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How Is the Internet Changing Labor Market Arrangements? Evidence from Telecommunications Reforms in Europe^{*}

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Abstract

This paper exploits variations in the timing of telecommunications reforms across Europe to analyze the relationship between the rise of alternative work arrangements and the emergence of the Internet. The paper evaluates whether sectors that are technologically more dependent on information and communications technologies experienced disproportionately larger changes in their employment outcomes after telecommunications reforms were introduced. The main results point to a disproportionate increase in total employment, part-time work, and home-based work among information and communications technologies-intensive sectors after the implementation of telecommunications reforms. The analysis does not find a link between the incidence of temporary employment, self-employment, second job holding, and telecommunications reforms. The main results are robust to several specifications.

JEL Classification: J20, J23, O33

Keywords: labor market arrangements, Internet, telecommunications, reforms, Europe

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1. Introduction

The share of workers in alternative work arrangements has increased dramatically in developed countries. In the United States, all the net employment growth between 2005 and 2015 occurred in alternative work arrangements (Katz and Krueger [2016]). In Europe, the share of workers in full-time, permanent salaried jobs has decreased for most countries since 2008 (World Bank [2016b]). At the same time, 17 percent of Europeans have used online platforms, with 23 percent of them also providing services through these new technologies (European Commission [2016]). Empirical evidence regarding the role of the Internet powering the growth of alternative work arrangements is scarce. Scholars have speculated that the rise of information and communications technologies (ICT) - which allow for better monitoring, remote work, standardization of job tasks and making information on workers' reputations more widely available – may have contributed to the observed increase in alternative work arrangements in the United States (see, for instance, Katz and Krueger [2016]). These aspects of ICT would facilitate the rise of self-employment as well as more flexible forms of work — such as temporary and part-time work— as firms can more easily break jobs down into smaller tasks.

Alternative work arrangements include several forms of employment, such as part-time work, working from home, temporary work, on-call jobs, and self-employment or freelancing. Unlike traditional wage employment, alternative work arrangements are associated with greater schedule flexibility and less job security. Individuals in alternative work arrangements are also less likely to have access to health or unemployment insurance, as well as old-age pensions, as these are typically covered by employers (Eurofound [2015]). Understanding the drivers of alternative work arrangements is important for several reasons. First, from the point of view of the worker, greater schedule flexibility and lower job security are likely to affect job satisfaction and compensating wage differentials (Mas and Pallais [2016]). Second, both greater schedule flexibility and working from home may boost the labor force participation

of individuals with family-care responsibilities or mobility constraints, such as the elderly and the disabled. Finally, a rising share of non-wage employment may increase the portion of the population uninsured against unemployment and health risks, as well as poverty in old-age – factors that may add additional strain to social protection systems.

This paper exploits variations in the timing of telecommunications reforms across Europe to study how the expansion of the Internet has been associated with the rise of alternative work arrangements. These reforms, which are intended to increase the availability and affordability of the Internet, have been linked with an increase in Internet adoption internationally (Howard and Mazaheri [2009]; Winkler [2016]). Given that the Internet remains unavailable to a majority of the world’s population (World Bank [2016a]), a better understanding of the unintended consequences of ICT adoption is important for the design of policies to help smooth the disruptive effects of the Internet in countries that have not yet experienced the digital revolution.

Since the timing of the reforms is not necessarily exogenous, instead of estimating their causal effects we focus on the mechanisms by which they would affect the labor market. We thereby construct the following test for the hypothesis that telecommunications reforms have affected labor markets in Europe by fostering Internet adoption. Using sector-level data, we first classify each sector of economic activity by its technological dependence on ICT. Then, under the assumption that such sectoral ICT dependence or intensity carries over from country to country, we compare several employment outcomes before and after the introduction of telecommunications reforms across sectors with different levels of ICT dependence. By controlling for country and sectoral trends as well as country-sector pairs fixed effects, we argue that if the Internet is affecting the labor market, we should see greater effects among more ICT-dependent sectors than in the rest of the economy.

Using data for 29 countries covering 19 years, we find that telecommunications reforms have been associated with significant changes in the European labor markets. More specifically, they have been accompanied by disproportionately higher employment creation and an increasing share of individuals working from home and part-time among ICT-intensive sectors. These results are robust to a number of alternative specifications. In contrast, we do not find evidence suggesting that the Internet has been associated with an increase in self-employment, temporary work and second job holding.

We focus on Europe for several reasons. First, many European countries have witnessed a dramatic increase in alternative work arrangements, and while there is a large body of literature examining the drivers of these trends, there is no empirical evidence on the role played by the Internet. Second, while telecommunications reforms may be a noisy measure of policy-driven Internet adoption when considering countries at very different levels of economic development, we expect that this concern would be attenuated when restricting the analysis to European economies. Finally, it allows us to use harmonized labor force surveys with detailed information on alternative work arrangements for 29 countries over a time span covering almost twenty years.

