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BACCARO, Lucio, *et al*.

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# Determinants of Indefinite Contracts in Europe: The Role of Unemployment

*Lucio Baccaro*
University of Geneva, Switzerland

*Rüya Gökhan Koçer*
University of Geneva, Switzerland
*rg.kocer@gmail.com*

*Jorge Galindo*
University of Geneva, Switzerland

*Valeria Pulignano*
University of Leuven, Belgium

## Abstract

Using individual-level data from the 2010 wave of the European Working Conditions Survey (EWCS), and country-level data on unemployment, employment protection legislation and union density for 21 European countries, this paper provides a comprehensive multi-level analysis of the determinants of indefinite employment contracts. The authors find that workers' autonomy on the job, the intensity of computer use, and the presence of general and specific skills are associated with greater contract security. Perhaps more importantly, the authors find a strong negative effect of unemployment, particularly on workers cumulating multiple sources of labor market vulnerability, such as young age, low skill, low autonomy, and immigrant status, especially but not exclusively in the Mediterranean countries most affected by the crisis.

## Keywords

indefinite contracts – unemployment – skills – occupations

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## 1 Introduction

The ongoing economic and financial crisis has heightened concerns about the increasingly precarious nature of employment contracts (Dieckhoff 2011; Kalleberg 2009; Standing 2011; Verick 2009). Insecure employment contracts have been linked to a host of negative consequences, such as lower commitment (Berkhoff and Schabracq 1992) and job satisfaction (Bardasi and Francesconi 2004); poorer health conditions (Rodríguez 2002; Waenerlund; Virtanen and Hammarström 2011); reduced psychological well-being (see Witte 1999 for a review); heightened stress (Burchell, Ladipo and Wilkinson 2005); and low self-esteem (Kinnunen, Feldt and Mauno 2003). Given the high relevance of the theme, it is important to understand what are the factors determining the prevalence of open-ended versus atypical contracts.[1]

There is already a large amount of research on this issue, although it generally focuses on the determinants of 'non-standard' contracts rather than 'standard' ones as we do in this paper. Most of it falls broadly in three camps: supply-side oriented, demand-side oriented, and institutional. The first type of argument emphasizes the preferences of workers. According to this argument, certain types of workers have a greater preference for employment flexibility than others (Canter 1988). For the demand-oriented explanations the crucial factor is the demand for labor expressed by firms. This literature holds that that the diffusion of precarious contracts is the consequence of the firms' attempts to minimize personnel costs (e.g. Golden and Appelbaum 1992). The institutional literature places employment protection legislation (EPL) at the center of the analysis and argues that this institution plays a crucial role in determining the distribution of employment contracts, since it creates cost differences between permanent and temporary contracts, thus altering firms' incentives at the margin (Bentolila and Dolado 1994; Polavieja 2006).

Our contribution in this paper emphasizes the impact of unemployment. We would argue that the role of unemployment has not received the attention it arguably deserves. Part of the reason is methodological: most studies we are aware of focus on workers in single countries. Although in theory the impact of unemployment could be assessed by comparing different regions in the same country, this type of analysis is rare in the literature (see: Pollmann-Schult 2005). Such neglect is unfortunate since it is well known that unemployment pushes workers to accept jobs that are less well-paid than the ones they

1 We use the expressions: 'indefinite', 'open-ended', 'regular', 'indeterminate duration', 'permanent' contract interchangeably to designate an employment contract in which the end-date has not been agreed in advance by the parties.

previously held (Arulampalam 2001; Gangl 2006, Gregg and Tominey 2005). A similar mechanism may apply to the determination of contract type: when job opportunities are scarce, firms may see a lesser need to offer secure positions, and workers may be willing to settle for employment contracts carrying less job security than they would choose in the absence of constraints. In brief, it stands to reason that the type of employment contracts held by workers would depend not just, and perhaps not even primarily, on the supply-, demand-, and institutional factors emphasized by previous research, but also on the level of unemployment prevailing in the country.

The dataset we analyze in this paper allows us to observe workers embedded in countries and thus to examine the role of individual characteristics and contextual factors simultaneously. We combine individual-level data for 21 European countries from the 2010 wave of the European Working Conditions Survey (EWCS) and country-level data on union density, unemployment, and EPL.

We find that the probability of holding an open-ended contract is positively related to the workers' autonomy on the job, to the intensity of computer use, and to the presence of general and firm-specific skills. Some of these results resonate with previous findings (e.g. Cappelli and Keller 2013; Davis-Blake and Uzzi 1993; Lautsch 2002, Masters and Miles 2002; Mayer and Nickerson 2005; Uzzi and Barsness 1998). Perhaps more importantly, we find that unemployment has a strongly negative impact on regular contracts. Model-based simulations suggest that moving from the maximum (corresponding to Spain) to the minimum level (Norway) of unemployment in the sample would increase the likelihood of regular contracts by 18 percent on average across countries (and much more in Greece, Poland, Ireland, Portugal, and Spain), and that the effect would be comparable in magnitude to the effect of an unrealistically large improvement in job characteristics. We find that unemployment does not affect all workers in the same way. While it spares professional workers, it exerts a massive depressive effect on the likelihood that low-skilled workers would hold regular contracts, especially when other features such as young age and immigrant status further contribute to their labor market vulnerability. For example, our model predicts that for a female low-skilled service-sector worker of immigrant origin in high unemployment Spain, Ireland, or Greece, the probability of holding an open-ended contract is only 31, 25, and 24 percent, respectively. Bringing full employment to the above countries would increase the probability for this worker by 116 percent in Spain, 84 percent in Ireland, and 75 percent in Greece.

In the remainder of the paper we proceed as follows. We begin by framing our hypotheses against the backdrop of the existing literature (Section 2).

We then move to a description of the data and the statistical approach (Section 3). We deliver our empirical results in three steps: first by discussing bivariate relationships (Section 4), then by performing a multi-level logistic analysis (Section 5), and finally by presenting predicted probabilities of holding open-ended contracts for different worker profiles (Section 6). We conclude with a compact discussion of the main findings and policy implications.

## 2 Theoretical Framework

Two broad literatures deal with the determinants of indeterminate duration contracts. The first issues from the sociology of work and industrial relations fields and emphasizes the way in which work is organized and managed. The second tradition emanates from economics and political economy and focuses on how institutional incentives, especially EPL, affect the trade-off between open-ended and temporary employment contracts.

In the first tradition, dependent work is to a large extent open-ended, in the sense that the employer's ability to control the content and quality of work is intrinsically limited. In most cases, the firm is unable to specify in advance exactly what kind of labor services it requires from the worker it hires, and needs therefore to find ways to motivate the worker to 'do her best' on the job. Especially when for technical or economic reasons workers are required to work with little direct supervision (Marsden 1999), this problem is most efficiently addressed by instituting a 'gift exchange' situation (Akerlof 1984), in which workers perceive that they are being treated fairly by firms and reciprocate by showing loyalty and commitment in return. In this configuration of circumstances, the firms have incentives to issue long-term employment relationships to workers who operate autonomously on the job. Indeed, the peculiarity of a long-term employment relationship is that it does not require firms to specify in advance all the performance parameters of a 'job well done'; instead, the firm buys the worker's availability to perform broadly-defined labor services for a predetermined amount of time, while keeping the exact terms of the contract conveniently incomplete (Bidwell 2009; Cappelli and Keller 2013; Davis-Blake and Uzzi 1993; Masters and Miles 2002).

The notion that the content of work may not be easily specified in advance by firms and management, has a long history. Marxists sociologists such as Friedman (Friedman 1977) and macroeconomists like Akerlof (Akerlof 1984) agree that it is very difficult if not impossible for firms to manage workers solely through monetary incentives and tight supervision, and that it is important for management to find alternative ways to enlist the workers' voluntary

cooperation and goodwill (Green 2008). The disruptive consequences of 'working to rule' are seen as clear indices of the limitations of management's reliance on the formal control of workers (Dandeker 1990; Sewell and Wilkinson 1992). In addition, the importance of 'tacit skills' points to the existence of worker competences which are difficult to formalize but are nonetheless an indispensable component of effective performance (Lautsch 2002; Piore and Sabel 1984; Polanyi 1957).

The literature on gift exchange generally focuses on the firms' willingness to pay 'efficiency' wages, i.e. wages higher than market-clearing levels, but in principle offering a long-term contractual relationship is likely to have a similar motivational effect on the worker especially when the external labor market is slack. Indeed, the motivational impact of an open-ended contract is likely to depend on general labor market conditions: in a labor market characterized by high unemployment, in which it is already a privilege to have a job independent of its form and duration, the worker may be willing to accept a lower degree of employment security all other things being equal. Vice versa, in a situation of (near) full employment, workers may demand higher levels of employment security.

Keeping worker autonomy constant, it may be argued that the type of employment contract is likely to depend on the workers' general skills as well. Skilled workers are generally in shorter supply than unskilled ones. It stands to reason that firms will be more likely to offer employment security to workers with scarce skills, since this will allow them to minimize recruitment and turnover costs. Moreover, some literature emphasizes the role of firm-specific skills as well (Doeringer and Piore 1971; Estevez-Abe, Iversen and Soskice 2001). However, it is important to distinguish between firm-specific skills and complex skills. Firm-specific skills are usually complex but complex skills are not necessarily firm-specific. For instance being a surgeon requires complex and scarce skills but they are not specific to the hospital in which surgeries are performed (Williamson 1981, Olsthoorn 2015). On the other hand, performing simple repairs in a munitions factory with an elaborate safety regime would require one to develop skills that are quite firm-specific. Therefore individuals with seemingly abundant skills may gradually enhance their capabilities by developing firm-specific scarce skills. Under these conditions firms may be inclined to offer open-ended contracts to such individuals. Indeed if firms invest in training, and if the resulting skills are at least partially marketable, the firms will have incentives to retain the trained workers by offering them long-term contracts. In brief, skills, both general and firm-specific, should matter for the distribution of employment contracts.

Other individual-level factors that have been proposed to explain variation in employment contracts have to do with the preference for flexibility of particular types of workers, i.e. women (Berger and Piore 1980; Canter 1988) and youth. Contingent contracts may make it easier to reconcile work and family obligations for women, and work and education for young people (Burgess and Connell 2006, Pulignano and Doerflinger 2013). In addition, workers of immigrant origins may be more willing to accept temporary work contracts than native workers. However, it is unclear whether these types of employees actually choose to be temporary, or rather adapt to more difficult labor market conditions. The fact that the share of involuntary contingent work tends to be higher in times of job shortages suggests that a high proportion of contingent work is involuntary (Bolton, Houlihan, and Laaser 2012; Gallagher and Sverke 2005), and casts doubt on the notion that women, youth, and immigrants select atypical contracts more frequently than mature (and native) men out of free choice. An alternative interpretation is that certain categories of workers such as women, young people, and immigrants face a steeper trade-off between employment and job security, and are more willing to accept lower levels of security than other workers at given levels of job scarcity.

Abstracting from individual characteristics, a second intellectual tradition underlines the role of labor market institutions. Employment protection legislation plays a key role in this literature. EPL modifies the relative costs of contracts. All other things being equal, firms are expected to choose the contractual relation that is less costly for them. Thus, keeping the cost of temporary contracts constant, if EPL legislation on regular contracts increases the costs of this type of employment relationship, firms should shift from regular contracts to temporary ones (e.g. Bentolila and Dolado 1994; García-Serrano 1998; Hijzen, Mondauto, and Scarpetta 2013; Kahn 2010; Polavieja 2005, 2006; Saint-Paul 1997).

