WPS7976

Policy Research Working Paper 7976

How Is the Internet Changing Labor Market Arrangements?

Evidence from Telecommunications Reforms in Europe

Emmanuel Vazquez
Hernan Winkler

WORLD BANK GROUP
Europe and Central Asia Region
Office of the Chief Economist
February 2017

Policy Research Working Paper 7976

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.

This paper is a product of the Office of the Chief Economist, Europe and Central Asia Region. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at hwinkler@worldbank.org.

How Is the Internet Changing Labor Market Arrangements? Evidence from Telecommunications Reforms in Europe[*]

Emmanuel Vazquez (CEDLAS)

Hernan Winkler (World Bank)[**]

JEL Classification: J20, J23, O33

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

[*] This is a background paper for the World Bank Regional Report *Reaping Digital Dividends: Leveraging the Internet for Development in Europe and Central Asia*. The views reported in this paper are the authors' own and do not necessary reflect those of the organizations with which they are affiliated or of their member countries. We would like to thank Piotr Lewandowski, Rita Almeida, Hans Timmer and two anonymous referees for valuable comments.
Hernan Winkler: hwinkler@worldbank.org
Emmanuel Vazquez: evazquez@cedlas.org
[**] Corresponding author.

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 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"

[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.

variable remain (this is due to small sample size or the way the 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 x 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 the reform

[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.

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	
Trasportation and acccomodation	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)	*mean*	11.4	11.6	0.2
	sd	1.9	1.9	
share temporary workers	*mean*	0.095	0.112	0.017
	sd	0.136	0.134	
share part-time workers	*mean*	0.131	0.155	0.024
	sd	0.156	0.160	
share working from home	*mean*	0.126	0.154	0.028
	sd	0.143	0.146	
share self-employed	*mean*	0.159	0.164	0.004
	sd	0.169	0.167	
share second job	*mean*	0.051	0.045	-0.006
	sd	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**	-0.000847	0.0857***	0.0127	-0.0626***	-0.00771
	(0.0743)	(0.0166)	(0.0139)	(0.0335)	(0.0147)	(0.00609)
	6,653	6,613	6,614	6,081	6,653	6,653
	0.001	0.000	0.006	0.000	0.003	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

		By gender		By age		
	All	Women	Men	25-34	35-49	50-64
log(employment)	0.186**	0.0800	0.276***	0.0775	0.149*	0.358***
	(0.0743)	(0.107)	(0.0813)	(0.116)	(0.0847)	(0.0985)
share temporary	-0.000847	-0.0174	-0.0115	0.00874	-0.0346*	0.0144
	(0.0166)	(0.0203)	(0.0179)	(0.0226)	(0.0188)	(0.0239)
share part-time	0.0857***	0.106***	0.0269**	0.0565***	0.0833***	0.116***
	(0.0139)	(0.0189)	(0.0106)	(0.0160)	(0.0164)	(0.0229)
share working from home	0.211***	0.166***	0.230***	0.158***	0.145***	0.236***
	(0.0319)	(0.0283)	(0.0340)	(0.0247)	(0.0279)	(0.0376)
share self-employed	-0.0626***	-0.00902	-0.0816***	-0.0564***	-0.0913***	-0.0569**
	(0.0147)	(0.0159)	(0.0184)	(0.0182)	(0.0179)	(0.0237)
share with two jobs	-0.00771	-0.0101	-0.00413	-0.0105	0.00879	-0.0360***
	(0.00609)	(0.00718)	(0.00829)	(0.00874)	(0.00791)	(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**	0.153*	0.174**	
	(0.0767)	(0.0802)	(0.0793)	
share part-time	0.0857***	0.0534***	0.0810***	0.0441***
	(0.0152)	(0.0147)	(0.0150)	(0.0140)
share working from home	0.211***	0.0203	0.188***	0.0157
	(0.0319)	(0.0221)	(0.0317)	(0.0234)