To our knowledge, this paper is the first to provide empirical evidence supporting a positive link between the expansion of the Internet and the rise of part-time employment. The share of workers in part-time jobs has dramatically increased in most European countries since the early 2000s, with more than 20 percent of workers having a part-time job across many European countries in 2014 (see Figure 1). This trend has important welfare implications, as part-time workers are more likely to be poor and a growing fraction of them find themselves in part-time work involuntarily, as they cannot find a full-time job (OECD [2016]; Horemans and Marx [2013]). Several hypotheses have been put forward to explain the rise of part-time work in Europe, such as more flexible labor market regulations, an increase in female labor force participation and a shift from manufacturing to services (see Buddelmeyer et al.

[2004]; Euwals and Hogerbrugge [2006]). Our methodology allows us to control for these alternative drivers of part-time employment. First, by controlling for country-level trends and comparing sectors with different degrees of ICT-dependence, we are able to control for any country-wide changes that affect all sectors equally such as labor market regulations. Second, we show that our main results hold for both men and women separately, addressing concerns of our findings deriving from an increase in female labor force participation. Finally, we address the potential confounding effect of an increase in the size of the services sector by including sector-year pairs fixed effects, and by showing that our results are robust to excluding agricultural and manufacturing sectors.

This paper also contributes to the literature on the impacts of the Internet on telecommuting, which has reached mixed conclusions thus far. On the one hand, Dettling (2016) finds evidence suggesting that Internet use increases married women's labor force participation in the United States. Telework and time saved in home production are the mechanisms that explain this outcome. On the other hand, Kolko (2012) uses slope of terrain as an instrument for broadband expansion in the United States and finds no effects of the latter on telecommuting or other home-based work. In addition, this paper contributes to the literature on the general impacts of ICT on labor markets. Our findings are consistent with empirical evidence showing that the Internet is associated with higher employment growth (Kolko [2012]; Forman et al. [2012]). There is also a large body of literature focusing on the effects of ICT on labor market polarization, a topic that is beyond the scope of this paper.¹

Finally, we also contribute to the literature studying the rise in other forms of alternative work arrangements such as temporary work, self-employment and second job holding. The incidence of temporary work has increased across Europe since the early 2000s (World Bank [2006]). There is

¹ Labor market polarization is characterized by an increasing share of both low and high-skilled jobs, and a decline of middle-skilled or routine jobs. See, for example, Acemoglu and Autor (2011) for the United States; Goos et al. (2009) for Western Europe; and Lewandowski et al. (2016) for Central Europe.

substantial empirical evidence that labor market reforms aimed at relaxing the conditions for the use of temporary contracts were important propellers of this increase (Kahn [2010]; Cahuc et al. [2016]), which may help explain why we do not find evidence that the Internet has played a major role in explaining such changes. Analyses of the drivers of second job holding are scarce. Zangelidis (2014) argues that job insecurity and volatility are important drivers of second job holding in Europe, as it provides a hedging strategy against labor market risk. Regarding self-employment, it has declined or remained stable across most European countries during the last 20 years (OECD [2014]). However, standard labor force surveys may fail to capture the increase in self-employment and multiple job holding allowed by online platforms (Katz and Krueger, 2016), which may contribute to explain why our findings do not support the hypothesis that the Internet has contributed to the rise of these forms of work.

The remainder of this paper is structured as follows. Section 2 describes the methodology and data sets used. They include the European Labour Force Surveys and the database on telecommunications reforms of Howard and Mazaheri (2009). Section 3 presents the main results and Section 4 concludes.

2. Data and methodology

2.1 Telecommunications reforms and Internet use in Europe

Following Howard and Mazaheri (2009), this paper uses four different types of telecommunications reforms. The first one is the first year the telecommunications sector was opened to competition, by allowing firms to build infrastructure and provide services and thereby undermine the monopoly power of the incumbent. The second type of reform is a variable to indicate regulatory depoliticization, which is measured by the time a regulatory authority is judged to be fully autonomous from the executive branch. The third type is an indicator of the privatization of the sector, measured by the year in which the government first sells a majority stake in the relevant state-owned telecommunication provider.

Finally, the fourth one is a variable to indicate regulatory independence, which is measured by the year in which the regulatory authority was separated from direct political oversight. Table 1 shows the years these reforms were introduced in each country. All these reforms are expected to improve the competition in the sector, raise efficiency, increase provision and lower prices. In fact, Howard and Mazaheri (2009) find that liberalizing the telecommunications market and separating the telecommunications regulator from direct control by the executive branch of government has encouraged technology adoption across the world. Winkler (2016) also shows that the liberalization of the telecommunications sector is highly correlated with subsequent growth in Internet adoption. While we examine the effects of all these reforms separately, our preferred specification uses the year in which the first of these reforms was introduced in each country. As seen in Figure 2, Internet penetration increased dramatically after countries introduced a telecommunications reform for the first time.

It is important to mention the caveat that even though these policy reforms are the most common form of regulating the telecommunications sector, their actual implementation has, in general, varied from country to country. For example, while privatization has actually improved competition in many countries, in others it has only enabled the creation of private monopolies (Howard and Mazaheri [2009]). By focusing on European economies, however, we would expect a higher degree of homogeneity in terms of the implementation of these reforms. Another caveat is that while it is plausible that the introduction of these reforms is not directly related to labor market performance, countries with already higher Internet adoption rates may have been more likely to implement them. In fact, as Figure 2 shows, Internet penetration was already increasing—albeit at a much slower pace—in the years before the reforms were introduced. For this reason, as we explain in the next section, instead of evaluating the causal effects of these reforms, our focus in this paper is on testing a mechanism through which such reforms may affect the labor market.

