Innovation and job quality. A firm-level exploration

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Abstract: The aim of this paper is to investigate the relation between innovation and job quality at the firm level for a large sample of companies in 32 European countries. Using data from the Third European Company Survey (ECS-2013) we develop indices of innovation and job quality that are later used to quantitatively explore their relationship. The results show significant differences in the relationship between the type of innovation (process, product, marketing and organizational) at the firm level and job quality, with a clear positive association only in the case of process innovation. Labor relations, the evolution of employment, outsourcing or the demographic characteristics of firm are important mediating factors. In particular, the analysis suggests that union representation plays an important role in facilitating the translation of innovation into higher job quality in the firm.

Keywords: job quality, technological innovation, organizational innovation, marketing innovation, Europe.

JEL: J08, J28, J51, J53, O32

Grande, R., R. Muñoz de Bustillo, E. Fernández-Macías y J. Antón. (2020). Innovation and job quality. A firm-level exploration. *Structural Change and Economic Dynamics*, 54: 130-142.
https://doi.org/10.1016/j.strueco.2020.04.002

1. Introduction

The growth in atypical jobs and non-standard employment in high income countries, with its implication in terms of low wages, insufficient and unstable working hours and high temporality rates, has underlined the importance of considering not only the number of jobs created in an economy but also the quality of those jobs. In this regard, it is important to note that the European Commission's Employment Strategy (now part of the Europe 2020 growth strategy) has from its inception in 1997 given the same importance to the twin goals of *more* and *better* jobs, although the dismal employment figures in some EU Member States over the last two decades often led in practice to a prioritizing of job quantity over job quality.

But today's debates on work and employment tend to be dominated again by quantitative considerations, with the return of one of the most recurrent themes in the history of economic thought: the fear of labour displacement and massive unemployment as a result of rapid technological change, brought about by digitalization, advanced robotics and artificial intelligence. Most of this debate is obsessively focused on how many, and what kinds, of jobs will disappear in the near future as a result of innovation and technical change, with hardly any discussion about the implications of these innovations on job quality and the nature of work.

In the political discourse, innovation is frequently associated with high quality jobs. In the words of President Obama: "innovation is more important than ever. It is the key to good, new jobs for the 21st century" (Executive Office of the President, 2009). But innovation, bringing Schumpeterian waves of creative destruction, can also be a source of deterioration of some of the dimensions of job quality.

The purpose of this paper is to study the impact of different types of innovation on job quality at the firm level, in a large sample of European countries. In contrast with most previous research on this subject (which tends to look at the aggregate labour market effects of innovation and technical change on job quality), this paper focuses on the implications of innovation on job quality within the firms that innovate. The research questions are simple but important. First, should we expect, *caeteris paribus*, better job quality in more innovative firms? And second, is innovation itself conductive to better job quality?

In order to answer these two questions, we will briefly present an account of the multiple channels connecting innovation to job quality. Against that background, we will use the European Company Survey 2013, a survey addressed to 32 European countries, to construct indicators of innovation (process, product, marketing and organizational) and job quality in order to test the strength of the innovation-job quality nexus, controlling for other attributes of the firms and the labor force that can be also part of the story.

2. Theoretical background and literature review

As strange as it may sound, considering the importance of both innovation and job quality for societal well-being, the theoretical and empirical literature devoted to the study of the relation between innovation and job quality is not precisely abundant, perhaps because the impact of

innovation on employment and the unending fear of technological unemployment (Mokyr et al. 2015) have shadowed the analysis of other potential impacts of innovation such as job quality.

The multiple links between innovation and job quality

Innovation and job quality are related through multiple and complex channels, going from innovation to job quality and vice versa. The first channel we would like to highlight is one linking innovation and job quality in a two-step process: 1) the impact of innovation on productivity and 2) the relation between productivity and job quality via higher wages and lower working time. As Krugman (1994) argued, "productivity isn't everything, but in the long run it is almost everything" and innovation is the driving force of productivity in the long run (Freeman and Soete, 1997; Hall, 2011; Mohnen and Hall, 2013), the "lever of riches" in the words of Joel Mokryl (1990).

