICT-intensive occupations has been associated with an increase in both higher-paying jobs and occupations with improved working conditions. However, these two dimensions do not always align perfectly.

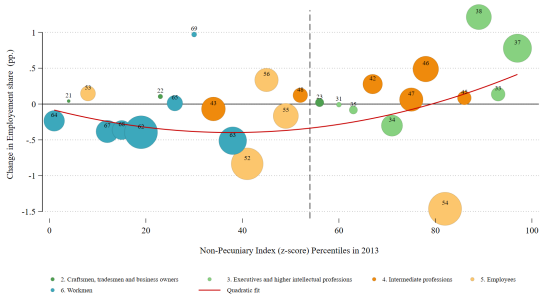
Figure 1: Changes in Employment Shares along the ICT, Wages and Working Conditions Distribution



(a) ICT percentiles



(b) Wage percentiles



(c) Working conditions percentiles

Notes: French Working Conditions Survey (WCS). These figures show changes in employment shares, in percentage points, from 2013 to 2019, by occupation on the Y-axis. Occupations are ranked from left to right based on their percentile of ICT use (or wages or working conditions) in 2013 on the X-axis. Weights are applied to ensure a representative sample. ICT use is defined as the proportion of daily work hours during which an individual uses ICT. Working conditions are measured using an aggregate indicator, the Non-Pecuniary Index (NPI), which is constructed from 12 sub-indicators: learning, autonomy, support, stability, physical comfort, physical risk, psychological integrity, standard working hours, no weekend work, flexibility, and unconstrained work pace. The size of each observation represents the initial employment share in 2013. Each observation is identified by its French occupation code (*Professions et catégories socioprofessionnelles*, PCS). The sample includes both the public and non-farm private sectors.

3 Empirical strategy

Our matched employer-employee data, combining employer survey responses with individual worker characteristics, enables us to implement an instrumental variable strategy, exploiting firm-level variation in ICT adoption to identify its impact on workers' wages and working conditions. Our identifying assumption is that a firm's ICT adoption rate captures an 'intention to treat,' while the intensity of ICT adoption by workers reflects actual treatment take-up. This approach allows us to estimate the causal effect of ICT adoption on wages and working conditions.

Changes in wages and working conditions due to ICT adoption are likely to influence workers' job satisfaction. Thanks to the richness of the data, we can assess the role of wages and working conditions in workers' job satisfaction, and to what extent these changes are due to ICT adoption. Thus, we combine the advantages of matched employer-employee data to identify 'demand' shocks in the adoption of ICT with information on job satisfaction of workers to investigate 'supply side' effects.

We first document how firm-level ICT adoption influences wages and working conditions. The data allow us to control for detailed occupation, employer, and worker characteristics that could affect these outcomes. To measure working conditions, we rely on a composite indicator encompassing a wide range of factors such as learning opportunities, autonomy, support, stability, physical comfort, physical safety, psychological integrity, adherence to standard working hours, work-life balance, flexibility, and work intensity. We also analyze the effect of ICT on each component separately.

3.1 ICT, Wages and Working Conditions

We begin by estimating the relationship between ICT use, wages and working conditions using the following specifications:

$$Y_{ijet} = \beta_Y + \pi_Y ICT_{it} + X_{it}\delta_Y + X_{et}\rho_Y + \alpha_t + \alpha_{r(i,t)} + \alpha_j + \alpha_e + \alpha_i + \varepsilon_{ijet}, \quad (1)$$

where Y_{ijet} represents the outcome variable (log hourly wage or working conditions) for individual i in occupation j, working in establishment e in year t. ICT_{it} denotes the share of normal workday hours during which individual i uses ICT in year t. X_{it} includes individual socio-demographic controls (gender, age, education, marital status, children, immigration status and whether individual is a full-time worker). X_{et} comprises establishment-level control variables (establishment workforce size, presence of a staff delegate, presence of a

staff union, and existence of a health and safety committee). We consider different model specifications with varying fixed effects, including year (α_t), occupation (α_j), establishment (α_e), individual (α_i), and region of residence $\alpha_{r(i,t)}$), where $r(i,t)$ denotes the region where individual i resided in year t.

All specifications are estimated on the merged employer-employee sample. In addition, we consider only individuals for whom both information on wages and working conditions have been specified. We use weighted least squares (WLS) regressions with sampling weights to ensure that the sample is representative of the whole labor force population.[2] We report robust standard errors clustered at the individual level.

3.2 IV strategy.

To aim at a causal effect of ICT intensity on wages and working conditions, we exploit the matched employer-employee dimension of our data and instrument our explanatory variable ICT_{iejt} by ICT intensity of the establishment in which the individual works.

Specifically, we use two dummy variables: the first equals one when the percent of employees in the establishment that use the internet is between 10% and 50% and zero otherwise; the second equals one if more than 50% of the employees of the establishment that use the internet and zero otherwise. Together, these indicators capture the establishment's "intention to treat" for using ICT. We interpret the individuals' ICT use intensity as "treatment take-up".