Another institutional factor that might affect open-ended contracts is the ability of trade unions to constrain firm choice both at the workplace level and in society at large. Yet the impact of trade unions is not univocal. On the one hand, if unions care about job security for all workers, and if they have market power, they should be able to impose indeterminate duration contracts to firms and thus increase their prevalence (Abraham 1988; Golden and Appelbaum 1992; Cappelli and Keller 2013; Davis-Blake and Uzzi 1993). We refer to the above as the 'sword of justice' effect of trade unions. On the other hand, the insider-outsider literature suggests that unions do not cater to the interests of all (or perhaps even most) workers, but only to the interests of insiders. Union insiders may have an interest in keeping in place a buffer of contingent workers

to enhance their own job security (Bentolila and Dolado 1994; Polavieja 2006; Saint-Paul 1997). Thus, the empirical relationship between unions and types of contracts seems difficult to determine a priori based on the existing literature.

Our contribution in this paper is to emphasize a factor that, we would argue, has not received adequate attention so far: the role of unemployment. Unemployment may have an impact both on the supply of secure contracts by firms and on the demand of contract security by workers. When jobs are scarce, the degree of contract security offered by firms is likely to be lower. By the same token, workers will be willing to settle for lower degrees of contract security. This expectation resonates with Karl Marx's 'reserve army' thesis (Marx [1867] 2004). In addition, the impact of unemployment is likely to depend on the workers' labor market position, and to be stronger for workers with low skills. Positing a causal link between unemployment and the type of employment contracts has important policy consequences in the current long international recession: it implies that reducing the unemployment rate, for example through activist (and possibly non-standard) monetary policies and countercyclical fiscal policies (e.g. Krugman 2012), would contribute to addressing the problem of contract precariousness as well.

Against the backdrop of the above discussion, we formulate the following hypotheses to be tested against the data:

(I) The more autonomous is the worker in the performance of her job tasks, the greater is the probability that she will hold a regular contract. This hypothesis resonates with the above discussion about firms' limited control of the content and quality of work and the need to stimulate voluntary cooperation by offering long-term employment relationships.
(II) The probability of open-ended contract should be increasing with workers' general skills.
(III) Firm-specific skills should be positively associated with open-ended contracts.
(IV) The higher is the level of employment protection legislation for regular workers, the lower should be the probability of open-ended contracts, controlling for employment protection for temporary workers.
(V) Unemployment should have a negative impact on the probability of open-ended contracts.
(VI) The impact of unemployment should be stronger for workers with low skills (and vice versa).

In the analysis, we also examine the impact of employment protection for temporary workers but we are unable to formulate a clear directional hypothesis.

It seems inappropriate to simply assume that by increasing the protection of temporary contracts (while keeping the costs of regular contracts constant) regular contracts would become more prevalent. Most temporary posts are low-productivity ones and thus the relevant jobs may disappear, or workers may be hired as independent contractors, or not receive a formal contract at all. In other words, the impact may be nil. Another variable that we include in the analysis but about which we formulate no clear hypothesis is union presence, which may be positively or negatively related to regular contract depending on whether the 'sword of justice' or 'insider-outsider' effect prevails. Finally, we control for sex, age, and national origin, under the assumption that women, youth, and immigrants should be less likely to hold open-ended contracts, all other things being equal.

## 3 Data and Variables

Our data come from the last wave of the European Working Conditions Survey (EWCS) conducted in 2010. The EWCS is based on face-to-face interviews with employees and self-employed people at their homes. Since we focus on dependent employment we exclude self-employed respondents and, as we are not interested in part-time or marginal work, we filter out employees working less than 30 hours per week. We also exclude people employed in agriculture. After list wise deletion of missing values, we have a total of 23359 observations covering 21 countries: Belgium, Czech Republic, Denmark, Germany, Estonia, Greece, Spain, France, Ireland, Italy, Luxembourg, Hungary, Netherlands, Austria, Poland, Portugal, Slovenia, Finland, Sweden, United Kingdom, and Norway.

For our dependent variable the question asked is: 'What kind of employment contract do you have?' The reply "an indefinite contract" is coded as 1. Due to the relatively small number of cases other than indefinite contract, we code all other valid answers (fixed term contract, temporary or employment agency contract, apprenticeship or other training scheme, or other) as 0. The choice to focus the empirical analysis on open-ended contracts is also motivated by the heterogeneity of the different forms subsumed under 'atypical work' (Hipp and Allmendinger 2015). We should emphasize that the translation of questions in different languages is carefully centrally supervised by the EWCS (see Eurofound 2010 for details).

We derive an index of 'autonomy' from seven 'yes or no' questions: "[does your main job involve]: assessing yourself the quality of your own work?; solving unforeseen problems?; complex tasks?; learning new things?; are you able to choose or change your order of tasks?; your methods of work?; your speed

or rate of work?". We add the scores for each respondent and rescale the result into the 0-100 range with a larger number indicating greater autonomy. The Cronbach alpha is 0.72, which is quite high given the dimensions and diversity of our dataset.

The measure of general skills is derived by aggregating information on occupation (two-digit ISCO codes) and educational achievement (one-digit ISCED categories). The procedure is detailed in Appendix A. We assume that occupations with statistically indistinguishable educational distributions require similar general skill sets. Hence by performing chi-square tests and merging occupations with statistically indistinguishable educational distributions, we generate 4 separate skill families. In this typology "professional skills" are unique in the sense that they refer only to the single ISCO category of professionals; "managerial skills" are common among technicians, associate professionals, senior officials and managers (all occupations generally requiring tertiary education); "clerical skills" are prevalent among clerks, service workers, shop and market sales workers; and finally "manual skills" are acquired by craft and related trades workers, plant and machine operators, assemblers, and people who perform elementary occupations. Thus the four skill categories appear to be in decreasing order of skill content: professional, managerial, clerical and manual skills. It should be noted that our results are robust to replacing the four skill categories with the underlying ISCO and ISCED categories, but we prefer the more parsimonious operationalization.

We also construct an additional measure of worker skills focused on the use of information technology at work. The '[intensity in] computer use' variable is derived from a question asking, "does your job involve working with computers, PCs, network, mainframe". We create a 7-point scale variable (1 = "never" and 7 = "all of the time").

We operationalize specific skills with the variable 'training', a dichotomous variable derived from the question, "have you undergone in past 12 months any training paid for or provided by your employer," which equals 1 if the answer is yes and 0 otherwise.

The unemployment variable is the annual country value reported by the OECD for 2010. The stringency of EPL for regular and temporary contracts is also taken from the OECD. These indicators "measure the procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts" (OECD 2016). For each country, they summarize more than 20 basic items in three main areas: protection of regular workers against individual dismissal; regulation of temporary forms of employment; and additional, specific requirements for collective dismissals (OECD 2014).

Union density rates for each country are derived from the ICWTSS database (Visser 2013), and we also use an individual-level binary variable from the EWCS taking a value of 1 if respondents report having employee representation at their establishments. This last variable does not distinguish between union and general representation. While the union density variable proxies for the unions' organizational power at the country level, the individual-level variable captures worker representation at the workplace level.

In addition, we include three demographic indicators: gender (with female as reference), age, and immigrant background. The latter indicator equals 1 if at least one parent is born outside the country of residence. We add to the analysis controls for industry and firm size since a firm's decision to offer open-ended contracts (or workers' decisions to accept them) may vary systematically according to these dimensions. For example, work in some portions of the service sector (e.g. hotels and restaurants) is of a seasonal nature and therefore conducive to flexible employment contracts.

In short, our variables include four micro variables that allow us to examine the impact of work characteristics and worker skills: autonomy, intensity of computer use, training by employer, and the general skill set; four macro variables and one additional micro variable enable us to test arguments about the role of EPL institutions, trade unions, and unemployment; finally, gender, age and immigrant background control for any systematic difference in the probability of open-ended contracts across demographic groups (see Table 1).

## 4 Bivariate Analysis

We start our inquiry by examining the cross-country distribution of open-ended contracts estimated from our data (Figure 1). In all countries indeterminate duration contracts are clearly the most diffuse type of contract for dependent employees working 30 hours per week or more. However, a group of low-scoring countries clearly stands out: in Greece, Ireland, Poland, Spain and Portugal, the proportion is lower than 75 percent. For other countries it is between 83 and 89 percent, with the Scandinavian countries, Luxembourg, Belgium, and surprisingly Hungary and Estonia, all displaying high scores.

Figures 2A and 2B display the bivariate relationships between the cross-country distribution of open ended contracts and the macro predictors discussed in the preceding section. The graphs also display the relevant regression lines. There is a negative relationship with unemployment (Figure 2A, upper panel), which is statistically significant and very robust in the sense that it retains its sign and significance when single countries are dropped one by one.

TABLE 1 *Dependent and independent variables*

| variables | survey questions/sources | scale | expected sign |
|---|---|---|---|
| *contract type* | "What kind of employment contract do you have?" | binary ( 1 = indefinite contract, 0 = fixed-term contract, temporary employment agency contract, apprenticeship or other training scheme, no contract) | dependent variable |
| *gender* | respondents' gender | binary (1 = male, 0 = female) | + |
| *age* | respondents' age | continous | + |
| *immigrant background* | "Were you or both of your parents born in this country?" | binary (1 = no, 0 = yes) | – |
| *autonomy* | "Does your main job involve: assessing yourself the quality of your own work; solving unforeseen problems; complex tasks; learning new things; are you able to choose or change your order of tasks; your methods of work, your speed or rate of work" | continuous (0-100) | + |
| *training* | "Have you undergone in past 12 months any training paid for or provided by your employer?" | binary (1 = yes, 0 = no) | + |
| *computer use* | "Does your job involve working with computers, PCs, network, mainframe" | increasing from 1 to 7 | + |
| *representation* | "At your workplace is there an employee acting as an employee representative?" | binary (1 = yes, 0 = no) | ? |
| *unemployment* | source: OECD | continuous | – |

| variables | survey questions/sources | scale | expected sign |
|---|---|---|---|
| *stringency of employment protection legislation for temporary contracts* | source: OECD | continuous | ? |
| *stringency of employment protection legislation for regular contracts* | source: OECD | continuous | – |
| *union density* | source: Database on Institutional Characteristisc of Trade Unions, Wage Setting, and State Intervention (ICTWSS version 4) | continuous | ? |

The graph for union density (Figure 2A, lower panel) is more scattered, and although the slope is positive, it is not statistically different from zero.

Figure 2B looks at EPL for regular contracts (upper panel) and temporary contracts (lower panel). The slope is slightly negative for EPL regular but there is no evidence of a significant, or just meaningful, relationship. Greece and Germany, or the UK and Ireland, have similar EPL scores for regular workers despite large differences in the percentage of open-ended contracts. As for EPL temporary, there is no relationship at all.

Figure 3A and 3B repeat the exercise for individual-level predictors by aggregating them at the country level. There is a positive and highly significant relationship with average autonomy (Figure 3A, upper panel), which remains significant when single countries are dropped. The relationship with computer use is also positive and statistically robust (Figure 3A, lower panel). Receiving training by the employer is positively associated with regular contracts as well (Figure 3B). However, the significance disappears when Greece is excluded (upper panel). Finally, the prevalence of workplace representation is significantly positively related to open-ended contracts (lower panel). It would seem that this association is statistically stronger than the association with union density at the country level.