The increase in productivity, in turn, allows firms to pay higher wages and improve working conditions. Although the long run relation between wages and productivity, as well as the cross-country relation between the two variables is a stylized fact of economic growth, in the last decade there has been growing concern about the growing gap between productivity and median wages, known by the literature as "decoupling" (OECD, 2018a; Sharpe and Uguccioni, 2017, or Schwellnus *et al.*, 2017). Without entering in the core of this debate, well beyond the scope of this article[1], it has to be acknowledged that the generalization of these types of dynamics would have important implications in terms of one of the elements that have been behind the improvement of working conditions in the past.

Productivity growth has allowed, again from a historical perspective, a radical reduction of working time, with average weekly working time for full time workers in 11 European countries going from 66 hours in 1870 (Huberman and Minns 2007) to less than 41 in 2018 (Eurostat). This reduction in working time was especially intense in the first half of the 20th century. Obviously, the growth in productivity was a necessary but not a sufficient condition for higher wages and lower working hours. In both cases the process was not automatic and needed of a strong labor movement and other institutional and labor market transformations to materialize (Roediger and Foner 1989). Nevertheless, without the increase in productivity neither processes would have been possible with the same (or anywhere near) intensity.

Secondly, innovation also affects the types of tasks performed by workers, potentially altering thus intrinsic job quality. The type of goods or services produced, the technology and materials used in their production, and the organization of work, which are all obviously affected by innovation, conform the material or intrinsic conditions of work, a major dimension of job quality. To give few examples, the potential impact of mouse usage on carpal tunnel syndrome (Shiri and Falah-Hassani 2015) or other upper-extremity disorders related to the use of computer keyboards are new risk factors affecting job quality, related to the introduction of

[1] According to the summary of the literature on decoupling produced by the OECD (2018a), there are large cross-country differences both in the overall decoupling and the extent to which the process of decoupling has been accompanied by real median wage stagnation. There are also important differences in the role played by decreasing labour shares and growing wage inequality in overall decoupling.

digital technologies in the production process. The substitution of pure physical power by fork lifts, or more recently the use of exoskeletons and robotic suits by workers to reduce the stress on certain parts of the body resulting from holding heavy tools and realizing repetitive movements (Thimany 2017), are further examples of how innovation affects well-being at work. In contrast with the previous link between innovation and job quality, the impact of this channel of transmission is more complex. While innovation has often contributed to job quality by reducing the physical burden of work, there are also cases where innovation has led to new risks, such as psychosocial risks associated with digital technologies. In the area of organizational innovation, Adam Smith warned 200 years ago, of the potential risks of an extreme division of labor: "The man whose whole life is spent in performing a few simple operations, […] has no occasion to exert his understanding or to exercise his invention in finding out expedients for removing difficulties which never occur. He naturally loses, therefore, the habit of such exertion, and generally becomes as stupid and ignorant as it is possible for a human creature to become." (Smith 1776: Book 1, Chapter 5).

The third link between innovation and job quality is of a different nature. The degree of productive innovation and the associated productivity effects can be very different across economic activities, leading some activities to thrive and some to disappear, while others may remain unchanged. In other words, innovation is also the driving force behind structural change in the economy, which also has direct and very significant implications for job quality. In fact, this is probably the aspect of the relationship between innovation and job quality that has received more attention in recent years, within lively debate about whether innovation and technical change produces skills upgrading or job polarization (Levy and Murnane 1992; Autor et al. 2006). Whereas the idea of skills upgrading has been linked to the hypothesis that recent technological change is biased with respect to skills (with technology being complementary to higher skills and substitutive to lower; Levy and Murnane 1992), the idea of job polarization has been linked to the hypothesis that recent technical change is biased against routine occupations and tasks, which tend to be in the middle of the wage distribution (Autor et al. 2006; Fernández-Macías *et al.* 2012).