2.2 Data and econometric model

Given the difficulty of finding an exogenous source of variation in Internet supply, instead of trying to estimate the direct causal effects of the Internet on the labor market, this paper follows a different approach. If lower cost and faster Internet access tends to increase the productivity of certain types of labor, then it would do so disproportionately more among industries that rely more heavily on this technology. Accordingly, if the Internet allows for new and alternative work arrangements, it would also disproportionately bring more changes in more ICT-intensive industries. This approach is similar in spirit to that of Rajan and Zingales (1998), who study the effects of financial development on economic growth by exploring the interaction effects of an industry's level of financial dependence and country-level measures of financial development.

More specifically, we estimate the following model:

$$y_{s,c,t} = \alpha + \beta ICT_intensity_s \times Reform_{c,t} + \mu_{s,t} + \mu_{s,c} + \mu_{c,t} + \varepsilon_{s,c,t} \quad (1)$$

where the dependent variable y refers to several sector-level variables of interest, and s , c , and t stand for sector, country, and year, respectively. $ICT_intensity$ is an index of ICT intensity of the sector, and $Reform$ is a dummy variable that is equal to one when the country introduces a telecommunication reform. We also control for sector-year ($\mu_{s,t}$), sector-country ($\mu_{s,c}$) and country-year pairs fixed effects ($\mu_{c,t}$). Thereby, equation (1) is equivalent to a differences-in-differences-in-differences model, where the coefficient β would measure the time change in the average labor market outcome y for high ICT-intensive sectors in a country that has introduced the reform, minus the time change in the mean of y for high ICT-intensive sectors in a country that has not yet introduced the reform, minus the time change in the mean of y for low ICT-intensive sectors in a country that has introduced the reform. It is important to mention that we do not include all the reforms simultaneously, because the number of

countries is not very large and the estimated coefficients would otherwise not be very precise. As mentioned above, we use the first year a country introduced any of these reforms to create the *Reform* variable in our preferred specification.

As is the case with Rajan and Zingales's (1998) measure of financial dependence, the measure of the sector's ICT intensity should not be driven by the local demand and supply of Internet in the economy. Otherwise, this variable would be endogenous to the introduction of telecommunications reforms. Instead, the measure of ICT intensity should be independent of each country's conditions. We assume that there is a technological reason to explain why some industries are more likely to adopt the Internet than others. For instance, the type of work carried out in certain industries may be more suitable to benefit from the use of the Internet at work. We measure the ICT intensity of a sector using data from a relatively frictionless environment. We argue that ICT use by firms in the United States is a relatively pure measure of their demand for this technology, because it is one of the first countries to have implemented telecommunications reforms to improve access and because its friendlier businesses environment may create more competitive pressures for firms to innovate and adopt new technologies.² As the measure of ICT intensity, therefore, we use data on ICT capital services per hour worked from EUKLEMS for the United States in the year 2007 (see **Table 2**).³

We estimate the dependent variables related to the labor market using the EU Labour Force Survey (EU-LFS) for the reference years 1995–2013. The EU-LFS is the largest European household survey, with 1.8 million interviews conducted each quarter throughout the participating countries. The survey collects labor and demographic information for residents living in private households in the 28 member states of

² There is a large literature on the effects of competition on innovation and technology adoption. Examples include Aguion et al. 2009; Ayyagari et al. 2012; Macher et al. 2015; Seim et al. 2011.

³ In a previous version of this paper we used, as a proxy for ICT intensity, the fraction of workers using a computer at work by sector taken from the Survey of Adult Skills (from the Programme for the International Assessment of Adult Competencies, PIAAC) for the United States. The results were very similar and are available from the authors upon request.

the European Union, as well as in two candidate countries and in three countries of the European Free Trade Association (Iceland, Norway, and Switzerland). The survey draws on nationally representative samples; sampling rates in any country vary between 0.2 and 3.3 percent.

To assure comparability, the EU-LFS uses output harmonization. This means that the European Union issues standards for the output of the LFS, including a list of variables and categories, minimum sampling precision, observation period, and periodicity, while the national statistical institutes across Europe are responsible for designing and conducting the survey. They must follow the standards and forward the results to Eurostat, which processes the information centrally. While some factors may make the survey less than perfectly comparable, this process of harmonization nonetheless makes it attractive for studying labor market dynamics.

This study makes use of the EU-LFS microdata that are available in the period 1995–2013 to analyze the impact of the internet on the labor market. The list of countries and years that are covered is shown in Table A 1 in the Appendix.⁴ All of the information is aggregated by sector of activity using the standardized NACE classification Rev. 1.1 at 1 digit.⁵ Averages of all the variables of interest are computed for workers aged 25–64 in each sector of activity, except for those working in public administration, in extra-territorial organizations and bodies, and households as employers, which are excluded from the sample.⁶ Although the statistics are computed using harmonized variables, some outliers in the “working from home” variable remain (this is due to small sample size or the way the

⁴ Data for Germany and the two candidate countries (Macedonia and Turkey) were not included in the 2014 release of the EU-LFS microdata. Malta was excluded because data for this country are only available from 2009 on.