The identification assumption is that the establishment's intention to treat affects the outcome Y_{ijet} only through the individual take-up. This is a reasonable assumption because the establishment information pertains to the propensity of ICT use for all of its employees, while only a handful of them – and typically only one (see Appendix A.1) – are sampled in the WCS. The exclusion restriction is reinforced by controlling for both individual and establishment control variables. We thus estimate the following equations using weighted two stage least squares (W2SLS) using sampling weights:

$$Y_{ijet} = \beta_Y + \pi_Y ICT_{it} + X_{it}\delta_Y + X_{et}\rho_Y + \alpha_t + \alpha_{r(i,t)} + \alpha_j + \varepsilon_{ijet}$$

with

$$ICT_{it} = \theta + \lambda_1 \chi_{10-50} + \lambda_2 \chi_{>50} + X_{it}\mu + X_{et}\sigma + \tau_t + \tau_{r(i,t)} + \tau_j + u_{ijet}$$

[2]See Appendix B for further details on the computation of weights.

Since the instrument varies by establishment, and some establishments do have more than one employee in the WCS, we report robust standard errors clustered at the establishment level.

This IV approach is an original contribution to the existing literature, which mainly focuses on correlations between ICT use, wages and working conditions. While improving causal inference, we must interpret the results with caution, since it is not unlikely that the W2SLS estimator identifies a local average treatment effect (LATE), rather than the average treatment effect (ATE). This would arise if, for instance individuals who know that they would see greater gains in their wages and working conditions respond more intensively to the intention to treat, causing the LATE to be greater than the ATE.

3.3 Mediation effect: Wages, Working Conditions and Job Satisfaction

If ICT use increases wages and overall working conditions, it should also affect workers' job satisfaction. We thus estimate how ICT diffusion influences workers' job satisfaction through improvements in these two aforementioned dimensions.

We estimate the following relationship:

$$LS_{it} = \kappa + \omega_w \log(wage)_{it} + \omega_{npi} npi_{it} + \omega_{ict} \text{ICT}_{it} + X_{it}\delta + X_{ct}\rho + \alpha_t + \alpha_{r(i,t)} + \alpha_j + \theta_{it}$$

where $\log(wage)_{it}$ and npi_{it} are functions of ICT_{it} use, as described in equation (1):

$$Log(wage)_{it} = \beta_w + \pi_w ICT_{it} + X_{it}\delta_w + X_{ct}\rho_w + \alpha_t + \alpha_{(r(i,t))} + \alpha_j + \epsilon_i t$$

$$NPI_{it} = \beta_{npi} + \pi_{npi} ICT_{it} + X_{it}\delta_{npi} + X_{ct}\rho_{npi} + \alpha''_t + \alpha''_{(r(i,t))} + \alpha''_j + \epsilon''_i t$$

ω_{ict} captures the direct effect of ICT on job satisfaction, conditional on wages ($\log(wage)_{it}$) and non-pecuniary working conditions (npi_{it}). The indirect effect of ICT via wages and working conditions is then $\omega_w \times \pi_w$ and $\omega_{npi} \times \pi_{npi}$. The total effect of ICT is the sum of its direct effect on job satisfaction, the indirect effect via wages, and the indirect effect via working conditions.

4 Estimates. Causal impact of ICT on Wages, Working Conditions, and Job Satisfaction

In this section, we examine how ICT diffusion influences wages and working conditions and how these, in turn, affect workers' job satisfaction. First, we estimate the effect of ICT on wages and working conditions using both OLS and 2SLS regressions. Second, we provide evidence on the relationship between ICT and job satisfaction and the extent to which this relation is mediated through wages and working conditions.

4.1 ICT, Wages and Working Conditions

Table 2 presents the results. Column (1) reports estimates including individual socio-demographic controls, as well as year and region fixed effects (our baseline specification). Column (2) adds 4-digit occupation fixed effects, restricting identification to within-occupation heterogeneity. Column (3) builds on Column (2) by incorporating establishment controls. Column (4) removes all establishment controls and instead introduces establishment fixed effects. Column (5) includes worker fixed effects, restricting identification to within-worker variation over time. Finally, Column (6) considers worker*establishment fixed effects to rely on within-worker and within-establishment variation.

In Panel A, we observe a positive association between more intensive ICT use and higher wages across all specifications. According to Column (3), a 10-percentage-point increase in the share of the workday spent using ICT is associated with a 0.74% wage increase (exp (0.0074) – 1) × 100%. However, this relationship weakens considerably and loses statistical significance once we account for within-establishment variation (Column (4)). Consistent with previous research, this suggests that the observed association between individual ICT intensity and wages is primarily driven by establishment-level characteristics.

In Panel B, we also find a consistently positive and statistically significant relationship between more intensive ICT use and better working conditions across all specifications. Comparing Column (1) and Column (2), the coefficient on ICT use drops significantly when occupation fixed effects are included, suggesting that a substantial portion of the variation in working conditions is driven by occupational sorting. Nevertheless, the relationship between ICT use and non-pecuniary working conditions remains both positive and statistically significant. According to Column (3), a 10-percentage-point increase in the share of the workday spent using ICT is associated with an increase in working conditions by

0.028 standard deviations (SD). Columns (4) and (5) test whether this relationship holds when controlling for establishment and worker fixed effects. The coefficient on ICT use remains very similar. According to Column (5), a 10-percentage-point increase in ICT use is associated with an increase in working conditions by 0.021 SD, confirming that the positive relationship between ICT use and working conditions persists even after accounting for establishment and worker-level variation.