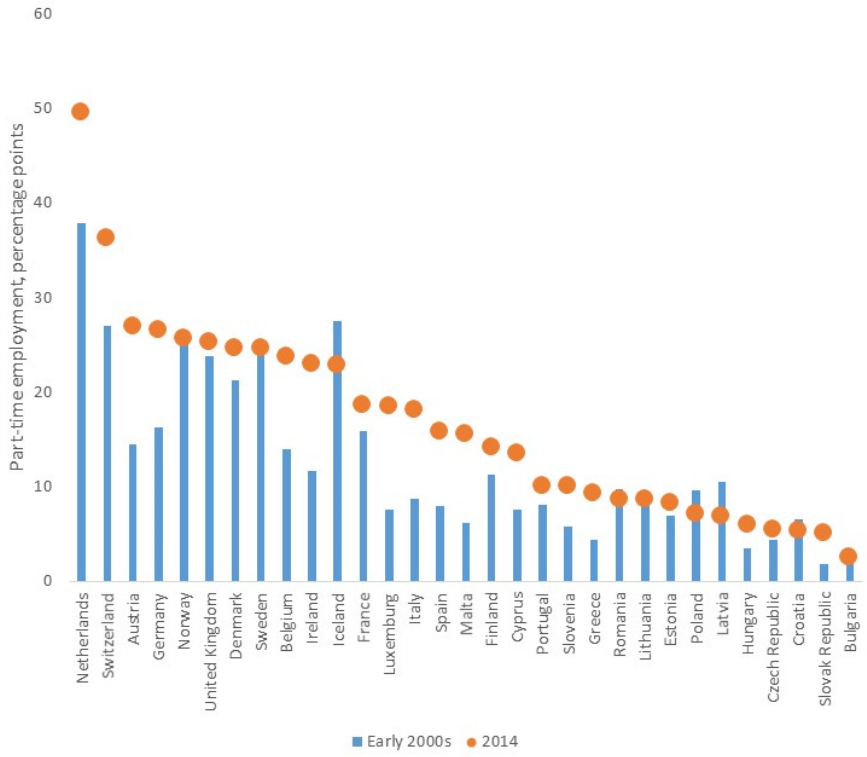
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell shows the OLS estimate of β in equation (1). The reform variable is a dummy variable equal to one after the country introduced its first telecommunications reform, except for the "working from home" variable, where the reform 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***	0.275***	0.268***	
	(0.0850)	(0.0894)	(0.0878)	
share part-time	0.0269**	0.0159	0.0286**	0.0450***
	(0.0116)	(0.0109)	(0.0118)	(0.0140)
share working from home	0.230***	0.0453*	0.208***	0.00153
	(0.0340)	(0.0252)	(0.0338)	(0.0263)

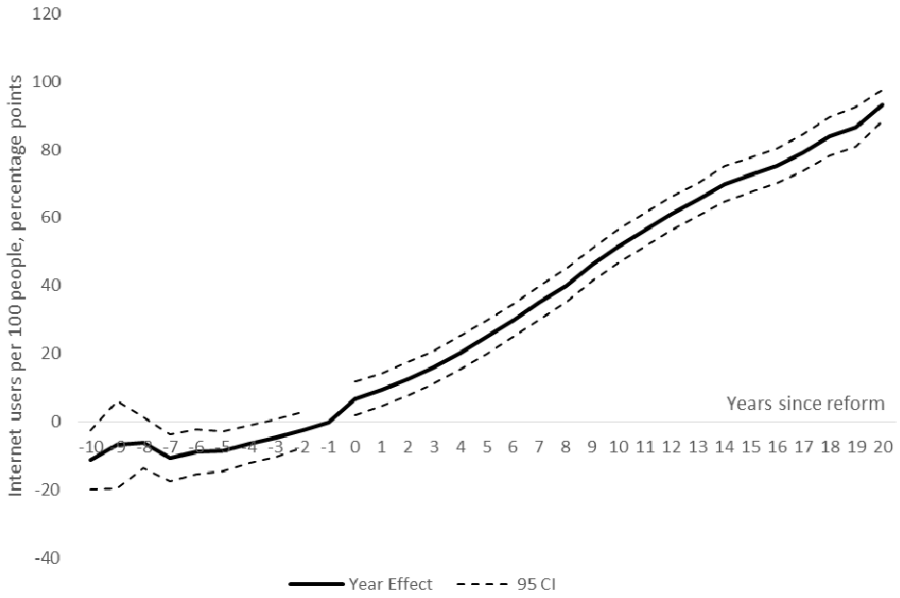
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell shows the OLS estimate of β in equation (1). Sample includes males only. The reform variable is a dummy variable equal to one after the country introduced its first telecommunications reform, except for the "working from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