In sum, among the macro level variables only unemployment seems to be significantly and negatively associated with the prevalence of open-ended

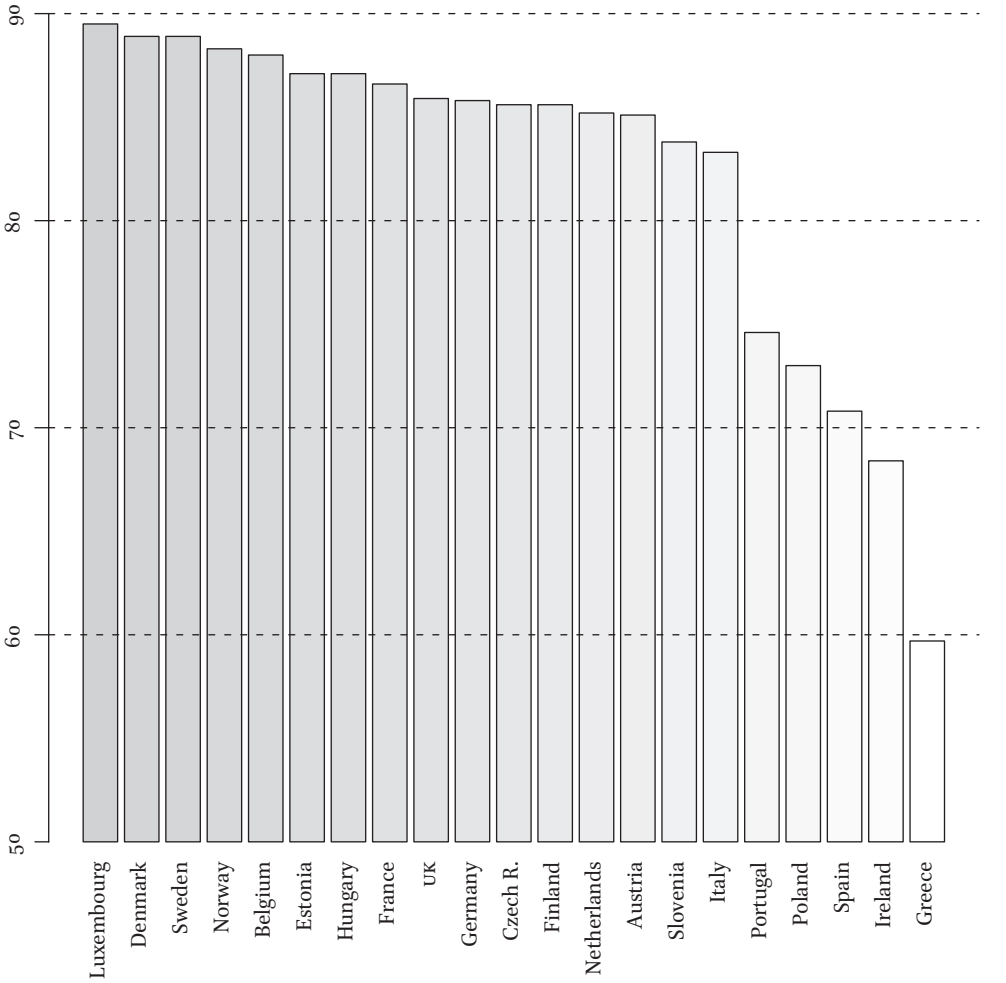



FIGURE 1 *Cross-country distribution of open-ended contracts, estimated from our data.*

contracts. The expected negative relationship between the strictness of EPL for regular workers and open-ended contracts is not borne out by the data. Among the aggregated micro level predictors, autonomy, intensity of computer use, and workplace representation display significant positive associations, while firm training is also positive but not robust. With the exception of EPL, so far the hypotheses formulated above seem to be confirmed.

Obviously the bivariate analysis is only a first approximation: the associations may be confounded by omitted variables simultaneously correlated with the dependent and the independent variable. In the next section we check whether the above relationships withstand the test of multivariate analysis.

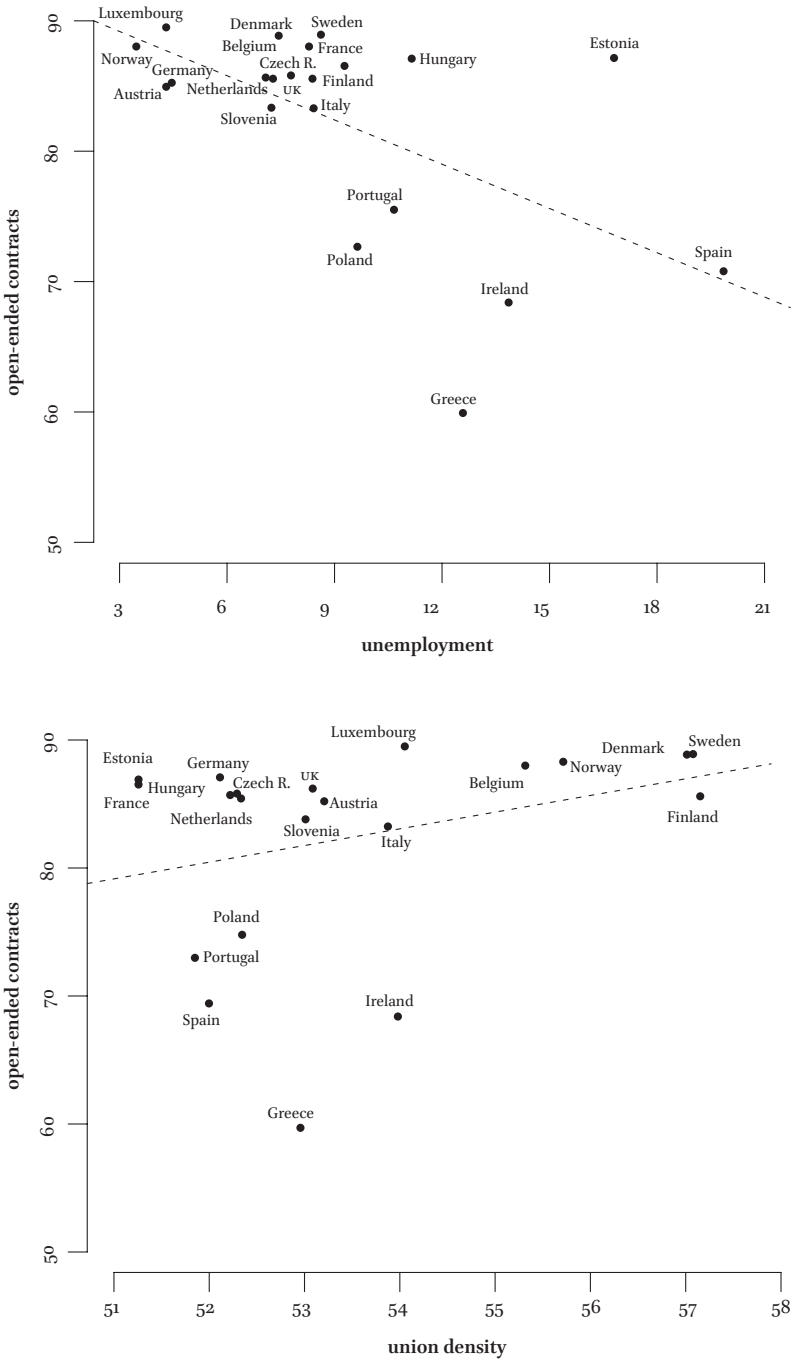



FIGURE 2A *Bivariate relationships between the cross-country distribution of open ended contracts and macro predictors.*

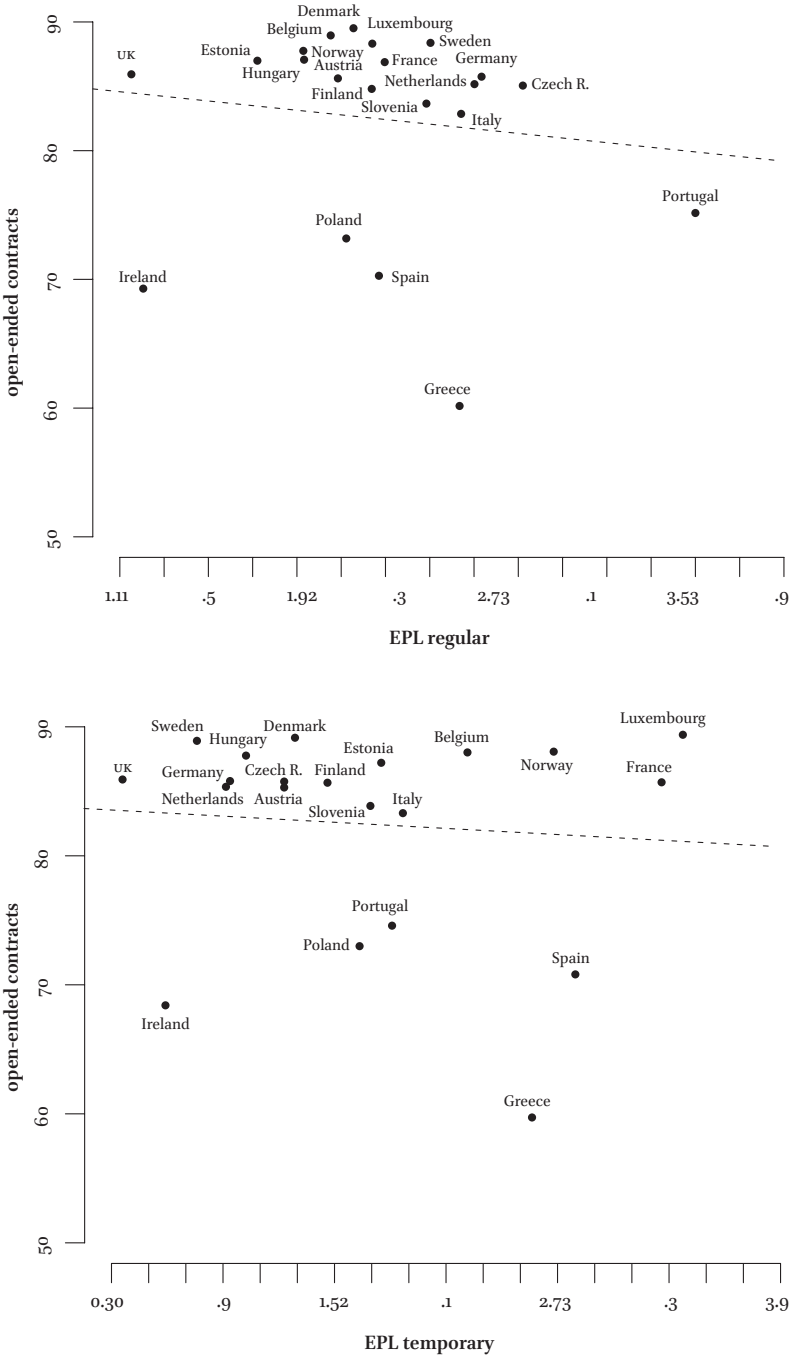



FIGURE 2B *Bivariate relationships between the cross-country distribution of open ended contracts and macro predictors.*