⁵ Unfortunately, the public version of this survey does not include a more disaggregated version by sector of economic activity.

⁶ No data on sector of activity are available for Poland in 1997, 1998, and 1998. These observations could therefore not be included in the estimations.

question is asked in some surveys); they are therefore not considered in the estimations.⁷ Table 3 shows some descriptive statistics.

3. Results

Table 4 shows the estimates of equation (1) using the first year a country introduced any of the four telecommunications reforms considered as our main policy variable (Table A 2 in the appendix shows the results for each reform individually). Column (1) shows that after the introduction of a reform, employment grew, on average, 2 percentage points more among ICT-intensive sectors than in the rest of the economy. We arrive to this figure multiplying the coefficient by the standard deviation of the ICT intensity variable according to Table 2 (i.e. $0.186 \times 0.114 = 0.02$). We also find statistically significant results for part-time employment, where its share increased approximately an additional 1 percentage point after the introduction of the reform among ICT-intensive sectors than in the rest of the economy.⁸ This estimated effect is roughly half of the average observed change in part-time employment at the sector level during this period in Europe (see Table 3).

Before analyzing the rest of the variables, we estimate equation (1) with lead and lagged effects, to test the validity of the identifying assumption of parallel trends across sectors with different levels of ICT intensity before the reform and to allow for fade-out effects. Figure 3 shows the results and confirms that the identifying assumption holds for total employment, part-time employment and working from home, as the estimated lead effects are not statistically different from zero. The results also show that the employment effects tend to increase every year after the reform. In contrast, the effects for the share of part-time workers peak the year of the reform and remain stable, and vanish nine years after

⁷ The outliers with respect to this variable are Croatia (2004–2005), Switzerland (1996–2000), and France (1995–2002).

⁸ The employment composition regressions are weighted by total employment in the sector-country-year cell, to reflect overall changes in the economy. As the robustness section shows, the results do not change when estimated with unweighted regressions.

the reform was introduced. It is interesting that the effects for working from home become positive and statistically significant two years after the reform, and remain stable ever since. In the rest of the paper, we then adjust the *Reform* dummy variable for the specification using “working from home” as a dependent variable, to capture the fact that the effects emerge two years after the introduction of the reform. In contrast, the results for self-employment show that they are mostly driven by pre-existing differences across sectors before the introduction of the reforms. Finally, as expected, there are no statistically significant lead or lag effects for the share of temporary workers and individuals with two jobs.

To illustrate which demographic groups were the drivers of these results, Table 5 shows the coefficients of the main specification disaggregated by gender and age. It shows that the total employment effects of the reforms were driven by males, in particular those older than 35 years. As expected, the effects for part-time work were mostly driven by women as the coefficient is much higher than for men, but the results for the latter are positive and statistically significant as well. Finally, the results for the share of individuals working from home were positive and statistically significant for both men and women, and for all age groups. The point estimate shows that the share of people working from home increased more than two additional percentage points among ICT-intensive sectors than in the rest of the economy after the first telecommunication reform was introduced. This magnitude is equivalent to the increase observed in the share of individuals working from home during this period (see Table 3).

Table 6 shows some robustness checks of the main results. In the second and third columns we alternatively exclude the agricultural and manufacturing sectors to verify that the results are not affected by their secular decline. The last column shows the results without weighting by total employment in the sector-country-year cell. Table 7 shows the robustness checks for the male sample. The results for total employment are robust to both robustness tests, in both samples. The results for

part-time work are statistically significant in all specifications of Table 6. The coefficient in the unweighted regression is smaller than that of the weighted regression, indicating that the expansion of part-time employment after the introduction of the reforms has been larger among those sectors whose total employment grew the most. As expected, the results for males are weaker, and do not pass the robustness test of excluding the agricultural sector, supporting the hypothesis that women were more likely than men to join part-time work after the introduction of the reforms, even when excluding the agricultural sector from the sample. Finally, the effect for “working from home”, though always positive, becomes statistically insignificant when excluding the agricultural sector in the full sample. However, the coefficient is statistically different from zero when excluding this sector in the male sample, but smaller in magnitude. More specifically, in this sample, the share of men working from home increases an additional 0.5 percentage point after the introduction of the reform in ICT-intensive sectors. In both the full and the male sample, the effect for “working from home” is not statistically significant in the unweighted regressions, indicating that the increase in the share of individuals working from home among ICT-intensive sectors after the reforms was largely driven by sectors that witnessed larger rates of job creation.

4. Discussion

To our knowledge, this is the first paper to analyze the association between the rise of ICT and alternative work arrangements. Using the variation brought about by differences in the timing of the introduction of telecommunications reforms in Europe, we test the hypothesis that better and more affordable access to the Internet brought more profound labor market changes among sectors that are intrinsically more prone to adopt the Internet. We find that telecommunications reforms were positively correlated with a disproportionate increase in total employment, share of part-time workers and

individuals working from home. We do not find evidence supporting the hypothesis that the Internet is associated with increasing self-employment, temporary work or second job holding.