Table 2: The Relationship Between ICT, Wages and Working Conditions

	Panel A: Log Hourly Wage					
	(1)	(2)	(3)	(4)	(5)	(6)
ICT	0.086***	0.079***	0.074***	0.038	0.106***	0.063
	(0.022)	(0.018)	(0.018)	(0.025)	(0.030)	(0.052)
	Panel B: Non-Pecuniary Index (z-score)					
	(1)	(2)	(3)	(4)	(5)	(6)
ICT	0.780***	0.278***	0.280***	0.198***	0.2015***	0.105
	(0.114)	(0.055)	(0.064)	(0.074)	(0.066)	(0.097)
Obs.	20,099	19, 948	19, 948	8,776	5,264	2,370
Individual Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Region Fixed Effects	✓	✓	✓	✓	✓	✓
Occupation FE 4-digits		✓	✓	✓	✓	✓
Establishment Controls			✓			
Establishment FE				✓		
Worker Fixed Effects					✓	✓
Establishment*Worker FE						✓

Notes: Working condition survey merged sample for 2013 and 2019 including public and private sectors. Weighted least square regressions with sampling weights defined to ensure a representative sample. Robust standard errors are clustered at the individual level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.2 Individual components of NPI.

Table 3 analyzes the relationship between ICT use intensity and the individual components of working conditions. We control for individual and establishment characteristics and include year, region and occupation fixed effects. The results reveal that the average positive impact on NPI is driven by several, sometimes contrasting effects. Consistent with the previous literature, we find that ICT is positively associated with better physical comfort

and safety. ICT is also positively associated with desired time-use conditions, like working less during the weekend and having more flexibility, but with undesirably greater pace of work.

4.3 Heterogeneity by sector.

We also test whether there are some differences across sector. The results are reported in Appendix Table C.1 and C.2. We find that ICT is associated with improved overall working conditions in both public and private sectors (with an estimated coefficient of ICT on the NPI of 0.274 for the public sector and 0.355 for the private sector, both significant at 1%, not reported in the tables). However, the channels differ across sectors. In the public sector, ICT intensity is associated with improved physical comfort and safety and desired time use (not working during the weekend and more flexibility). In contrast, in the private sector, ICT intensity is associated not only with improved physical comfort, physical safety and desired time use (working standard hours, not working during the weekend and more flexibility), but also more constrained work pace. Thus, the average negative effects of ICT on pace of work reported in Table 3 above are concentrated in the private sector.

Table 3: The Relationship between ICT, Wages and Components of Working Conditions

	Learning & Development	Autonomy	Support	Stability	Physical comfort	Physical safety
	(1)	(2)	(3)	(4)	(5)	(6)
ICT	0.076	0.052	-0.024	0.036	0.492***	0.396***
	(0.059)	(0.066)	(0.049)	(0.054)	(0.047)	(0.048)
	Psycho safety	Standard workhours	Not working weekend	Flexibility	Work-life balance	Uncons. work pace
	(7)	(8)	(9)	(10)	(11)	(12)
ICT	-0.119	0.126**	0.229***	0.124**	-0.038	-0.120*
	(0.073)	(0.057)	(0.045)	(0.059)	(0.062)	(0.062)
Obs.	19,948	19,948	19,948	19,948	19,948	19,948
Individual Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Region Fixed Effects	✓	✓	✓	✓	✓	✓
Occupation FE 4-digits	✓	✓	✓	✓	✓	✓
Establishment Controls	✓	✓	✓	✓	✓	✓

Notes: Working condition survey merged sample for 2013 and 2019 including public and private sectors. Weighted least square regressions with sampling weights defined to ensure a representative sample. All non-pecuniary working conditions have been standardized. Robust standard errors are clustered at the individual level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.4 IV strategy.

We now exploit the matched employer-employee dimension of our data and instrument our explanatory variable ICT_{iejt} by ICT intensity of the establishment in which the individual works.

Table 4 provides evidence that larger ICT use causes higher hourly wages and improved aggregated working conditions. Panel A reveals a strong first stage, with an F-statistic above 16. The point estimates on ICT use in Panels B and C are much larger than those reported in Table 2, which, as discussed above, is consistent with a LATE interpretation, where the W2SLS emphasize the effect of the treatment on the treated, rather the potential impact on non-treated individuals. According to column (6), a 10-percentage point increase in ICT use will increase wages by 7.1% and working conditions by 0.12 SD.

We also estimate the IV strategy on the individual components of working conditions. Consistent with findings reported in Table 3, we find that great ICT intensity use causes better physical comfort, worse psychological safety, and more desirable time use (work during standard hours and not working during the weekend). In addition, the W2LS results suggest that greater ICT use promotes more learning and development on the job. Tables C.3 and C.4 in Appendix additionally reports the W2SLS estimates of the impact of ICT by sector.

4.5 Mediation: Wages, Working Conditions and Job Satisfaction

Table 6 reports the results of our mediation analysis. ICT is instrumented with the share of workers using the internet at the establishment level, as previously described. The results provide evidence of a positive relationship between ICT and job satisfaction. According to Column (3), an increase of 1 SD in ICT use would increase job satisfaction by 0.30 SD (although the results are not statistically significant at conventional levels).