Complementarily, it can be argued that job quality in itself can be a driver of innovation. This is at least one of the hypotheses behind the literature of High-Performance Work Systems, HPWS (Hefferenan *et. al*. 2011; Eurofound 2017) according to which better working conditions will facilitate both the development of innovations in the firm and the adoption of innovations by the firm. From a different perspective, the theory of Efficiency Wages could be interpreted in a similar way (Akerlof and Yellen 1986): if higher wages can lead to higher productivity via mechanisms such as increasing morale or selection of better workers, higher wages can also be associated to more innovation at the workplace, either coming from the workers themselves or better facilitated by them.

Summing up, the first and fourth channels of transmission reviewed above (productivity growth as a driver of job quality and job quality as a driver of innovation) tend to point to the existence of a positive relation between innovation and job quality, while the sign of the impact of the second and third channels (change in production processes and structural change) is more

ambiguous. By changing the production process, innovation can improve job quality by reducing the physical burden of work, for example, but it can also deteriorate it, by generating new risks. The final outcome is unclear. Regarding structural change, the impact is also uncertain as it depends of the types of jobs and tasks created and destroyed by the innovation process.

Evidence on the relation between innovation and job quality

If we turn to the empirical literature on the relationship between innovation and job quality, we mostly find studies looking at one or other specific dimension of job quality, most frequently wages and skills, with very few papers looking at job quality from a multidimensional perspective covering different conditions of work and employment simultaneously. Although it is out of the scope of this paper to produce a detailed account on this literature, we will briefly review some of the most important recent findings on this topic, emphasizing the multiple and even conflicting effects that innovation can have on different aspects of job quality.

One of the areas that has received more attention in this respect is work intensification. In this regard, several studies (Green 2004, 2006; Felstead et al., 2013), point to the existence of a significant association between innovation, especially in ICT and digital technologies, and work intensification. In a study for the US, Chesley (2014) concludes that ICT use is related to higher levels of employee strain and distress via work intensification in the form of faster-paced work and greater levels of interruptions and multitasking. According to Nam (2013), "when the Internet is perceived as a tool for work, more frequent use of the Internet at a workplace significantly increases workload" (p. 1017). New technologies can also allow managers to better monitor workers, increasing stress levels (Green 2002). In this regard, a recent report by the EU-OSHA (2018) concludes that: "psychosocial and organisational factors that will become increasingly more important because ICT-ETs can drive changes in the types of work available; the pace of work; how, where and when it is done; and how it is managed and overseen" (p.6). The expected increase in levels of psychological stress related with the digitalization of productive processes (and the slight to strong decrease of hazardous tasks) is also highlighted in a 2019 analysis of the impact of digitalization in the European Chemical sector (Kramer et al., 2019).

The link between innovation and work-life balance has been also studied, in particular with respect to the challenges and opportunities brought about by ICT and mobile technologies. For instance, Towers et al. (2006) argue that mobile technologies provide flexibility with respect to the timing and location of work, making it easier to accommodate both work and family, but they can also increase expectations of managers and colleagues regarding when one should be available for work. The paradoxical consequence is that work-life balance can be very negatively affected, with many employees being increasingly expected to be available anytime and anywhere (Prasopoulou and Pouloudi, 2006).

Finally, there are also some papers looking at the other side of the relationship between innovation and job quality: the role that job quality can have as a driver of innovation. A recent study by Von Treuer and McMurray (2012), based on an ad hoc survey to firms, found that organizational strategies encouraging autonomy and co-worker cohesion were conducive to

workplace innovation. As previously mentioned, the literature on High Performance Work Systems (HPWS) has repeatedly found positive effects of employment security, decentralisation of decision making, comparatively high compensation or extensive training (Pfeffer 1988; Hefferenan et. al. 2008; Harden et al. 2006; Flood et al. 2008; Fu et al. 2015) on worker productivity and workplace innovation.