Figure 1. Part-time employment trends in Europe.



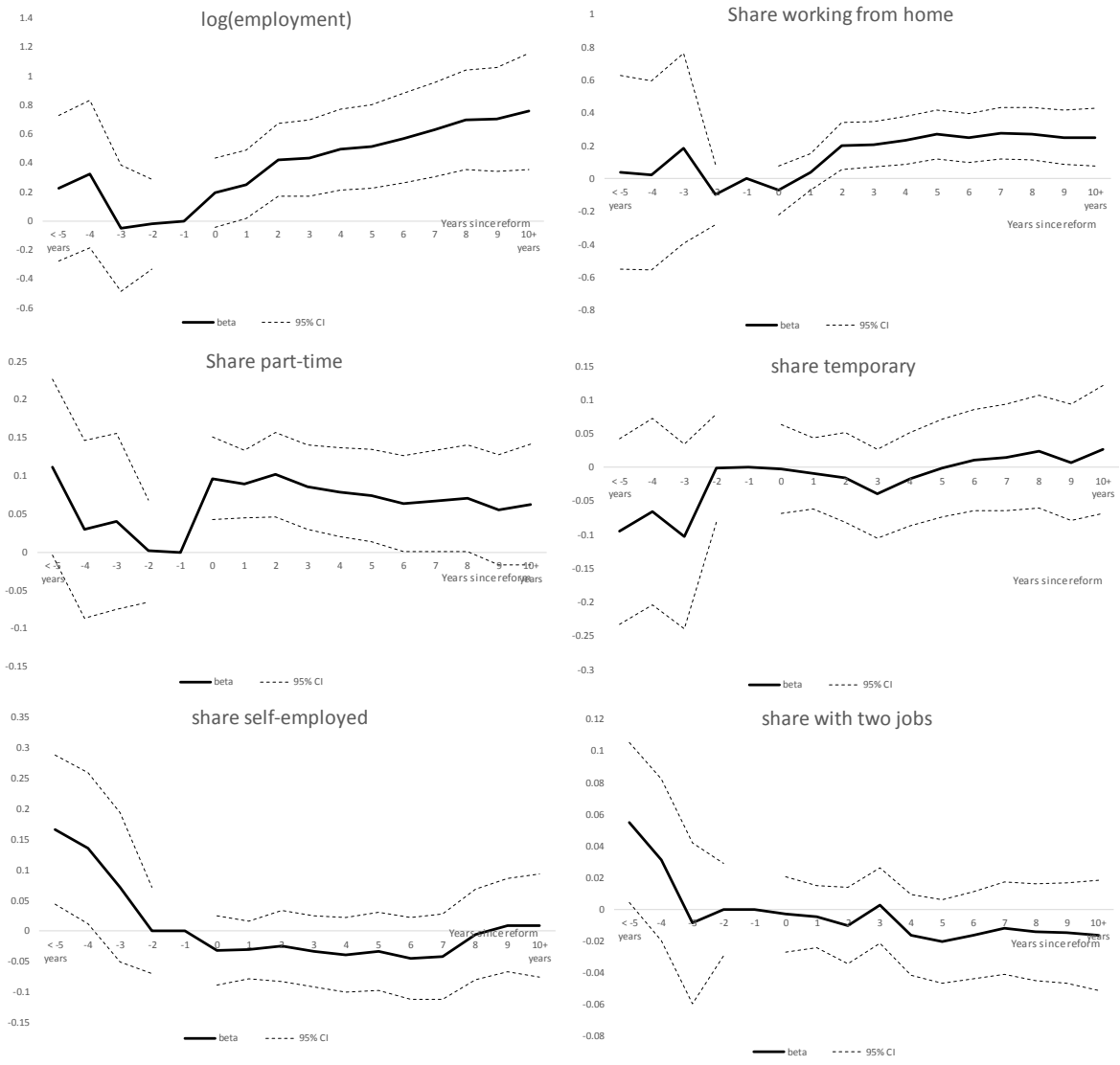
Note: based on estimates from Eurostat, http://ec.europa.eu/eurostat/web/lfs/data/database.