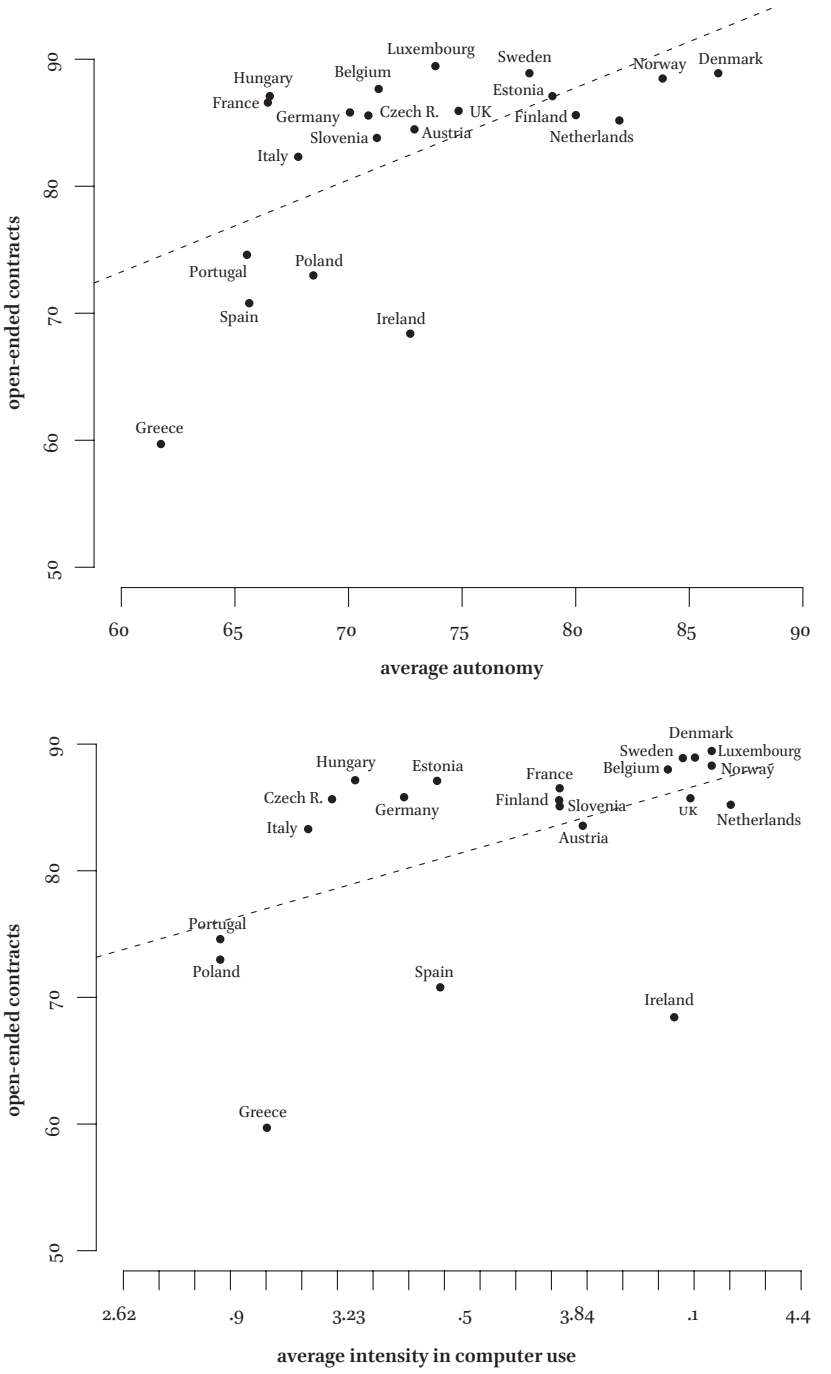
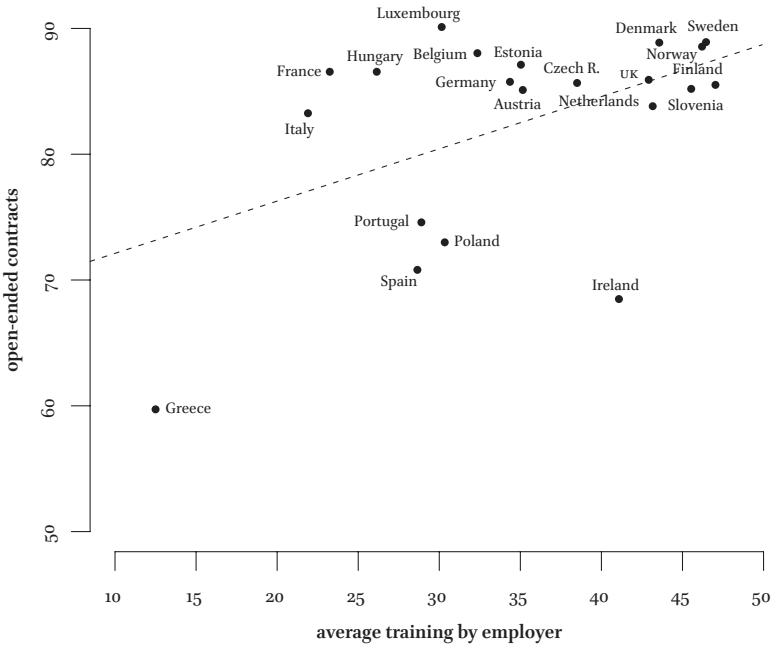



FIGURE 3A *Bivariate relationships between the cross-country distribution of open ended contracts and individual-level predictors, aggregated at country level.*



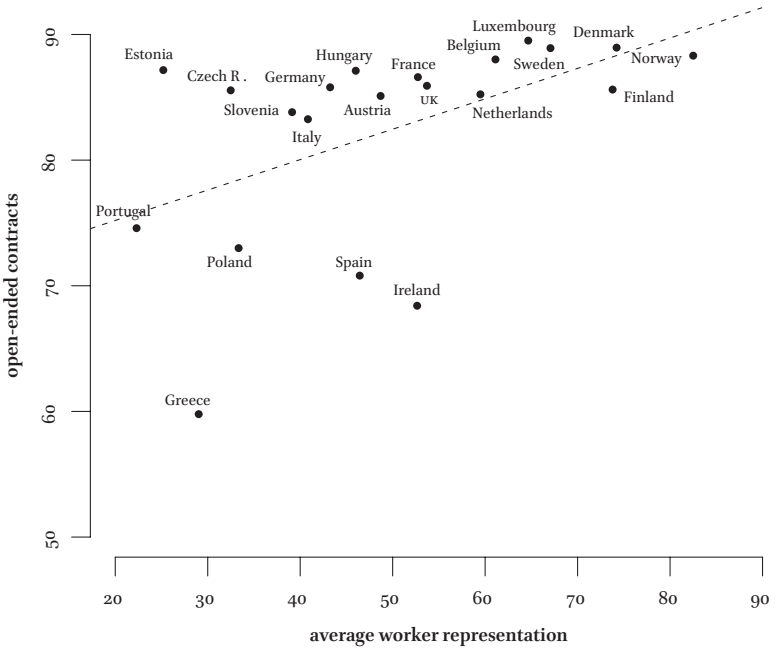




FIGURE 3B *Bivariate relationships between the cross-country distribution of open ended contracts and individual-level predictors, aggregated at country level.*

## 5 Multivariate Analyses

We use a multi-level logistic regression model that takes individuals as first and countries as second level, nesting the former within the latter. Random intercepts take into account unmeasured country-level heterogeneity, while retaining an acceptable number of degrees of freedom. This is, in our view, a reasonable compromise between imposing full uniformity of parameters and letting all parameters vary freely across countries. However, the appropriate number of macro units (countries in our case) needed to construct reliable multi-level models has been an issue in the literature. The main concern is that when maximum likelihood estimation is used and the number of macro units is small, standard errors based on asymptotic assumptions may be underestimated, and this may inflate the significance levels of macro level variables. There is no agreement on the minimum number of macro level units that would prevent such bias; Snijders and Bosker (1999:4) claim that 10 macro units would suffice, Stegmueller warns strongly against using less than 15 (2013:754); Bickel (2007:272) argues that one should have at least 20 units; Maas and Hox (2005:90-91) hold that even 30 units would not be entirely sufficient. Our second level is based on 21 countries. To be sure that our model would be sound, we conducted a Monte Carlo simulation approximating the main features of our dataset in terms of nesting structure and number of macro level variables. The results, reported in Appendix B, are reassuring about the ability to draw meaningful inferences from the model: if there is a variance-deflating bias, it should be in the order of 6 percent at maximum. The model is as follows:

Individual level:

(1) $Y_{ij} \sim Bernoulli(p_{ij})$

(2) $$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \beta_{0j} + \beta_1 x_{1ij} + .... + \beta_k x_{kij} + \varepsilon_{ij}$$

(3) $$\varepsilon_{ij} \sim Logistic\left(0, \frac{\pi^2}{3}\right)$$

Country level:

(4) $\beta_{0j} = \alpha_o + u_j$

(5) $u_j \sim \text{Normal}\ (0, \sigma^2)$

Equation (1) expresses whether a respondent i from country j has an open-ended contract as a random variable with Bernoulli distribution with probability $p_{ij}$. Equation (2) models the corresponding odds ratio as a linear function of the independent variables discussed above. As shown in equation (3) all error terms are assumed to have independent standard logistic distributions with fixed variance equating approximately to 3.29. In this model all coefficients are fixed but the intercept changes across countries (4). The error terms of the country level are assumed to have independent normal distributions with zero mean and constant variance (5).

Results are presented as average partial effects (other details may be provided on request). Logistic regression coefficients should not be directly compared across models due to the fixed value used for error variance (see equation 3) that causes coefficients to be scaled by the real underlying variance. This scaling factor changes across models as new independent variables are added even if they are not correlated with the independent variables already included, and thus coefficients across models may be scaled differently (Mood 2010; Winship and Mare 1984:517). Average partial effects, which are obtained by averaging the marginal effects estimated at each data point separately, enable us to circumvent this problem and obtain values that may be compared across specifications (Cramer 2006:5-8; Mood 2010:75-80).

The first set of models is presented in Table 2. Beginning with individual-level variables, two things are immediately clear: first, in all models all individual factors except for the manual skills category are statistically significant and signed according to expectations; second, the sign, significance and magnitude of the effects remain virtually unchanged across specifications, suggesting robustness.

All demographic variables are signed as expected, but their relative importance varies: men are more likely to hold a regular contract than women but the difference is only about 2 percent in probability terms. Age is quantitatively a much more important determinant, adding 0.6 percent per year to the individual probability, i.e. 18 percent after 30 years. It is likely that at least part of the effect of age is due to tenure and to the accumulation of job-specific skills associated with it. Immigrant background reduces the probability by 4.4 percent, more than twice the effect of gender.

Confirming hypothesis 1, worker autonomy increases the probability of regular contracts. Each unit of autonomy adds 0.1 percent. Since the variable ranges between 0 and 100, shifting from minimum to maximum work autonomy increases the probability by 10 percent, which is the equivalent of 16.7 additional years of age. It should be emphasized that the effect of autonomy is net of the effect of skill, i.e. it is estimated within skill families.

TABLE 2 *Multi-level logistic regression models with average partial effects*

| | models | | | | | | |
|---|---|---|---|---|---|---|---|
| **variables** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| gender | 2.00 ** | 1.98 ** | 2.00 ** | 2.00 ** | 1.97 ** | 2.00 ** | 1.97 ** |
| age | 0.57 ** | 0.57 ** | 0.57 ** | 0.57 ** | 0.57 ** | 0.57 ** | 0.57 ** |
| immigrant background | −4.43 ** | −4.40 ** | −4.43 ** | −4.45 ** | −4.46 ** | −4.46 ** | −4.46 ** |
| autonomy | 0.09 ** | 0.09 ** | 0.09 ** | 0.09 ** | 0.09 ** | 0.09 ** | 0.09 ** |
| training | 2.02 ** | 2.00 ** | 2.01 ** | 2.03 ** | 2.03 ** | 2.03 ** | 2.03 ** |
| computer use | 0.76 ** | 0.76 ** | 0.76 ** | 0.76 ** | 0.75 ** | 0.75 ** | 0.75 ** |
| worker representative | 2.32 ** | 2.29 ** | 2.31 ** | 2.31 ** | 2.24 ** | 2.29 ** | 2.27 ** |
| managerial skills | 2.36 * | 2.35 * | 2.36 * | 2.35 * | 2.33 * | 2.35 * | 2.33 * |
| clerical skills | 1.82 * | 1.82 * | 1.82 * | 1.82 * | 1.81 * | 1.82 * | 1.80 * |
| manual skills | 1.19 | 1.21 | 1.19 | 1.18 | 1.18 | 1.18 | 1.18 |
| unemployment rate | | −0.70 ** | | | −0.78 ** | | −0.85 ** |
| EPL regular | | | | −1.02 | −1.92 | −0.89 | −2.18 |
| EPL temporary | | | | 1.09 | 1.47 | 1.14 | 1.44 |
| union density | | | 0.03 | | | 0.03 | −0.04 |
| log-likelihood | −6272 | −6268 | −6272 | −6271 | −6267 | −6271 | −6267 |

*Note*: Country-level intercepts, sector and firm size indicators are included but not reported here. **: p<0.01 | *: p<0.05 | ° : p<0.1

Coming to the effect of general skills, the reference category of professional skills has a significantly lower probability of holding an open-ended contract than managerial skills and clerical skills, while the difference with manual skills is insignificant. Therefore while, as predicted by hypothesis II, manual workers have a lower probability than the two more skilled categories, professional workers have a significantly lower probability than these two categories. This implies that Hypothesis II is only partially confirmed. At this point it is useful to reflect on the finding about professional skills which may look puzzling. In our view, it reflects the fact that complex (and thus relatively scarce) skills would lead to open-ended contracts if they are also firm-specific. Obviously, once the dimension of firm-specificity is accounted for by other variables in

our model (primarily by the training variable but may also be at least partially covered by autonomy and computer use variables), what remains in terms of complexity in professional skills becomes not firm-specific thus becomes not conducive to open-ended contracts.