It is important to mention that given that the timing of the introduction of telecommunications reforms is not necessarily exogenous, our findings should be interpreted with caution. While they do not prove that telecommunications reforms had a causal effect on labor market outcomes, they do support the prediction that if the Internet affects the labor market, it would disproportionately do so among ICT-intensive sectors. Another caveat is that the labor force surveys used in this paper may not be able to capture new forms of work such as online freelancing or multiple job holding. Thereby, exploring the causal effects of new technologies on the rise of alternative work arrangements - in particular using more detailed surveys aimed to capture these new forms of work - is an important avenue for future research.

Table 1. Timing of telecommunications reforms across Europe.

| Country | Type of reform | | | |
|----------------|----------------|-----------------------------|---------------|-----------------------|
| | Liberalization | Regulatory depoliticization | Privatization | Regulatory separation |
| Austria | 1998 | 1997 | 2000 | 1997 |
| Belgium | 1998 | 1993 | 1995 | 1993 |
| Bulgaria | 2003 | . | . | 1998 |
| Switzerland | 1998 | . | 1992 | 1992 |
| Cyprus | 2003 | . | . | 2001 |
| Czech Republic | 2001 | . | . | 1994 |
| Denmark | 1996 | 1997 | 1998 | 1991 |
| Estonia | 2001 | . | 1998 | 1998 |
| Greece | 2001 | . | 1996 | 1992 |
| Spain | 1998 | 1996 | 1997 | 1987 |
| Finland | 1994 | 1998 | 2002 | 1998 |
| France | 1998 | 1997 | . | 1997 |
| Croatia | 2003 | 2003 | 2001 | 2003 |
| Hungary | 2002 | . | 1993 | 1990 |
| Ireland | 1999 | 1997 | 1996 | 1997 |
| Iceland | 1998 | 1997 | . | 1997 |
| Italy | 1998 | 1997 | 1997 | 1997 |
| Lithuania | 2003 | . | 1998 | 2000 |
| Luxembourg | 1998 | 1997 | . | 1997 |
| Latvia | 2003 | 2001 | . | 2001 |
| Netherlands | 1997 | 1997 | 1995 | 1997 |
| Norway | 1998 | 1998 | . | 1987 |
| Poland | 2003 | . | 2000 | 1990 |
| Portugal | 2000 | 1989 | 1997 | 1989 |
| Romania | 2003 | . | 2003 | 2002 |
| Sweden | 1993 | 1992 | 2002 | 1992 |
| Slovenia | 2001 | 2001 | . | 2001 |
| Slovakia | 2003 | 2003 | 2000 | 1993 |
| United Kingdom | 1982 | 1984 | 1984 | 1984 |

Source: Howard and Mazaheri (2009)

Table 2. ICT intensity by sector

| | Mean | Standard Deviation |
|-----------------------------------|-------|--------------------|
| Agriculture | 0.007 | |
| Mining and Quarrying | 0.079 | |
| Manufacturing | 0.060 | |
| Electricity and Water | 0.241 | |
| Construction | 0.017 | |
| Wholesale and retail | 0.049 | |
| Transportation and accommodation | 0.037 | |
| Information and communication | 0.348 | |
| Finance | 0.300 | |
| Real Estate and personal services | 0.139 | |
| Arts and other services | 0.013 | |
| Education | 0.018 | |
| Health | 0.018 | |
| Total | 0.102 | 0.114 |

Note: ICT intensity come from EUKLEMS data for the United States in 2007, and it is define as ICT capital services per hour worked, divided by 100. Public administration workers are excluded from the estimation sample.

Table 3. Descriptive statistics of labor market variables.

| | | Initial year | 2013 | Change |
|-------------------------|-------------|---------------------|-------------|---------------|
| log(employed) | <i>mean</i> | 11.4 | 11.6 | 0.2 |
| | <i>sd</i> | 1.9 | 1.9 | |
| share temporary workers | <i>mean</i> | 0.095 | 0.112 | 0.017 |
| | <i>sd</i> | 0.136 | 0.134 | |
| share part-time workers | <i>mean</i> | 0.131 | 0.155 | 0.024 |
| | <i>sd</i> | 0.156 | 0.160 | |
| share working from home | <i>mean</i> | 0.126 | 0.154 | 0.028 |
| | <i>sd</i> | 0.143 | 0.146 | |
| share self-employed | <i>mean</i> | 0.159 | 0.164 | 0.004 |
| | <i>sd</i> | 0.169 | 0.167 | |
| share second job | <i>mean</i> | 0.051 | 0.045 | -0.006 |
| | <i>sd</i> | 0.046 | 0.042 | |

Note: based on labor market outcomes sectoral-averages, EULFS 1995-2013.

Table 4. Telecommunications reforms and labor market outcomes

| | log(employment) | share temporary | share part-time | share working from home | share self-employed | share with two jobs |
|--------------------|---------------------|-----------------------|-----------------------|-------------------------|------------------------|-----------------------|
| ICT x Reform (any) | 0.186** (0.0743) | -0.000847 (0.0166) | 0.0857*** (0.0139) | 0.211*** (0.0319) | -0.0626*** (0.0147) | -0.00771 (0.00609) |
| | 6,653 0.001 | 6,613 0.000 | 6,614 0.006 | 6,081 0.000 | 6,653 0.003 | 6,653 0.000 |

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell shows the OLS estimate of β in equation (1). The reform variable is a dummy variable equal to one after the country introduced its first telecommunications reform.