This positive relationship is primarily driven by the indirect effect of ICT on workers' job satisfaction through higher wages and improved working conditions. We find that workers positively value increases in both wages and working conditions. Specifically, a 1 SD increase in log hourly income increases job satisfaction by 0.07 SD and a 1 SD increase in working conditions increases job satisfaction by 0.40 SD. By contrast, the direct effect of ICT on job satisfaction, controlling for wages and working conditions, is negative and not significant.

Of the total increase in job satisfaction observed through higher use of ICT (0.30 SD), we can attribute 5% (=0.016/0.305) to the direct effect of ICT on job satisfaction, leaving 95% to the indirect effect of ICT on job satisfaction through better wages and working conditions.

Table 4: The Relationship Between ICT, Wages, and Working Conditions (W2SLS)

	Panel A (First Stage): ICT		
	(1)	(2)	(3)
$1\{0.1 \leq \text{Internet} \leq 0.5\}$	0.092**	0.030**	0.030**
	(0.039)	(0.013)	(0.013)
$1\{\text{Internet} > 0.5\}$	0.184***	0.068***	0.070***
	(0.028)	(0.012)	(0.012)
K-P F-Stat	25.53	16.55	16.29
	Panel B: Log Hourly Wage		
	(4)	(5)	(6)
ICT (instrumented)	0.679***	0.772**	0.714**
	(0.159)	(0.323)	(0.319)
	Panel C: Non-Pecuniary Index (z-score)		
	(7)	(8)	(9)
ICT (instrumented)	1.048**	1.492**	1.183*
	(0.490)	(0.667)	(0.710)
Observations	20,099	19,948	19,948
Year FE	✓	✓	✓
Region FE	✓	✓	✓
Occupation FE (4-digits)		✓	✓
Establishment controls			✓

Notes: Working condition survey merged sample for 2013 and 2019 including public and private sectors. Weighted two-stage least square regressions with sampling weights defined to ensure a representative sample. Robust standard errors are clustered at the establishment level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Of the indirect effect, 8% can be further attributed to the indirect impact of ICT through better wages, and 92% to the indirect effect through improved working conditions. Thus, these results suggest that ICT increases workers' job satisfaction, and that this increase is mainly driven by the indirect effect of ICT through improved working conditions.

Table 5: The Relationship Between ICT, Wages and Individual Components of Working Conditions (W2SLS)

	Learning & Development	Autonomy	Support	Stability	Physical comfort	Physical safety
	(1)	(2)	(3)	(4)	(5)	(6)
ICT (instrumented)	3.426***	0.577	0.095	-1.503*	1.316**	0.693
	(0.891)	(0.856)	(0.782)	(0.780)	(0.573)	(0.775)
K-P F-stat	16.29	16.29	16.29	16.29	16.29	16.29
	Psycho safety	Standard workhours	Not working weekend	Flexibility	Work-life balance	Uncons. work pace
	(7)	(8)	(9)	(10)	(11)	(12)
ICT (instrumented)	-1.449*	1.128*	-0.005	1.450**	0.339	-0.207
	(0.793)	(0.667)	(0.572)	(0.697)	(0.666)	(0.839)
K-P F-stat	16.29	16.29	16.29	16.29	16.29	16.29
Obs.	19,948	19,948	19,948	19,948	19,948	19,948
Individual Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Region Fixed Effects	✓	✓	✓	✓	✓	✓
Occupation FE 4-digits	✓	✓	✓	✓	✓	✓
Establishment Controls	✓	✓	✓	✓	✓	✓

Notes: Working condition survey merged sample for 2013 and 2019 including public and private sectors. Weighted two-stage least square regressions with sampling weights defined to ensure a representative sample. All non-pecuniary working conditions have been standardized. Robust standard errors are clustered at the establishment level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6: The Relationship between Job Satisfaction, Wages, and Working Conditions (2019)

	Job Satisfaction (z-score)				
	(1)	(2)		(3)	
Total Effect:					
ICT (instrumented) (z-score)	0.130	0.244		0.305	
	(0.087)	(0.237)		(0.237)	
Direct Effect:					
ICT (ω_{ict}) (instrumented) (z-score)	-0.219*	-0.024	(10%)	0.016	(5%)
	(0.113)	(0.240)		(0.239)	
Log Hourly Wages (z-score) (ω_w)	0.110***	0.067***		0.066***	
	(0.015)	(0.018)		(0.018)	
Non-pecuniary index (z-score) (ω_{npi})	0.369***	0.403***		0.398***	
	(0.036)	(0.026)		(0.026)	
Indirect Effect:					
ICT (z-score) ($\omega_w\pi_w + \omega_{npi}\pi_{npi}$)	0.345	0.271	(90%)	0.292	(95%)
	(0.267)	(1.003)		(1.043)	
Log Hourly Wages (z-score) ($\omega_w\pi_w$)	0.034	0.028	(10%)	0.024	(8%)
	(0.044)	(0.080)		(0.090)	
Non-pecuniary index (z-score) ($\omega_{npi}\pi_{npi}$)	0.311	0.243	(90%)	0.269	(92%)
	(0.241)	(0.926)		(0.954)	
Obs.	9,367	9,254		9,240	
Individual controls	✓	✓		✓	
Region FE	✓	✓		✓	
Occupation FE (4-digits)		✓		✓	
Establishment controls				✓	

Notes: Estimates based on the 2019 working condition survey, merged sample. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

5 Conclusion

This paper unveils the critical role of ICT in shaping workers' job satisfaction. While the total effect of ICT on job satisfaction is positive (0.30 SD for a 1 SD increase in ICT use), our mediation analysis reveals that this effect is overwhelmingly indirect. A striking 95% of the impact stems from improvements in wages and, more importantly, non-pecuniary working conditions.