Using computer intensely at work, and mastering the associated skills, increases the probability of indeterminate duration contracts by 0.75 percent per unit. Since the range of the variable is between 1 and 7, this variable makes a rather modest contribution overall. Accumulating firm-specific skills (hypothesis III), proxied by undergoing training paid by the employer, makes a positive contribution as expected, but of limited magnitude: only 2 percent.

Moving to the macro-level variables, the models 2 to 7 in Table 2 display different combinations of the four variables. This structure enables us to isolate the most important variables. Unemployment appears in models 2, 5 and 7 and emerges in all these models as the sole significant macro predictor. Neither union density (in models 3, 6, 7) nor employment protection legislation scores for regular and temporary contracts (in models 4, 5, 6 and 7) have significant effects. Comparing (rounded) log-likelihood scores, model 2 with only unemployment as macro predictor has the best fit. One percentage point increase in the unemployment rate reduces the probability of open-ended contracts by 0.70 percent, on average. Unemployment remains significant when model 2 is re-estimated excluding one country at a time. Confirming hypothesis V, these results imply that high unemployment is a serious obstacle to employment security in crisis-stricken Europe. Instead, hypothesis IV on the impact of EPL for regular workers receives no support. While union density at the country level is an insignificant predictor, the individual-level measure of workplace representation is associated with a significantly higher probability of 2.3 percent, a magnitude comparable to the employer training and gender effects. Hence, it seems that worker representation at the workplace is more clearly positively associated with contract security than trade union strength at the national level, as captured by the union density rate.

It should be noted that the estimates for macro variables are not affected by the small possible variance-deflating bias we discussed above. In fact, the two EPL variables and union density are insignificant despite the bias, and the unemployment variable would remain significant at the 0.05 level in a two-sided test even if the variance was inflated by 50 percent, i.e. well-above the magnitude of the estimated bias (see Appendix B). Furthermore, the results of the multivariate analysis are in line with the results of the bivariate analysis. In particular, no association is found between the rigidity of employment protection legislation and the prevalence/probability of regular contracts in either bivariate or multivariate analysis.

The next step is to test whether the impact of unemployment is uniform or depends on skill or job-related characteristics such as autonomy and computer use. From a policy point of view, the underlying question is whether it would be possible to attenuate the insecurity-increasing effect of unemployment.

TABLE 3 *Interaction models with average partial effects*

| | variations of model 2 | | | | | | |
|---|---|---|---|---|---|---|---|
| **variables** | **A** | **B** | **C** | **D** | **E** | **F** | **G** |
| gender | 1.90 ** | 1.99 ** | 2.00 ** | 1.90 ** | 1.93 ** | 2.01 ** | 1.92 ** |
| age | 0.57 ** | 0.57 ** | 0.57 ** | 0.58 ** | 0.57 ** | 0.57 ** | 0.57 ** |
| immigrant background | −3.16 ** | −4.29 ** | −4.33 ** | −3.05 ** | −3.08 ** | −4.30 ** | −3.03 ** |
| autonomy | 0.03 | 0.09 ** | 0.09 ** | 0.04 | 0.04 | 0.09 ** | 0.05 ° |
| training | 1.67 ** | 2.04 ** | 2.09 ** | 1.69 ** | 1.71 ** | 2.09 ** | 1.71 ** |
| computer use | 0.83 ** | −0.23 | 0.73 ** | 0.15 | 0.82 ** | 0.07 | 0.34 |
| worker representative | 2.83 ** | 2.28 ** | 2.29 ** | 2.82 ** | 2.84 ** | 2.28 ** | 2.83 ** |
| managerial skills | 2.90 ** | 2.33 * | 9.11 ** | 2.88 ** | 8.45 ** | 9.23 ** | 8.54 ** |
| clerical skills | 2.14 * | 1.80 * | 6.71 ** | 2.13 * | 5.62 * | 5.96 * | 5.18 * |
| manual skills | 1.73 ° | 1.18 | 10.61 ** | 1.73 ° | 8.57 ** | 8.42 ** | 7.11 ** |
| unemployment rate | −1.20 ** | −1.05 ** | 0.00 | −1.32 ** | −0.57 ° | −0.35 | −0.77 * |
| autonomy × unemployment | 0.01 ** | | | 0.00 ° | 0.00 ° | | 0.00 |
| computer use × unemployment | | 0.10 ** | | 0.07 * | | 0.07 ° | 0.05 |
| managerial skills × unemployment | | | −0.75 ** | | −0.62 * | −0.77 ** | −0.63 * |
| clerical skills × unemployment | | | −0.55 * | | −0.39 | −0.47 ° | −0.35 |
| manual skills × unemployment | | | −1.03 ** | | −0.75 ** | −0.79 ** | −0.59 * |
| log-likelihood | −6341 | −6262 | −6259 | −6338 | −6335 | −6257 | −6334 |

*Note*: Country-level intercepts, sector and firm size indicators are included but not reported here. **: p<0.01 | *: p<0.05 | ° : p<0.1

In Table 3 we estimate a set of additional models interacting unemployment with autonomy, computer use, and the skill families.

From specifications A, B and C in Table 3 it transpires that autonomy, intensity in computer use and the three general skill categories all significantly modify the impact of unemployment, and that the impact of unemployment is growing in autonomy and computer use. This suggests that both factors might counteract the negative effect of unemployment. However, when the interactions of autonomy and computer use are entered simultaneously with interactions between unemployment and the skill categories (model G), the significance of the former disappears and the magnitude of their average partial effect declines (dramatically in the case of autonomy). In other words, when accounting for the heterogeneous effect of unemployment across skill categories, the moderating effect of autonomy and computer use vanishes.

The specification with unemployment interacted systematically with the skill categories (model C) provides the best fit and is our preferred model. The main effect of unemployment in model C is zero. This means that the reference category of professionals is not affected by unemployment. However, the main effects of the skill categories are all significantly higher than the reference category of professional workers. Clerical skills category (clerks, service, shop and market sales workers) loses on average 0.55 percentage points in probability of open-ended contracts for each percentage point increase in the unemployment rate; managerial skills category (technicians, associate professionals, senior officials and managers) loses 0.75 percent; and the manual skills category (trade workers, plant and machine operators, assemblers, and elementary occupations) 1.03 percent. Clearly, not all workers feel the effect of unemployment with the same level of intensity: while for professionals it is non-existent, it is most damaging for workers belonging to the lowest skill category, thus confirming hypothesis VI. The heterogeneous impact of unemployment on skill categories may at least in part depend on the fact that for given levels of the overall unemployment rate in a country, low-skilled categories tend to have a higher skill-specific unemployment rate (e.g. OECD 2011).

## 6 Probability Analysis for Different Worker Profiles

In a logistic regression equation the impact of a variable on the predicted outcome depends on the coefficients and values of all other variables in the model. Thus, to assess how different factors combine to shape the individual probability of holding an open-ended contract, in this section we calculate predicted probabilities for ideal typical worker profiles. We engage in a

counterfactual exercise in which certain characteristics are kept constant and others are allowed to vary.

Before we run the simulations, we present in Table 4 a rough 'goodness of fit' test by comparing the predicted country-by-country average probability of workers holding an indeterminate duration contract with the weighted sample proportions of open-ended contracts. The predicted probabilities are calculated from Model C in Table 3, using the information about every single respondent in our dataset. Averaging these probability scores over countries yields the results in column 2. As one can see, the model outcomes are always

TABLE 4 *Proportion of open-ended contracts and model predictions for different countries*

| | **proportion of open-ended contracts** | **average probability of having open-ended contract in percentage points*** |
|---|---|---|
| Belgium | 88.2 | 88.9 |
| Czech Republic | 85.4 | 85.4 |
| Denmark | 89.6 | 91.1 |
| Germany | 85.7 | 87.6 |
| Estonia | 87.1 | 87.2 |
| Greece | 59.8 | 59.4 |
| Spain | 73.0 | 73.0 |
| France | 86.8 | 88.2 |
| Ireland | 68.7 | 68.5 |
| Italy | 83.3 | 83.8 |
| Luxembourg | 89.5 | 89.7 |
| Hungary | 87.2 | 86.4 |
| Netherlands | 86.3 | 89.6 |
| Austria | 85.2 | 87.1 |
| Poland | 72.9 | 75.2 |
| Portugal | 74.5 | 77.0 |
| Slovenia | 83.9 | 85.9 |
| Finland | 85.4 | 85.4 |
| Sweden | 88.6 | 90.9 |
| UK | 86.0 | 87.6 |
| Norway | 88.4 | 91.9 |

*: derived from model C in Table 3.

close to the sample proportions and in some cases (Czech Republic, Estonia, Greece, Spain, Luxembourg and Finland) almost identical. We conclude that the model provides an acceptable basis for the simulations.

To isolate the impact of autonomy, training, and computer use, on the one hand, and of unemployment, on the other hand, Table 5 reports the results of model-based simulations. In column 1 the average country probability is displayed. In columns 2 and 3 the three individual-level characteristics, which may be seen as key ingredients of a 'quality job', are set to their minimum and maximum values, respectively, while all other variables are kept to their historical values, and then predicted probabilities are calculated by averaging across all workers in each country. The goal of the exercise is to understand what difference improving job characteristics from 'worst' to 'best' would make for the probability of holding a secure contract in different countries. Columns 3 and 4 in the same Table 5 perform a similar exercise by setting unemployment to the highest (corresponding to the Spanish value of 19.85 percent) and lowest values (corresponding to the Norwegian value of 3.52 percent, a value which one could reasonably equate with full employment) in the sample.

The predicted probabilities reported in Table 5 suggest that reducing unemployment from the highest to the lowest value increases the probability of indefinite contract by 18 percent on average, i.e. not much less than increasing autonomy, training, and computer use from their minimum to their maximum levels would. However, while the second counterfactual is utterly unrealistic, since it is arguably impossible for all jobs in an economy to have the maximum level of worker autonomy, computer intensity, and on-the-job training, the first counterfactual is not unrealistic, since it is certainly conceivable for an economy to have an unemployment rate corresponding to *de facto* full employment (i.e., with mostly frictional unemployment), and full employment was indeed a common feature of European political economies in a not-so-distant past (Armstrong, Glyn and Harrison 1991). Interestingly, Table 5 also reveals that the countries characterized by low prevalence of open-ended contracts, i.e. Greece, Spain, Ireland, would greatly benefit both from job improvement and the elimination of unemployment, suggesting that both the characteristics of jobs and the labor market situation are sources of insecurity for workers in these countries.