Table 5. Telecommunications reforms and labor market changes by socio-demographic groups

| | All | By gender | | By age | | |
|-------------------------|------------------------|----------------------|------------------------|------------------------|------------------------|------------------------|
| | | Women | Men | 25-34 | 35-49 | 50-64 |
| log(employment) | 0.186** (0.0743) | 0.0800 (0.107) | 0.276*** (0.0813) | 0.0775 (0.116) | 0.149* (0.0847) | 0.358*** (0.0985) |
| share temporary | -0.000847 (0.0166) | -0.0174 (0.0203) | -0.0115 (0.0179) | 0.00874 (0.0226) | -0.0346* (0.0188) | 0.0144 (0.0239) |
| share part-time | 0.0857*** (0.0139) | 0.106*** (0.0189) | 0.0269** (0.0106) | 0.0565*** (0.0160) | 0.0833*** (0.0164) | 0.116*** (0.0229) |
| share working from home | 0.211*** (0.0319) | 0.166*** (0.0283) | 0.230*** (0.0340) | 0.158*** (0.0247) | 0.145*** (0.0279) | 0.236*** (0.0376) |
| share self-employed | -0.0626*** (0.0147) | -0.00902 (0.0159) | -0.0816*** (0.0184) | -0.0564*** (0.0182) | -0.0913*** (0.0179) | -0.0569** (0.0237) |
| share with two jobs | -0.00771 (0.00609) | -0.0101 (0.00718) | -0.00413 (0.00829) | -0.0105 (0.00874) | 0.00879 (0.00791) | -0.0360*** (0.0114) |

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell shows the OLS estimate of β in equation (1). The reform variable is a dummy variable equal to one after the country introduced its first telecommunications reform, except for the “working from home” variable, where the reform variable is equal to one two years after the reform.

Table 6. Telecommunications reforms and labor market changes: Robustness Checks

| | Baseline | Excluding Agriculture | Excluding Manufacturing | Without weighting by employment |
|-------------------------|-----------------------|-----------------------|-------------------------|---------------------------------|
| log(employment) | 0.186** (0.0767) | 0.153* (0.0802) | 0.174** (0.0793) | |
| share part-time | 0.0857*** (0.0152) | 0.0534*** (0.0147) | 0.0810*** (0.0150) | 0.0441*** (0.0140) |
| share working from home | 0.211*** (0.0319) | 0.0203 (0.0221) | 0.188*** (0.0317) | 0.0157 (0.0234) |

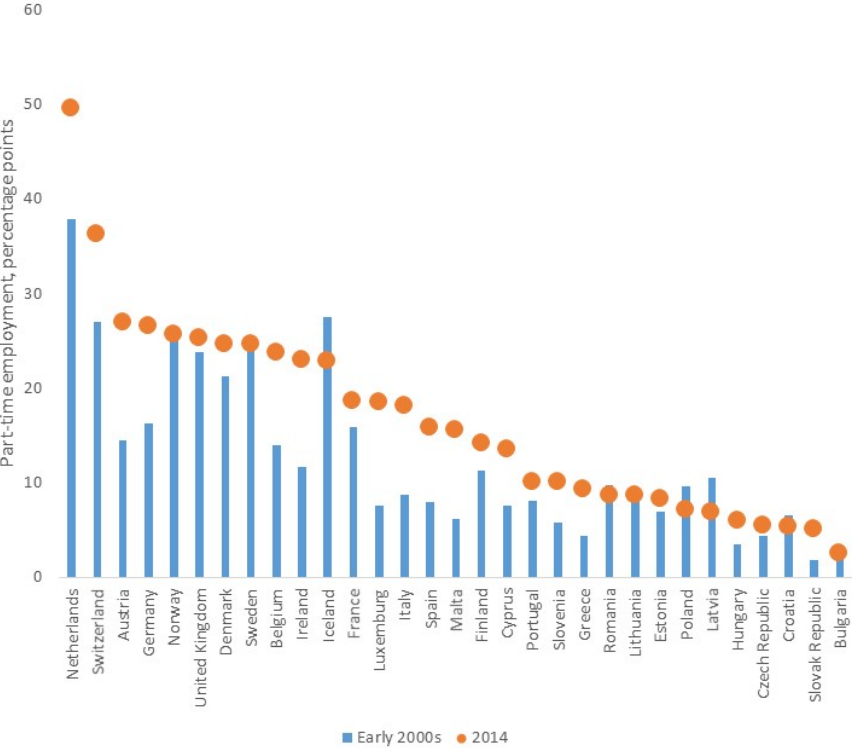
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell shows the OLS estimate of β in equation (1). The reform variable is a dummy variable equal to one after the country introduced its first telecommunications reform, except for the “working from home” variable, where the reform variable is equal to one two years after the reform.