Workers highly value both dimensions, but the dominant force behind higher job satisfaction is improved working conditions (92% of the indirect effect), with wage growth playing a smaller role (8%). This finding challenges the conventional wisdom that ICT adoption primarily benefits workers through higher earnings. Instead, our results highlight the transformative power of technology in enhancing job quality beyond mere financial compensation.

A promising avenue for future research is to exploit between-occupation heterogeneity in ICT diffusion to analyze its varied consequences on job satisfaction. Understanding how different occupational groups experience technological change will provide deeper insights into the broader labor market implications of digital transformation.

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A Appendix: Descriptive Statistics

Table A.1: Distribution of Employees per Establishment (Merged Sample, 2013 and 2019)

Number of employees in establishment	Number of observations	Percent	Number of establishments
1 employee	11,810	54.74	11,106
2 employees	3,499	16.22	1,623
3 employees	1,435	6.65	440
4 employees	1,041	4.83	233
5 employees	573	2.66	102
6 employees	475	2.20	70
7 employees	447	2.07	59
8 employees	216	1.00	24
9 employees	296	1.37	30
10 employees	223	1.03	19
11 employees	185	0.86	15
12 employees	152	0.70	12
13 employees	92	0.43	6
14 employees	107	0.50	7
15 employees	115	0.53	7
16 employees	53	0.25	3
17 employees	60	0.28	3
18 employees	47	0.22	2
19 employees	151	0.70	7
20 employees	46	0.21	2
21 employees	50	0.23	2
22 employees	76	0.35	3
23 employees	51	0.24	2
24 employees	50	0.23	2
25 employees	54	0.25	2
26 employees	60	0.28	2
29 employees	32	0.15	1
32 employees	38	0.18	1
35 employees	38	0.18	1
36 employees	45	0.21	1
58 employees	58	0.27	1

Table A.2: Descriptive Statistics (Merged Sample)

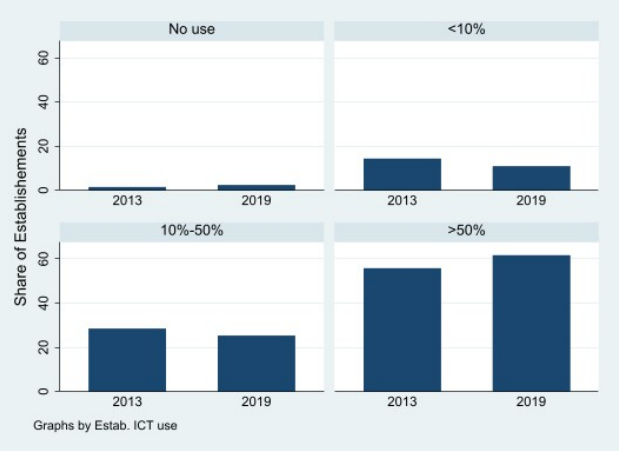
	Merged Sample				
	Both 2013 and 2019			2013	2019
Variable	Obs.	Mean	SD	Mean	Mean
	(1)	(2)	(3)	(4)	(5)
ICT	21,818	0.45	0.38	0.38	0.54
Log Hourly Wage	23,032	2.98	0.43	2.96	3.00
NPI (unstandardized)	20,811	0.63	0.12	0.63	0.64
Learning (unstandardized)	22,478	0.60	0.24	0.59	0.61
Autonomy (unstandardized)	23,432	0.56	0.21	0.56	0.56
Support (unstandardized)	23,725	0.81	0.25	0.81	0.82
Stability (unstandardized)	23,247	0.68	0.18	0.66	0.70
Physical comfort (unstandardized)	23,802	0.59	0.34	0.58	0.60
Physical risk (unstandardized)	23,807	0.74	0.29	0.73	0.74
Psychological safety (unstandardized)	22,764	0.57	0.21	0.57	0.57
Standard working hours (unstandardized)	23,862	0.77	0.31	0.77	0.78
Not working weekend (unstandardized)	23,862	0.68	0.38	0.68	0.68
Flexibility (unstandardized)	22,572	0.62	0.21	0.62	0.62
Work-life balance (unstandardized)	22,759	0.40	0.14	0.40	0.40
Uncons. work pace (unstandardized)	22,602	0.55	0.23	0.55	0.56
10.1 $\leq$ Internet $\leq$ 0.5	18,247	0.27	0.44	0.28	0.23
1Internet ¿ 0.5	18,247	0.56	0.50	0.57	0.55