The next step is to create ideal typical worker profiles (reported in Table 6) and then calculate the corresponding predicted probabilities. The first profile is that of a young female service worker of immigrant origin with low general skills (manual skills category) and very low autonomy and computer usage scores. She does not receive any training by her employer nor does she benefit

TABLE 5 *Average effects of improving job characteristics and unemployment conditions*

| | | job characteristics | | | unemployment | | |
|---|---|---|---|---|---|---|---|
| | *expected probability* | *worst* | *best* | *gain in %* | *highest (19.85, Spanish value)* | *lowest (3.52, Norwegian value)* | *gain in %* |
| Belgium | 0.89 | 0.80 | 0.93 | 17.3 | 0.81 | 0.91 | 13.1 |
| Czech Republic | 0.85 | 0.75 | 0.92 | 21.8 | 0.74 | 0.88 | 19.3 |
| Denmark | 0.91 | 0.80 | 0.94 | 16.4 | 0.84 | 0.93 | 10.5 |
| Germany | 0.88 | 0.79 | 0.93 | 18.0 | 0.76 | 0.90 | 17.5 |
| Estonia | 0.87 | 0.77 | 0.92 | 19.9 | 0.85 | 0.94 | 10.5 |
| Greece | 0.59 | 0.47 | 0.75 | 59.2 | 0.50 | 0.71 | 43.2 |
| Spain | 0.73 | 0.60 | 0.83 | 39.7 | 0.73 | 0.88 | 20.4 |
| France | 0.88 | 0.80 | 0.93 | 16.9 | 0.80 | 0.91 | 13.9 |
| Ireland | 0.68 | 0.51 | 0.78 | 52.9 | 0.62 | 0.78 | 26.3 |
| Italy | 0.84 | 0.73 | 0.91 | 23.4 | 0.73 | 0.87 | 19.5 |
| Luxembourg | 0.90 | 0.80 | 0.94 | 16.6 | 0.79 | 0.90 | 13.6 |
| Hungary | 0.86 | 0.78 | 0.93 | 19.3 | 0.79 | 0.91 | 16.0 |
| Netherlands | 0.90 | 0.78 | 0.92 | 18.8 | 0.80 | 0.90 | 12.2 |
| Austria | 0.87 | 0.77 | 0.92 | 19.5 | 0.73 | 0.88 | 19.6 |
| Poland | 0.75 | 0.62 | 0.85 | 36.4 | 0.62 | 0.81 | 30.9 |
| Portugal | 0.77 | 0.65 | 0.87 | 33.1 | 0.66 | 0.84 | 26.2 |
| Slovenia | 0.86 | 0.74 | 0.91 | 22.8 | 0.75 | 0.88 | 17.1 |
| Finland | 0.85 | 0.72 | 0.90 | 24.7 | 0.75 | 0.88 | 17.2 |
| Sweden | 0.91 | 0.80 | 0.94 | 16.5 | 0.86 | 0.92 | 7.8 |
| UK | 0.88 | 0.76 | 0.92 | 20.5 | 0.79 | 0.90 | 14.2 |
| Norway | 0.92 | 0.82 | 0.94 | 14.8 | 0.82 | 0.92 | 12.7 |
| column averages | 0.84 | 0.73 | 0.90 | 25.2 | 0.75 | 0.88 | 18.2 |

from worker representation. She is employed by a mid-sized private service firm (she may be cleaning offices after working hours). This profile combines several characteristics that are conducive to insecure contracts: age, gender, immigrant origin, low general and specific skills, low autonomy and computer use.

The second profile is that of a mature industrial worker. He is male, 50 years old, native, with an intermediate autonomy score of 50, and moderate use of

TABLE 6 *Ideal typical worker profiles*

| | **service worker** | **industrial worker** | **young industrial worker** | **young professional** |
|---|---|---|---|---|
| gender | female | male | male | female |
| age | 25 | 50 | 20 | 25 |
| immigrant background | yes | no | no | yes |
| autonomy | 15 | 50 | 50 | 100 |
| training | no | yes | yes | no |
| computer use | 1 | 3 | 3 | 7 |
| worker representative | no | yes | yes | no |
| skill group | manual skills | manual skills | manual skills | professional skills |
| sector | private service | industry | industry | private service |
| firm size | between 100 and 249 | more than 500 | more than 500 | between 100 and 249 |

computers; he is trained by his employer, enjoys worker representation, and works in a large establishment with more than five hundred employees. Like the service worker, he belongs to the bottom skill category of manual workers. The third profile is of a young industrial worker. He shares all characteristics of the mature industrial worker except for age: he is only 20 years old. Comparing these two profiles would allow us to isolate the effect of age. The last profile is that of a young professional. She is an immigrant worker of 25 years with highest autonomy and computer usage scores, and professional skills; a mid-sized private service firm employs her. She has some traits in common with the service sector worker: young age and immigrant status, which would pull her down towards employment insecurity, but compensates with general skills, autonomy, and computer proficiency. Comparing these two profiles would allow us to see the extent to which skills and autonomy make a difference.

We are interested to see both how the predicted probabilities of these ideal typical worker types vary across countries (as a result of unobserved heterogeneity captured by the random intercepts) and how unemployment affects them. For this second purpose we set unemployment to two values: the historical country value in 2010 and the minimum rate of unemployment in the

sample: that of Norway. The question addressed by this second simulation, is: what would happen to each worker profile if countries were to move to full employment?

The results are reported in Table 7. For each profile there are three columns; the first one reports the predicted probability of holding an open-ended contract in a particular country with unemployment set at the 2010 rate; the second one the probability with the value of unemployment set to 3.52 percent; the third the percentage gain associated with the transition to full employment. Comparing countries across the first column reveals the extent to which contract security varies across countries for the same worker type; across the second column reveals the effect of unobserved country-specific conditions captured by the random intercept; across the third column reveals the impact of eliminating unemployment in a particular country for a particular profile.

Unsurprisingly, the service worker has the lowest probability scores of the four profiles, but with a large variation across countries. In Luxembourg, France and Belgium her probability is greater than 60 percent; in Sweden, UK, Italy, Estonia, Czech Republic, Denmark, and Hungary 50 percent; in Greece, Spain, and Ireland, less than 32 percent. If unemployment could be brought to the Norwegian level of 3.52, the probability of this worker would increase by 116 percent in Spain; 84 percent in Ireland; and 75 percent in Greece. The average gain across countries would be around 30 percent. Clearly, a vulnerable labor market profile such as service worker is heavily negatively influenced by unemployment, particularly but not exclusively in Mediterranean countries.

The old industrial worker appears to have the most secure job of all four profiles. Despite low skill and intermediate autonomy, he is protected by age. Even in Greece, Ireland, and Spain, his probability is at least 82 percent; and in the other countries it is no less than 90 percent. The transition to full employment would not make a big difference for this worker, unless he is resident in Spain, Ireland, or Greece, in which case it would increase the probability by more than 10 percent. The average gain would be of 3.3 percent, around 1/10 of that of service worker. This implies that unemployment is not a major concern for mature industrial workers, at least in so far as contract security is concerned.

The situation is rather different for the young industrial worker. His probability of holding an indeterminate duration contract is much more volatile and varies between 0.50 (in Greece and Ireland) and 0.88 (in Luxembourg). The transition to full employment would considerably improve his probability of regular contracts if he resides in Spain (46 percent), Ireland (43 percent), or Greece (38 percent), but less so elsewhere. The average gain would be 13 percent, almost four times the average gain of mature industrial worker, but less than half the gain of service worker despite similarly low general skills.

TABLE 7 *Probabilities of open-ended contracts across countries for four ideal typical profiles*

| | service worker | | | industrial worker | | | young industrial worker | | | young professional | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *unemployment = 2010 value* | *unemployment = 3.52* | *gain in %* | *unemployment = 2010 value* | *unemployment = 3.52* | *gain in %* | *unemployment = 2010 value* | *unemployment = 3.52* | *gain in %* | *unemployment = 2010 value* | *unemployment = 3.52* | *gain in %* |
| Belgium | 0.61 | 0.71 | **16.4** | 0.96 | 0.97 | **1** | 0.83 | 0.88 | **6** | 0.79 | 0.79 | **0** |
| Czech Republic | 0.51 | 0.60 | **17.6** | 0.94 | 0.95 | **1.1** | 0.77 | 0.82 | **6.5** | 0.69 | 0.69 | **0** |
| Denmark | 0.55 | 0.64 | **16.4** | 0.95 | 0.96 | **1.1** | 0.79 | 0.85 | **7.6** | 0.73 | 0.73 | **0** |
| Germany | 0.59 | 0.66 | **11.9** | 0.95 | 0.96 | **1.1** | 0.81 | 0.86 | **6.2** | 0.75 | 0.75 | **0** |
| Estonia | 0.49 | 0.76 | **55.1** | 0.93 | 0.98 | **5.4** | 0.75 | 0.91 | **21.3** | 0.83 | 0.83 | **0** |
| Greece | 0.24 | 0.42 | **75** | 0.82 | 0.91 | **11** | 0.50 | 0.69 | **38** | 0.52 | 0.52 | **0** |
| Spain | 0.31 | 0.67 | **116.1** | 0.87 | 0.97 | **11.5** | 0.59 | 0.86 | **45.8** | 0.75 | 0.75 | **0** |
| France | 0.62 | 0.73 | **17.7** | 0.96 | 0.97 | **1** | 0.83 | 0.89 | **7.2** | 0.80 | 0.80 | **0** |
| Ireland | 0.25 | 0.46 | **84** | 0.83 | 0.92 | **10.8** | 0.51 | 0.73 | **43.1** | 0.57 | 0.57 | **0** |
| Italy | 0.50 | 0.61 | **22** | 0.93 | 0.96 | **3.2** | 0.76 | 0.83 | **9.2** | 0.70 | 0.70 | **0** |
| Luxembourg | 0.70 | 0.71 | **1.4** | 0.97 | 0.97 | **0** | 0.88 | 0.89 | **1.1** | 0.79 | 0.79 | **0** |
| Hungary | 0.53 | 0.69 | **30.2** | 0.94 | 0.97 | **3.2** | 0.78 | 0.88 | **12.8** | 0.77 | 0.77 | **0** |
| Netherlands | 0.56 | 0.58 | **3.6** | 0.95 | 0.95 | **0** | 0.80 | 0.81 | **1.3** | 0.68 | 0.68 | **0** |
| Austria | 0.58 | 0.60 | **3.4** | 0.95 | 0.95 | **0** | 0.81 | 0.82 | **1.2** | 0.69 | 0.69 | **0** |
| Poland | 0.38 | 0.52 | **36.8** | 0.90 | 0.94 | **4.4** | 0.66 | 0.77 | **16.7** | 0.62 | 0.62 | **0** |
| Portugal | 0.40 | 0.56 | **40** | 0.90 | 0.95 | **5.6** | 0.67 | 0.80 | **19.4** | 0.66 | 0.66 | **0** |
| Slovenia | 0.53 | 0.61 | **15.1** | 0.94 | 0.96 | **2.1** | 0.78 | 0.83 | **6.4** | 0.70 | 0.70 | **0** |
| Finland | 0.45 | 0.56 | **24.4** | 0.92 | 0.95 | **3.3** | 0.72 | 0.80 | **11.1** | 0.66 | 0.66 | **0** |
| Sweden | 0.53 | 0.64 | **20.8** | 0.94 | 0.96 | **2.1** | 0.78 | 0.85 | **9** | 0.73 | 0.73 | **0** |
| UK | 0.55 | 0.64 | **16.4** | 0.94 | 0.96 | **2.1** | 0.79 | 0.85 | **7.6** | 0.73 | 0.73 | **0** |
| Norway | 0.62 | 0.62 | **0** | 0.96 | 0.96 | **0** | 0.84 | 0.84 | **0** | 0.71 | 0.71 | **0** |
| **column averages** | **0.50** | **0.62** | **29.7** | **0.93** | **0.96** | **3.3** | **0.75** | **0.83** | **13.2** | **0.71** | **0.71** | **0** |

The professional worker is unaffected by unemployment thanks to her high general skills. Yet her probability is only slightly above a coin toss in Greece (0.52), while it reaches 0.83 in Estonia. Interestingly, it is 75 percent in Spain, a country that generally displays low probability scores. The cross-country average is 71 percent, meaning that she is less likely to hold an indeterminate duration contract than the young industrial worker. Her higher autonomy, general skills, and computer usage are counterbalanced by her gender, immigrant status, and lack of workplace representation. However, it is also possible that her strong marketable skills would make her less interested in a regular contract than her industrial colleague.