Table 7. Telecommunications reforms and labor market changes for males: Robustness Checks

| | Baseline | Excluding Agriculture | Excluding Manufacturing | Without weighting by employment |
|-------------------------|----------------------|-----------------------|-------------------------|---------------------------------|
| log(employment) | 0.276*** (0.0850) | 0.275*** (0.0894) | 0.268*** (0.0878) | |
| share part-time | 0.0269** (0.0116) | 0.0159 (0.0109) | 0.0286** (0.0118) | 0.0450*** (0.0140) |
| share working from home | 0.230*** (0.0340) | 0.0453* (0.0252) | 0.208*** (0.0338) | 0.00153 (0.0263) |

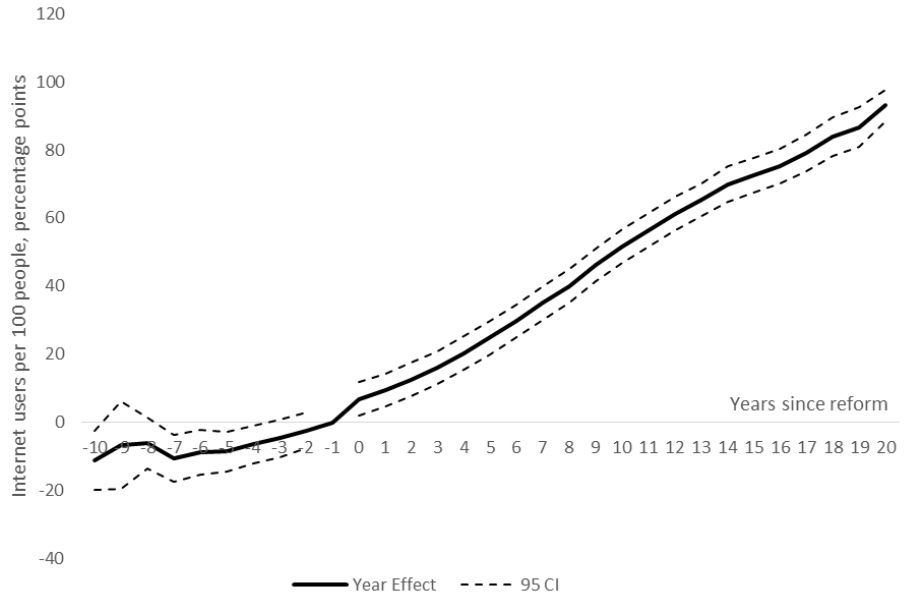
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell shows the OLS estimate of β in equation (1). Sample includes males only. The reform variable is a dummy variable equal to one after the country introduced its first telecommunications reform, except for the “working from home” variable, where the reform variable is equal to one two years after the reform

Figure 1. Part-time employment trends in Europe.



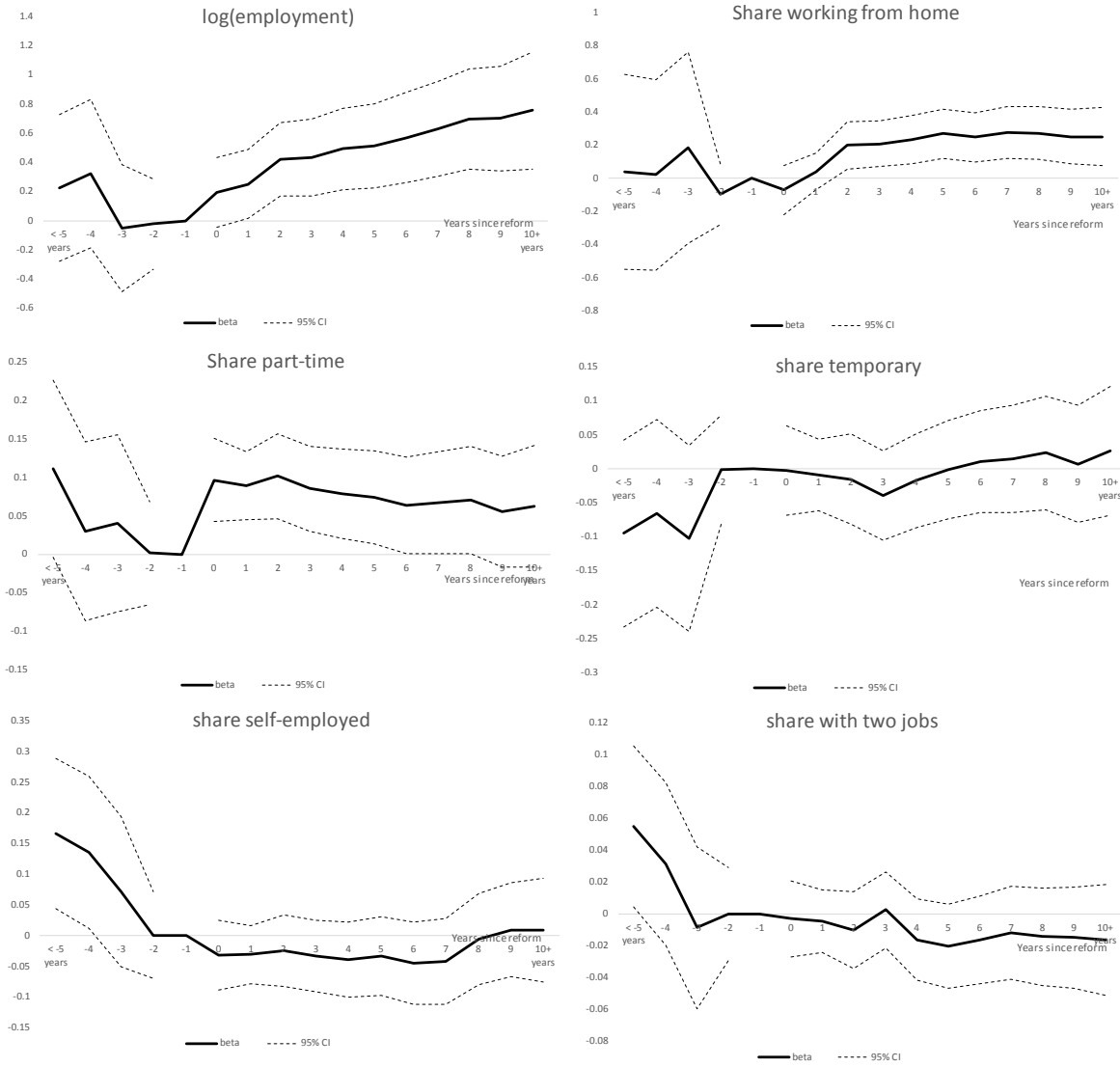
Note: based on estimates from Eurostat, <http://ec.europa.eu/eurostat/web/lfs/data/database>.