Table A.3: Correlation Matrix

Variable	Learning	Autonomy	Support	Stability	Physical Comfort	Physical Risk
	(1)	(2)	(3)	(4)	(5)	(6)
Learning	1					
Autonomy	0.009	1				
Support	0.284	-0.123	1			
Stability	0.159	0.071	0.025	1		
Physical Comfort	0.235	0.237	0.092	0.109	1	
Physical Risk	0.112	0.105	0.063	0.088	0.457	1
Psychological Safety	0.155	0.149	0.123	0.044	0.140	0.065
Standard Working Hours	0.021	0.197	0.005	0.032	0.339	0.237
Not Working Weekend	0.009	0.180	0.022	-0.003	0.360	0.127
Flexibility	0.166	0.182	0.125	0.078	0.325	0.078
Work-Life Balance	0.194	0.067	0.125	0.094	0.213	0.099
Unconstrained Work Pace	0.184	0.243	0.132	0.094	0.253	0.124

	Psycho safety	Standard work hours	Not working weekend	Flexibility	Work life balance	
	(7)	(8)	(9)	(10)	(11)	
Psychological Safety	1					
Standard Working Hours	0.099	1				
Not Working Weekend	0.155	0.589	1			
Flexibility	0.137	0.254	0.272	1		
Work-Life Balance	0.153	0.204	0.188	0.222	1	
Unconstrained Work Pace	0.271	0.126	0.135	0.200	0.224	

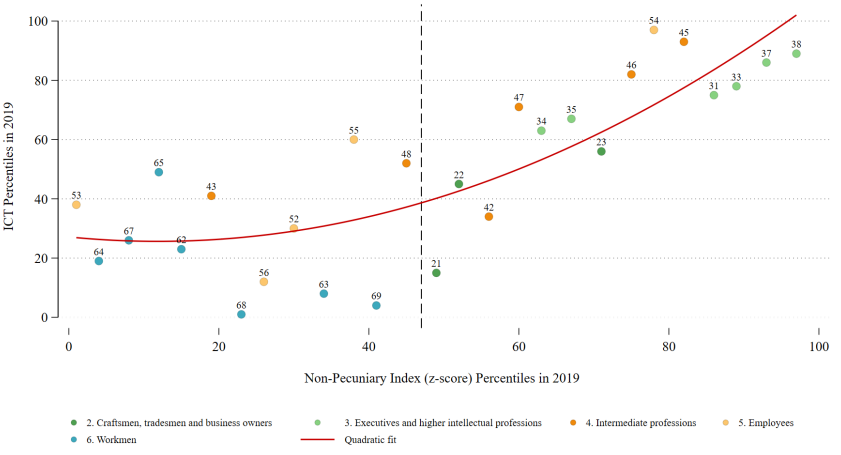
Figure A.1: Distribution of establishments by ICT intensity



Notes: The figure reports the distribution of establishments over ICT-intensity categories: establishments where the share of employees using ICT is 0%, below 10% (but more than zero), 10–50% and above 50%. The percentages across these four categories are reported in 2013 and in 2019.

Figure A.2: Correlation between ICT and NPI distributions

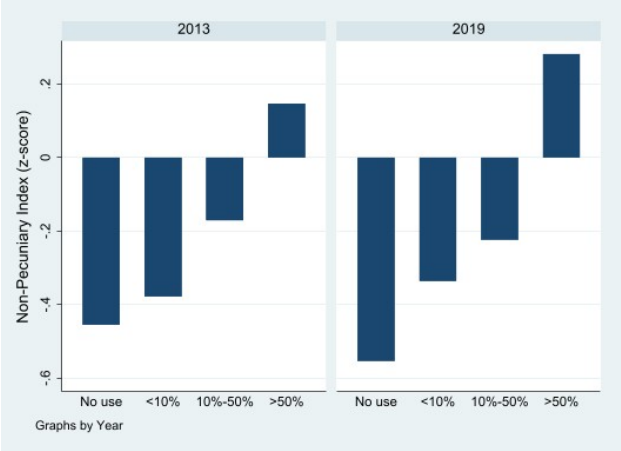
(a) 2013



(b) 2019

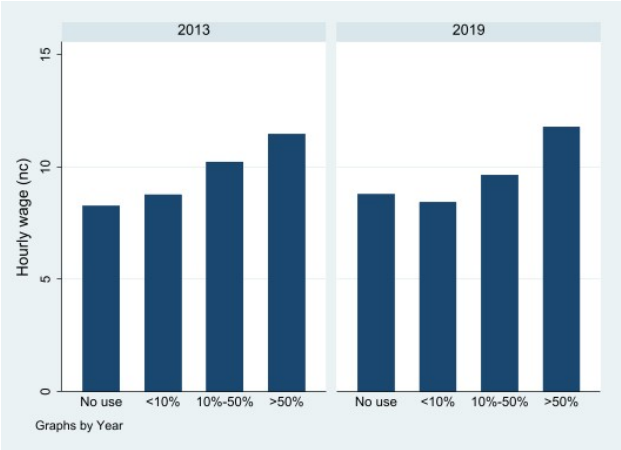
Notes: The figure reports scatter plots where 2-digit occupations are ranked on the x-axis according to their average NPI percentile in the aggregate NPI distribution and on the y-axis according to their average ICT percentile in the ICT distribution. Panels (a) and (b) reports this for 2013 and 2019, respectively.