In brief, the analysis of predicted probabilities suggests considerable variability across countries for identical worker profiles, and confirms that the impact of unemployment is contingent on other characteristics: workers combining multiple sources of vulnerability on the labor market, such as young age, low general and specific skills, and low autonomy, are more heavily affected by unemployment, and consequently also more likely to benefit from tighter labor markets in terms of employment security.

## 7 Overview of Findings and Concluding Remarks

In this paper we have sought to provide a comprehensive analysis of the determinants of employment contracts in 21 European countries in 2010, by taking into account both individual-level characteristics and country-level ones.

Our theoretical framework has brought together two literatures that do not interact with one another very frequently: a literature inspired by the sociology of work and industrial relations, on the one hand, and a literature in economics and political economy on the other. For the first, the type of employment contract depends to a large extent on the way work is organized and managed, and particularly on the autonomy of workers. In the case of autonomous workers, the firm is unable or unwilling to write down in a spot contract all performance parameters, and thus prefers motivating the worker to do her best on the job by offering an open-ended relationship (Marsden 1999). The second literature focuses on labor market institutions, and especially on the impact of EPL legislation. By modifying the costs of indeterminate duration contracts relative to the temporary contracts alternative, employment protection legislation tilts the preferences of firms away from secure contracts and encourages precariousness (Saint Paul 1997). Other literatures emphasize the importance of worker skills, arguing that workers with scarce skills, either general or specific, should be in higher demand and therefore, all other things being equal,

more likely to be offered open-ended contracts by firms (Doeringer and Piore 1971; Estevez-Abe, Iversen and Soskice 2001).

Our own contribution to the theory of employment contracts has been to return to Marx's argument about a 'reserve army' and work out its implications for the prevalence of secure contracts. We have argued that when there is an excessive labor supply in the economy, firms are more likely to offer insecure jobs and workers are more likely to accept them for lack of better alternatives.

Our empirical tests have combined simple bivariate graphs with multi-level regression analysis, and have produced convergent results. The hypotheses we formulated were largely confirmed, with the exception of the EPL one. Table 8 provides a compact overview of the test results.

Instead of revisiting each of the hypotheses here, let us focus on the bigger picture and associated implications for public policy. Our results suggest that simultaneously increasing worker autonomy, computer use, and employer training from the minimum to the maximum level would increase the probability of workers holding regular jobs by 14.8 percent at least in all countries, and by 25.2 percent on average. However, while a strategy of job enrichment through greater autonomy and training is certainly desirable, it seems highly unlikely for all jobs to be performed at the maximum level of autonomy and training.

A strategy of unemployment reduction seems to be more promising. Indeed, the most surprising finding issuing from our analysis is the large effect of unemployment, especially for workers cumulating multiple sources of vulnerability, such as young age, immigrant status, low-skill, and low autonomy on the job. The simulations reported above suggest that a Spanish low-skill female service sector worker of immigrant origin has only a 1 in 3 probability of landing on a regular contract, but her chances would more than double if unemployed was eliminated from the Spanish labor market.

Another notable and unexpected result of the analysis has been the absence of any statistical association between the strictness of EPL and the prevalence of regular contracts. This finding is surprising given the focus on labor market rigidities in both academic and policy debates (Cahuc and Postel-Vinay 2002; Nicoletti, Scarpetta and Boylaud 1999). We hesitate to draw strong policy conclusions from this result. Nonetheless, we note that the countries with the highest prevalence of non-standard contracts are not those with overly rigid employment protection legislation, but four out of five of them (Greece, Ireland, Spain, and Portugal) are countries that were hit hard by the economic crisis and ones in which unemployment increased dramatically as a result of it. We can probably exclude that EPL increases contract precariousness indirectly by increasing unemployment. In fact, theoretical and empirical analyses fail to associate EPL with levels of unemployment (Bertola 1990; OECD 2013).

TABLE 8 *Overview of findings*

| | hypotheses | bivariate analysis | multivariate analysis |
|---|---|---|---|
| I | *The more autonomous is the worker in the performance of her job tasks, the greater is the probability that she will hold a regular contract.* | confirmed | confirmed |
| II | *The probability of open ended contract should be increasing together with workers' general skills.* | not tested | partially confirmed (does not apply to professionals) |
| III | *Specific skills should be positively associated with open-ended contracts.* | partially confirmed (non robust) | confirmed |
| IV | *The higher is the level of employment protection legislation for regular workers, the lower should be the probability of open ended contracts, controlling for employment protection for temporary workers.* | not confirmed | not confirmed |
| V | *Unemployment should have a negative impact on the probability of open-ended contracts.* | confirmed | confirmed |
| VI | *The impact of unemployment should be stronger for workers with low general skills (and vice versa).* | not tested | confirmed |

One possible critique of our study is that, with a purely cross-sectional research design, our analysis is picking up correlations but is unable to identify causal relationships. Although the critique applies in general terms, it is useful to examine in what way any bias would affect our main conclusion that unemployment decreases the probability that workers with non-professional skills would hold indeterminate duration contracts. Such bias would have to be a consequence of either omitted variables correlated with the included predictors, or of reversed causality from the dependent to the independent variable. We cannot think of any omitted variable confounding the relationship between country-level unemployment and the individual probability

of holding an open-ended contract, aside from the variables that have been included in the analysis (such as skill), and the relevant literature does not suggest any. With regard to reversed causality, we would argue that the objection is perhaps plausible when applied to some of the other individual-level predictors. For example, it has been argued that employment security is a precondition for workers investing in job-specific skills (Estevez-Abe, Iversen and Soskice 2001). However, we do not see how the individual probability of holding particular contracts could affect the national-level unemployment rate. In other words, we are willing to interpret the negative correlation between unemployment and open-ended contracts in causal terms.

If so, our study has important consequences for policy-making. It suggests that if policy makers are really concerned about the spread of precarious jobs in Europe, they should aim to bring down the unemployment rate by using all available means, for example through non-traditional monetary policies or expansionary fiscal policies or both (Krugman 2012). Our analysis suggests that lack of jobs and job precariousness are closely related phenomena, and that policies addressing the former would go a long way towards addressing the latter as well.

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## Appendix A Deriving Skill Categories

Step 1: Under the assumption that general skills derive from education, we cross tabulate ISCO occupational and ISCED educational categories, and convert this cross-tabulation into percentage scale. The goal is to uncover similarities across occupational categories in terms of the general skills that they require (Table A.1).

TABLE A.1 *Occupations and education*

| | percentages | | | | | | |
|---|---|---|---|---|---|---|---|
| | Pre-primary education | Primary education or first stage of basic education | Lower secondary or second stage of basic education | (Upper) secondary education | Post-secondary non-tertiary education | First stage of tertiary education | Second stage of tertiary education |
| isco1 – Legislators, senior officials and managers | 0.5 | 2.8 | 13.2 | 31.0 | 5.0 | 46.1 | 1.5 |
| isco2 – Professionals | 0.0 | 0.2 | 1.8 | 10.2 | 2.1 | 78.9 | 6.8 |
| isco3 – Technicians and associate professionals | 0.1 | 0.4 | 9.8 | 35.4 | 7.0 | 46.8 | 0.5 |
| isco4 – Clerks | 0.4 | 2.1 | 19.5 | 45.6 | 6.5 | 25.6 | 0.4 |
| isco5 – Service workers and shop and market sales workers | 0.4 | 3.9 | 22.2 | 52.5 | 5.2 | 15.8 | 0.1 |
| isco7 – Craft and related trades workers | 0.9 | 7.7 | 27.0 | 54.4 | 3.3 | 6.7 | 0.0 |
| isco8 – Plant and machine operators and assemblers | 0.4 | 6.4 | 30.4 | 52.4 | 4.3 | 6.0 | 0.1 |
| isco9 – Elementary occupations | 1.0 | 13.1 | 35.7 | 41.8 | 3.1 | 5.3 | 0.1 |

Step 2: We obtain chi-square values from this percentage table for all rows (i.e. occupations) by using each and every row as observed and expected values (Table A.2).

TABLE A.2 *Chi-square values obtained from comparison of rows in Table 1*

| | chi square values | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **isco.1** | **isco.2** | **isco.3** | **isco.4** | **isco.5** | **isco.7** | **isco.8** | **isco.9** |
| **isco.1** | 0.0 | 188.5 | 19.5 | 27.1 | 110.1 | 320.3 | 307.6 | 378.5 |
| **isco.2** | 71.2 | 0.0 | 123.3 | 276.6 | 1211.6 | 2357.4 | 1401.4 | 1990.6 |
| **isco.3** | 5.2 | 127.7 | 0.0 | 26.2 | 82.0 | 278.0 | 307.4 | 366.4 |
| **isco.4** | 20.4 | 372.4 | 29.6 | 0.0 | 10.4 | 68.2 | 74.2 | 100.8 |
| **isco.5** | 42.8 | 562.4 | 77.2 | 7.5 | 0.0 | 16.5 | 19.5 | 36.7 |
| **isco.7** | 76.8 | 1016.4 | 216.1 | 36.8 | 11.3 | 0.0 | 1.7 | 8.5 |
| **isco.8** | 78.4 | 961.4 | 179.1 | 32.4 | 10.9 | 1.5 | 0.0 | 7.8 |
| **isco.9** | 119.2 | 1943.6 | 516.8 | 92.1 | 40.3 | 9.8 | 11.3 | 0.0 |

Step 3: We obtain probabilities associated with each chi-square value (Table A.3). These p-values show the probability of two occupations being statistically identical in terms of the skills that they require (when p>0.1).

TABLE A.3 *Probabilities obtained from chi-square values in Table A.2*

| | probabilities | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **isco.1** | **isco.2** | **isco.3** | **isco.4** | **isco.5** | **isco.7** | **isco.8** | **isco.9** |
| **isco.1** | 1 | 0 | 0.003 | 0 | 0 | 0 | 0 | 0 |
| **isco.2** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| **isco.3** | 0.521 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **isco.4** | 0.002 | 0 | 0 | 1 | 0.108 | 0 | 0 | 0 |
| **isco.5** | 0 | 0 | 0 | 0.281 | 1 | 0.011 | 0.003 | 0 |
| **isco.7** | 0 | 0 | 0 | 0 | 0.08 | 1 | 0.945 | 0.203 |
| **isco.8** | 0 | 0 | 0 | 0 | 0.092 | 0.958 | 1 | 0.25 |
| **isco.9** | 0 | 0 | 0 | 0 | 0 | 0.133 | 0.08 | 1 |

In order to identify common skills across occupations this probability table should be examined both vertically and horizontally. Skill sets may be partly overlapping (when there is only row-wise or column-wise insignificance between two occupation) as in the case of isco.1 and isco.3 or entirely identical (when there is row-wise or column-wise insignificance between two occupations) as in the case of isco. 4 and isco. 5. An occupation may have no common skills with others when there is no row-wise and column-wise insignificance with any other occupation as in the case of isco.2. These intersections are depicted in Figure A.1.