Figure 2. Telecommunications reforms and Internet use



Note: Sample includes European countries listed in the Appendix, for the years 1990 to 2013. The solid lines show the OLS coefficients of a regression of Internet use per 100 people on a set of dummy variables denoting the number of years after the introduction of the first reform to the telecommunications sector, while controlling for country fixed effects. The dashed lines are the associated 95% confidence intervals. The number of Internet users per 100 people comes from the World Development Indicators.

Figure 3. OLS estimates with lead and lag effects



Note: the solid lines show the estimates of β from equation (1), and the dashed lines show the associated 95 percent confidence intervals. The reform variable is a dummy variable equal to one after the country introduced its first telecommunications reform.

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Appendix

Table A 1. Countries and years used in the estimations.

| Country | Years |
|-----------------|--------------|
| Austria | 1995–2013 |
| Belgium | 1995–2013 |
| Bulgaria | 2000–2013 |
| Switzerland | 1996–2013 |
| Cyprus | 1999–2013 |
| Czech Republic | 1997–2013 |
| Denmark | 1995–2013 |
| Estonia | 1997–2013 |
| Greece | 1995–2013 |
| Spain | 1995–2013 |
| Finland | 1995–2013 |
| France | 1995–2013 |
| Croatia | 1995–2013 |
| Hungary | 2002–2013 |
| Ireland | 1995–2013 |
| Iceland | 1995–2013 |
| Italy | 1995–2013 |
| Lithuania | 1998–2013 |
| Luxembourg | 1995–2013 |
| Latvia | 1998–2013 |
| Netherlands | 1995–2013 |
| Norway | 1995–2013 |
| Poland | 2000–2013 |
| Portugal | 1995–2013 |
| Romania | 1997–2013 |
| Sweden | 1995–2013 |
| Slovenia | 1996–2013 |
| Slovak Republic | 1998–2013 |
| United Kingdom | 1995–2013 |

Table A 2. OLS results for all telecommunications reforms

| | log(employment) | share temporary | share part-time | share working from home | share self-employed | share with two jobs |
|---|----------------------|-----------------------|-----------------------|-------------------------|------------------------|-------------------------|
| a. Regulatory Separation Reforms | | | | | | |
| ICT x Separation | 0.0523 (0.0677) | 0.0113 (0.0158) | 0.0597*** (0.0133) | -0.00656 (0.0311) | -0.0681*** (0.0141) | -0.00830 (0.00583) |
| Observations | 6,653 | 6,613 | 6,614 | 6,081 | 6,653 | 6,653 |
| R-squared | 0.000 | 0.000 | 0.003 | 0.000 | 0.004 | 0.000 |
| b. Depoliticization Reforms | | | | | | |
| ICT x Depoliticization | 0.229*** (0.0804) | 0.0162 (0.0184) | 0.0549*** (0.0168) | 0.0184 (0.0284) | -0.0156 (0.0157) | 0.00163 (0.00623) |
| Observations | 4,508 | 4,494 | 4,495 | 4,196 | 4,508 | 4,508 |
| R-squared | 0.002 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 |
| c. Liberalization Reforms | | | | | | |
| ICT x Liberalization | 0.190*** (0.0549) | -0.00829 (0.0117) | 0.0174* (0.00986) | 0.0117 (0.0205) | -0.00672 (0.0104) | -0.0114*** (0.00429) |
| Observations | 6,653 | 6,613 | 6,614 | 6,081 | 6,653 | 6,653 |
| R-squared | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| d. Privatization Reforms | | | | | | |
| ICT x Privatization | -0.0701 (0.0657) | -0.0388** (0.0170) | 0.0419*** (0.0145) | 0.112*** (0.0294) | -0.0248* (0.0149) | -0.00992 (0.00610) |
| Observations | 4,628 | 4,615 | 4,602 | 4,316 | 4,628 | 4,628 |
| R-squared | 0.000 | 0.001 | 0.002 | 0.003 | 0.001 | 0.001 |

Note: each coefficient shows the estimates of β from equation (1).