Figure A.3: Working conditions by establishment ICT intensity



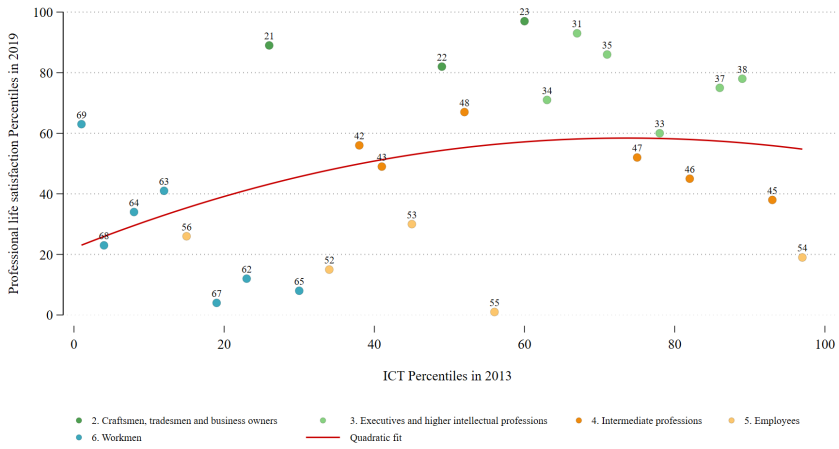
Notes: The figure reports the average working condition (the NPI) by ICT-intensity of establishments: establishments where the share of employees using ICT is 0%, below 10% (but more than zero), 10–50% and above 50%. The NPI across these four categories is reported in 2013 and in 2019.

Figure A.4: Average wages by establishment ICT intensity

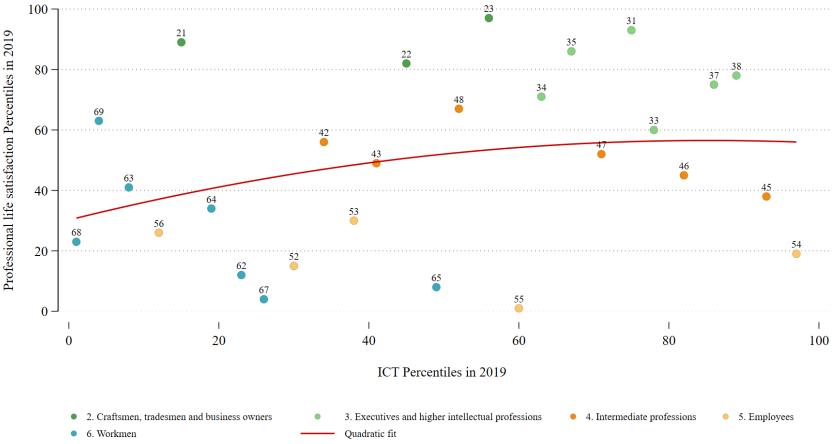


Notes: The figure reports average wages by ICT-intensity of establishments: establishments where the share of employees using ICT is 0%, below 10% (but more than zero), 10–50% and above 50%. The average wages across these four categories are reported in 2013 and in 2019.

Figure A.5: Correlation between ICT in 2013-2019 and job satisfaction in 2019



(a) 2013



(b) 2019

Notes: The figure reports scatter plots where 2-digit occupations are ranked on the x-axis according to their average ICT percentile in the aggregate ICT distribution and on the y-axis according to their average job satisfaction percentile in the 2019 job satisfaction distribution. (job satisfaction is reported only in 2019). Panels (a) and (b) reports this for 2013 and 2019, respectively.

B Appendix: The weighting strategy

The weighting process was conducted using the "*ipfweights*" command of Stata, which adjusts survey weights iterative through proportional fitting (IPF) to align the sample with known population margins. Separate weights were generated for both the unbalanced and balanced panels, as well as for the public, private, and combined sectors.

For the unbalanced panel, weights were calculated so that the sample in each year reflects the population of that same year. In contrast, for the balanced panel, weights were designed to ensure that the sample for both 2013 and 2019 remains representative of the population in 2013. Seven key demographic and labor market variables were used for this weighting process: gender, age category (five-year intervals from 15 to over 70), education level (five groups), a 2-digit occupational classification (27 categories), region (13 regions, with the 2013 data adjusted to reflect the 2015 regional reform for consistency with 2019), sector of employment (public/private), and employment contract type (full-time/part-time).

It is important to note that certain variables â€"such as full-time/part-time status or regionâ€" we only have information at the aggregate level (i.e., public and private sector together). Additionally, the percentage of individuals employed in the public versus private sector was only used for the combined weights, as this distinction holds no relevance when sector-specific weights are being generated. The population margins for these variables were sourced from Social Security data for the respective years.

The iterative procedure in "*ipfweights*" was executed with 120 iterations to minimize the difference between sample and population margins within a specified tolerance threshold. This ensured accurate and reliable weights for the analysis.