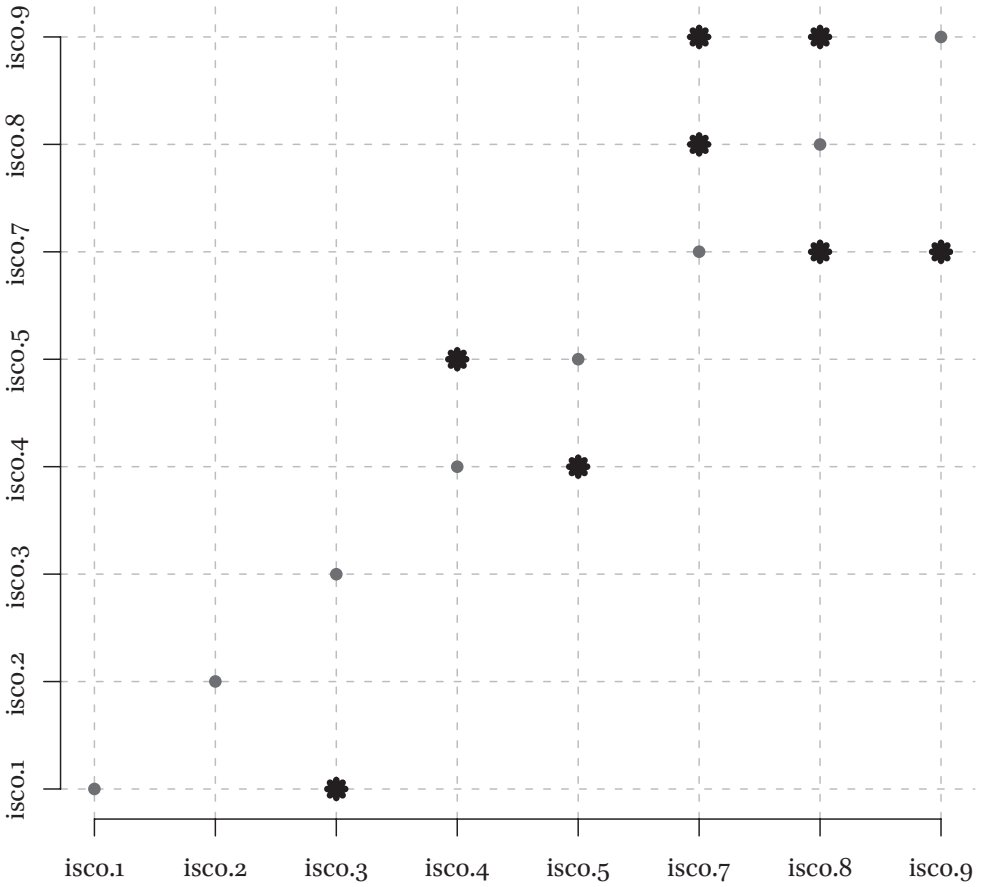


FIGURE A.1 *Intersections between skills in ISCO categories.*

Step 4: The information revealed by the probability table and Figure A.1 is used to draw a Venn representation of occupations (Figure A.2). Common areas show overlapping skills. Consequently, we observe four distinct skill categories. One of these only contains isco.2, i.e. professionals.

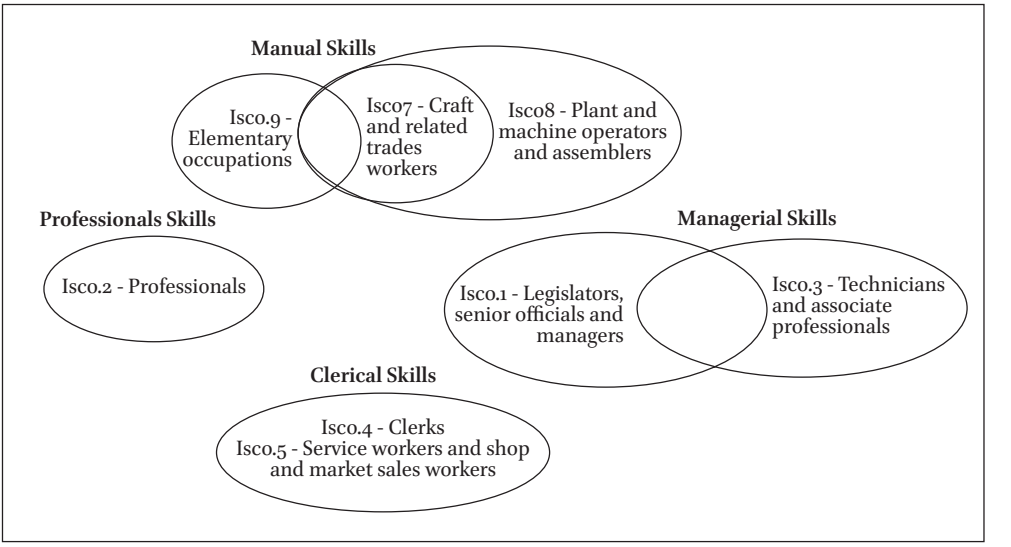


FIGURE A.2 *Venn scheme of skill categories derived from Table A.3 and Figure A.1.*

## Appendix B Monte Carlo Simulation

We set up the Monte Carlo simulation to approximate the data and variable structure we have in our analysis.

The first step is to create independent variables that would generate our dependent variable values. We define three independent variables as shown in (1) below. The first variable X is at the individual level; it is binary (which imitates our skill indicators); we assign 0 and 1 values to this indicator by using a uniform distribution. We assign 0.5 as a population parameter to X. The next variable is $Z_1$ and is at the country level. Its values are randomly chosen from the range of actual unemployment levels in our dataset and its population parameter is set at -0.03. To introduce another element from our actual model into our simulation, we also create an interaction between $Z_1$ and X with a population parameter of -0.002. The last variable is $Z_2$ which has a range that is similar to our EPL variables. This variable has zero as its population parameter and would allow us to examine the ability of our model to detect insignificance

correctly. Finally we assign -0.25 as population value to a vector which consists of 1's to be used as intercept.

We examine three scenarios by considering 5, 15 and 21 units of macro variables, respectively. The last scenario corresponds to the number of countries in our data set and, in each scenario, we create 588 micro units for each macro unit which is the minimum number of individuals nested in a country in our dataset. Thus we have three simulation scenarios consisting of 2940, 8820 and 12348 values for each variable, respectively. For each scenario, after creating the independent variable matrix {1, X, $Z_1$, $XZ_1$, $Z_2$} we construct equation (4) by adding normal errors in equation (2) and logistic errors in equation (3). Error variances given in (2) and (3) are identical to the variance values estimated by our model C in Table 3. The probabilities generated by equation (4) are converted into a binary variable by using 0.5 as threshold so as to create our simulated dependent variables each with an underlying Bernoulli distribution as expressed in equations (5) and (6). Merging these y values with the independent variable values generates the model matrix: {Y, 1, X, $Z_1$, $XZ_1$, $Z_2$}. For each scenario, 1000 repetitions of steps 2 to 5 give our simulation set-up consisting of 1000 datasets each of which resembles our original data.

$$(1)\quad \begin{bmatrix} x \\ z_1 \\ z_2 \end{bmatrix} = \begin{bmatrix} binary:\{0,1\} \\ scale:[3,20] \\ scale:[0.3,4.5] \end{bmatrix} \text{ and } \begin{bmatrix} \alpha_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} = \begin{bmatrix} -0.25 \\ 0.5 \\ -0.03 \\ -0.002 \\ 0 \end{bmatrix}$$

$$(2)\quad \beta_{0j} = a_0 + u_j \text{ where } u_j \sim Normal(0, \sigma^2 = 0.1384)$$

$$(3)\quad \varepsilon_{ij} \sim Logistic(0, \frac{\pi^2}{3})$$

$$(4)\quad p_{ij} = \frac{\exp(\beta_{0j} + \beta_1 x + \beta_2 z_1 + \beta_3 x z_1 + \beta_4 z_2 + \varepsilon_{ij})}{1 + \exp(\beta_{0j} + \beta_1 x + \beta_2 z_1 + \beta_3 x z_1 + \beta_4 z_2 + \varepsilon_{ij})}$$

$$(5)\quad y_{ij} = \begin{cases} p_{ij} < 0.5 \Rightarrow y_{ij} = 0 \\ p_{ij} < 0.5 \Rightarrow y_{ij} = 1 \end{cases}$$

$$(6)\quad y_{ij} \sim Bernoulli(p_{ij})$$

$$(7)\quad \log\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_{0j} + b_1 x + b_2 z_1 + b_3 x z_1 + b_4 z_2$$

To test our model we construct equation (7) and estimate its parameters by using the lmer function in R for each of 1000 datasets. This function uses Laplace approximation to likelihood (Bates 2010: 115, Austin 2010: 6).

$$(8) \qquad \left| 100 \frac{\sum_{i=1}^{100} I_i - 950}{950} \right|$$

We report two outcomes. The first one is the extent to which the 95 % confidence interval estimated for each coefficient in equation (7) covers the corresponding real population parameter given in equation (1). One would expect that when implemented for 1000 samples the standard errors generated by our model should allow us to build 950 confidence intervals that cover the real value. To estimate actual coverage, first we define an indicator for each coefficient in each model and give it a value of 1 if the confidence interval covers the real value. Summing up indicator vectors for each coefficient over 1000 simulations gives us the actual coverage figures. As expressed in equation (8), the absolute value of the difference between the expectation and the actual coverage, converted to percentages, shows the error that our model makes. The second thing we look at, for those confidence intervals that fail to cover the real population value, is how much the standard deviation would have to be inflated to correct the failure. This is estimated by extending the confidence interval so as to make the real population parameter its boundary value, and determining the percentage increase to be applied to the standard error to achieve coverage of the population parameter.

The results of our three simulation scenarios are provided in Table B.1. Scenario 3 mirrors our data structure quite closely. The errors for individual level coefficients are close to zero, and are all below 5 percent for macro level coefficients. This should be considered very low (Maas and Hox 2005: 89). The same is true for deflation of standard errors in this scenario, which is well below 10 percent. Against this background we can safely argue that our model is sound. However, it is worthwhile noting that even with 15 countries the results are not very inaccurate, the error level being less than 6.5 percent for all macro variables and deflation figures all below 10 percent. It is, however, remarkable that when we use only 5 countries the error level increases to around 25 percent for macro variables, and deflation in standard errors reaches the same figure.

TABLE B.1 *Simulation outcomes*

| scenario I | 5 countries each with 588 individuals | | | | | |
|---|---|---|---|---|---|---|
| | coverage | | | non-coverage | | |
| parameters | actual | expected | error in % | actual | expected | average deflation in sd in % |
| intercept | 714 | 950 | 24.8 | 286 | 50 | 17.7 |
| B.1 | 954 | 950 | 0.0 | 46 | 50 | 4.7 |
| B.2 | 723 | 950 | 23.9 | 277 | 50 | 13.4 |
| B.3 | 953 | 950 | 0.0 | 47 | 50 | 4.0 |
| B.4 | 684 | 950 | 28.0 | 316 | 50 | 25.9 |

| scenario II | 15 countries each with 588 individuals | | | | | |
|---|---|---|---|---|---|---|
| | coverage | | | non-coverage | | |
| parameters | actual | expected | error in % | actual | expected | average deflation in sd in % |
| intercept | 890 | 950 | 6.3 | 110 | 50 | 6.6 |
| B.1 | 957 | 950 | 0.7 | 43 | 50 | 4.2 |
| B.2 | 893 | 950 | 6.0 | 107 | 50 | 8.2 |
| B.3 | 965 | 950 | 1.6 | 35 | 50 | 3.4 |
| B.4 | 896 | 950 | 5.7 | 104 | 50 | 8.2 |

| scenario III | 21 countries each with 588 individuals | | | | | |
|---|---|---|---|---|---|---|
| | coverage | | | non-coverage | | |
| parameters | actual | expected | error in % | actual | expected | average deflation in sd in % |
| intercept | 910 | 950 | 4.2 | 90 | 50 | 5.7 |
| B.1 | 942 | 950 | 0.8 | 58 | 50 | 3.9 |
| B.2 | 927 | 950 | 2.4 | 73 | 50 | 6.3 |
| B.3 | 948 | 950 | 0.2 | 52 | 50 | 4.3 |
| B.4 | 924 | 950 | 2.7 | 76 | 50 | 6.2 |