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 $\boldsymbol{\beta}$ 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.

References

Acemoglu, Daron, and David Autor. "Skills, Tasks and Technologies: Implications for Employment and Earnings." *Handbook of Labor Economics* 4 (2011): 1043-1171.

Aghion, Philippe, et al. "The effects of entry on incumbent innovation and productivity." *The Review of Economics and Statistics* 91.1 (2009): 20–32.

Akerman, Anders, Ingvil Gaarder, and Magne Mogstad. "The Skill Complementarity of Broadband Internet." *The Quarterly Journal of Economics* 130.4 (2015): 1781–1824.

David, H., Lawrence F. Katz, and Alan B. Krueger. "COMPUTING INEQUALITY: HAVE COMPUTERS CHANGED THE LABOR MARKET?." Quarterly Journal of Economics 113.4 (1998).

David, H., Frank Levy, and Richard J. Murnane. "The skill content of recent technological change: an empirical exploration."*Quarterly Journal of Economics* 118.4 (2003).

Autor, David, and David Dorn. "This Job Is Getting Old": Measuring Changes in Job Opportunities Using Occupational Age Structure." *The American Economic Review* 99.2 (2009): 45–51.

Autor, David. *Polanyi's Paradox and the Shape of Employment Growth*. Working Paper no. 20485. National Bureau of Economic Research, 2014.

Ayyagari, Meghana, Asli Demirgüç-Kunt, and Vojislav Maksimovic. "Firm Innovation in Emerging Markets: The Role of Finance, Governance, and Competition." *Journal of Financial and Quantitative Analysis* 46.06 (2012): 1545–1580.

Buddelmeyer, Hielke, Gilles Mourre, and Melanie Ward. "The Determinants of Part-Time Work in EU Countries: Empirical Investigations with Macro-Panel Data." (2004). IZA DP No. 1361

Cahuc, Pierre, Olivier Charlot, and Franck Malherbet. "Explaining the spread of temporary jobs and its impact on labor turnover." International Economic Review 57.2 (2016): 533-572.

Dettling, L. (2016). Broadband in the Labor Market:The Impact of Residential High Speed Internet on Married Women's Labor Force Participation Industrial and Labor Relations Review. doi: 10.1177/0019793916644721. http://ilr.sagepub.com/content/early/2016/04/20/0019793916644721.abstract.

EU Labour Force Survey Statistics Explained http://ec.europa.eu/eurostat/statistics-explained/index.php/EU_labour_force_survey_%E2%80%93_data_and_publication

Eurofound (2015), "New forms of employment", Publications Office of the European Union, Luxembourg (www.eurofound.europa.eu/publications/report/2015/workingconditions-labour-market/new-forms-of-employment).

European Commission, "The use of collaborative platforms", Flash Eurobarometer 438, June 2016. ET-02-16-426-EN-N. ISBN 978-92-79-58261-5. doi:10.2873/ 598782

Euwals, Rob, and Maurice Hogerbrugge. "Explaining the Growth of Part-time Employment: Factors of Supply and Demand." Labour 20.3 (2006): 533-557.

Forman, Chris, Avi Goldfarb, and Shane Greenstein. "The Internet and local wages: A puzzle." The American Economic Review 102.1 (2012): 556-575.