C Appendix: Estimation results

Table C.1: The Relationship between ICT, Wages and Components of Working Conditions. Public sector

	Learning & Development	Autonomy	Support	Stability	Physical comfort	Physical safety
	(1)	(2)	(3)	(4)	(5)	(6)
ICT	0.108	0.052	-0.018	0.026	0.490***	0.369***
	(0.067)	(0.075)	(0.056)	(0.062)	(0.054)	(0.055)
	Psycho safety	Standard workhours	Not working weekend	Flexibility	Work-life balance	Uncons. work pace
	(7)	(8)	(9)	(10)	(11)	(12)
ICT	-0.142*	0.097	0.0288***	0.131*	-0.037	-0.106
	(0.084)	(0.064)	(0.051)	(0.070)	(0.073)	(0.071)
Obs.	10,584	10,584	10,584	10,584	10,584	10,584
Individual Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Region Fixed Effects	✓	✓	✓	✓	✓	✓
Occupation FE 4-digits	✓	✓	✓	✓	✓	✓
Establishment Controls	✓	✓	✓	✓	✓	✓

Notes: Working condition survey merged sample for 2013 and 2019 including public sector. Weighted least square regressions with sampling weights defined to ensure a representative sample. All non-pecuniary working conditions have been standardized. Robust standard errors are clustered at the individual level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table C.2: The Relationship between ICT, Wages and Components of Working Conditions. Private sector

	Learning & Development	Autonomy	Support	Stability	Physical comfort	Physical safety
	(1)	(2)	(3)	(4)	(5)	(6)
ICT	-0.047	0.072	-0.047	0.066	0.503***	0.538***
	(0.061)	(0.063)	(0.060)	(0.053)	(0.049)	(0.054)
	Psycho safety	Standard workhours	Not working weekend	Flexibility	Work-life balance	Uncons. work pace
	(7)	(8)	(9)	(10)	(11)	(12)
ICT	0.009	0.310**	0.304***	0.152***	-0.042	-0.205*
	(0.063)	(0.053)	(0.057)	(0.058)	(0.063)	(0.063)
Obs.	9.307	9.307	9.307	9.307	9.307	9.307
Individual Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Region Fixed Effects	✓	✓	✓	✓	✓	✓
Occupation FE 4-digits	✓	✓	✓	✓	✓	✓
Establishment Controls	✓	✓	✓	✓	✓	✓

Notes: Working condition survey merged sample for 2013 and 2019 including private sector. Weighted least square regressions with sampling weights defined to ensure a representative sample. All non-pecuniary working conditions have been standardized. Robust standard errors are clustered at the individual level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table C.3: The Relationship Between ICT, Wages and Individual Components of Working Conditions (W2SLS). Public sector

	Learning & Development	Autonomy	Support	Stability	Physical comfort	Physical safety
	(1)	(2)	(3)	(4)	(5)	(6)
ICT (instrumented)	3.681***	0.872	-0.094	-1.495*	1.554***	0.957
	(0.879)	(0.853)	(0.798)	(0.797)	(0.575)	(0.734)
K-P F-stat	16.68	16.68	16.68	16.68	16.68	16.68
	Psycho safety	Standard workhours	Not working weekend	Flexibility	Work-life balance	Uncons. work pace
	(7)	(8)	(9)	(10)	(11)	(12)
ICT (instrumented)	-1.448	1.473**	-0.041	1.756**	0.408	0.155
	(0.836)	(0.677)	(0.586)	(0.710)	(0.680)	(0.742)
K-P F-stat	16.68	16.68	16.68	16.68	16.68	16.68
Obs.	10,584	10,584	10,584	10,584	10,584	10,584
Individual Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Region Fixed Effects	✓	✓	✓	✓	✓	✓
Occupation FE 4-digits	✓	✓	✓	✓	✓	✓
Establishment Controls	✓	✓	✓	✓	✓	✓

Notes: Working condition survey merged sample for 2013 and 2019 including public sector. Weighted two-stage least square regressions with sampling weights defined to ensure a representative sample. All non-pecuniary working conditions have been standardized. Robust standard errors are clustered at the establishment level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table C.4: The Relationship Between ICT, Wages and Individual Components of Working Conditions (W2SLS). Private sector

	Learning & Development	Autonomy	Support	Stability	Physical comfort	Physical safety
	(1)	(2)	(3)	(4)	(5)	(6)
ICT (instrumented)	1.390	-2.978	-0.419	-0.361	-0.667*	-3.477
	(1.862)	(2.944)	(1.519)	(0.941)	(2.058)	(2.251)
K-P F-stat	2.73	2.73	2.73	2.73	2.73	2.73
	Psycho safety	Standard workhours	Not working weekend	Flexibility	Work-life balance	Uncons. work pace
	(7)	(8)	(9)	(10)	(11)	(12)
ICT (instrumented)	-3.156*	-0.595	0.937	-3.415	-5.371	0.516
	(1.773)	(1.386)	(1.400)	(2.109)	(3.122)	(1.593)
K-P F-stat	2.73	2.73	2.73	2.73	2.73	2.73
Obs.	9.307	9.307	9.307	9.307	9.307	9.307
Individual Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Region Fixed Effects	✓	✓	✓	✓	✓	✓
Occupation FE 4-digits	✓	✓	✓	✓	✓	✓
Establishment Controls	✓	✓	✓	✓	✓	✓

Notes: Working condition survey merged sample for 2013 and 2019 including private sector. Weighted two-stage least square regressions with sampling weights defined to ensure a representative sample. All non-pecuniary working conditions have been standardized. Robust standard errors are clustered at the establishment level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.