Gaggl, Paul, and Greg C. Wright. "A Short-Run View of What Computers Do: Evidence from a UK Tax Incentive." Working paper (2014).

Goos, Maarten, Alan Manning, and Anna Salomons. "Job Polarization in Europe." *The American Economic Review* 99.2 (2009): 58–63.

Horemans, Jeroen, and Ive Marx. In-work poverty in times of crisis: do part-timers fare worse?. No. 13/14. Herman Deleeck Centre for Social Policy, University of Antwerp, 2013.

Howard, Philip N., and Nimah Mazaheri. "Telecommunications Reform, Internet Use and Mobile Phone Adoption in the Developing World." *World Development* 37.7 (2009): 1159–1169.

Kahn, Lawrence M. "Employment protection reforms, employment and the incidence of temporary jobs in Europe: 1996–2001." Labour Economics 17.1 (2010): 1-15.

Katz, Lawrence F., and Alan B. Krueger. "The Rise and Nature of Alternative Work Arrangements in the United States, 1995–2015." Working paper (2016).

Kolko, Jed. "Broadband and local growth." *Journal of Urban Economics* 71.1 (2012): 100-113.

Lewandowski, Piotr, Wojciech Hardy, and Roma Keister. *Technology or Upskilling? Trends in the Task Composition of Jobs in Central and Eastern Europe*. No. 01/2016. Instytut Badañ Strukturalnych, 2016.

Macher, Jeffrey, Nathan H. Miller, and Matthew Osborne. "Finding Mr. Schumpeter: Concrete Evidence on Competition and Technology Adoption." Working paper (2015).

Mas, Alexandre, and Amanda Pallais. Valuing Alternative Work Arrangements. No. w22708. National Bureau of Economic Research, 2016.

OECD (2014), OECD Factbook 2014: Economic, Environmental and Social Statistics, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/factbook-2014-en

OECD, Society at a Glance 2016: OECD Social Indicators, OECD Publishing, Paris. 2016. DOI: http://dx.doi.org/10.1787/9789264261488-en.

Rajan, Raghuram G., and Luigi Zingales. "Financial Dependence and Growth." *American Economic Review* (1998): 559–586.

Seim, Katja and V. Brian Vaiard. "The Effect of Market Structure on Cellular Technology Adoption and Pricing." *American Economic Journal: Microeconomics* 3.2 (2011): 221–251.

Welz, C., and F. Wolf. "Telework in the European Union: Eurofound." Working paper (2010).

Winkler, Hernan. "How does the Internet affect migration decisions?." Applied Economics Letters (2016): 1-5.

World Bank. 2016a. *World Development Report 2016: Digital Dividends.* Washington, DC: World Bank. doi:10.1596/978-1-4648-0671-1.

World Bank. 2016b. “Polarization and Populism.” ECA Economic Update (October), World Bank, Washington, DC. Doi: 10.1596/978-1-4648-0753-4.

World Bank. *Reaping Digital Dividends: Leveraging the Internet for Development in Europe and Central Asia* (forthcoming).

Zangelidis, Alexandros. "Labour Market Insecurity and Second Job-Holding in Europe." Browser Download This Paper (2014).

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	0.0113	0.0597***	-0.00656	-0.0681***	-0.00830
	(0.0677)	(0.0158)	(0.0133)	(0.0311)	(0.0141)	(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. Depolitization Reforms						
ICT x Depolitization	0.229***	0.0162	0.0549***	0.0184	-0.0156	0.00163
	(0.0804)	(0.0184)	(0.0168)	(0.0284)	(0.0157)	(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***	-0.00829	0.0174*	0.0117	-0.00672	-0.0114***
	(0.0549)	(0.0117)	(0.00986)	(0.0205)	(0.0104)	(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	-0.0388**	0.0419***	0.112***	-0.0248*	-0.00992
	(0.0657)	(0.0170)	(0.0145)	(0.0294)	(0.0149)	(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).