Conversely, several studies have found a negative effect of job instability on innovation at the workplace. For example, Cetrulo et al. (2018), after exploring the relationship between temporary employment and product innovation in France, Germany, Italy, Spain and the Netherlands between 1998 and 2012, conclude that industries using temporary employment tend to have weaker product innovation propensity, especially in medium and high-tech sectors. The same conclusion, the fall in innovation when firms increase the share of temporary workers, is reached for Italy by Franceschi and Mariani (2014). Wachsen and Blind (2016) focus on the impact of labour flexibility (both external numerical and wage flexibility) on innovation in the Netherlands, concluding that that "the relationship strongly depends on the type of innovation as well as the predominant innovation regime in which a company operates", with a negative impact of labour flexibility on innovation in "routinised innovation regimes", characterised by the existence of leading innovators and high entry barriers. In contrast, these authors find no effects in so called "entrepreneurial innovation regimes", characterised by high competition, low market entry barriers and generally available knowledge. A similar conclusion, regarding the routinised innovation regimes, also for the Netherlands, is reached by Vergeer et al. (2015). In her analysis of the relation labour flexibility-innovation for Russia, Smirnykh (2016) finds a positive impact of flexibility on innovation, but only when fixed term contracts are used in limited quantities. Focusing on product innovation, Zhou, Dekker and Kleinknecht (2011), using longitudinal data from 1988 on also for the Netherlands, conclude that firms with high share of fixed-term contracts perform significantly worse regarding innovation in new products (as opposed to imitative new products). In contrast, research from transition Middle East, North Africa and Sub-Saharan African economies found a higher incidence of temporary employment in more innovative firms (Avenyo 2017; Richiardi and Postolachi 2017).

However, both findings can be simultaneously correct if there is a conflict between innovation and stability: innovative firms may be more likely to hire temporary workers because they are more organizationally fluid, but temporary employment may be negative for innovation because it decreases involvement and trust in the workplace.

Summing up, both the theoretical analysis and the empirical literature briefly reviewed above confirm the existence of multiple links, both positive and negative, between innovation and job quality going in both directions, always mediated by the institutional context in which the innovation takes place, and the type of innovation itself. This diverse impact of innovation makes it advisable to explore, in an integrated framework, the relations between both variables.

3. Methods and data

Data and Sample

The third wave of European Company Survey (ECS), which we will use is in this paper, was carried out in 2013. It is a questionnaire-based representative sample survey conducted by telephone in the language(s) of the country. When possible, certain questions in the survey were addressed both to management and employees´ representatives. Each wave of the ECS focuses on a special theme, and the third survey focused on issues dealing with workplace organisation, workplace innovation, employee participation and social dialogue in European workplaces. The total sample for the 32 participating countries was 27,019 management interviews and 7,629 employee representative interviews, with the national samples ranging from 300 to 1,650 depending on the country size. The interviews took place from February to May 2013. The sample is representative of all establishments in the country with 10 or more employees in all economic activities with the exceptions of agriculture, forestry and fishing, activities of the household, and activities of extraterritorial organization and bodies (for more methodological details see Eurofound 2015).

Analytical Strategy

a) Building a multidimensional index of job quality from the ECS 2013

For the analysis of job quality at the workplace level, we constructed a Summary Index of Job Quality (SIJQ), following the guidelines presented in Muñoz de Bustillo *et al.* (2011a) although with some adaptations imposed by the ECS data used. In a nutshell, we propose a multidimensional indicator of job quality, the SIJQ, composed of four different dimensions: a) Employment quality, b) Intrinsic job quality, c) Work-life balance, and d) Participation. The dimensions of job quality selected are similar to other proposals, such as the indicators of job quality proposed by the ETUI (Leschke, Watt and Finn, 2008), Green et al (2013) or by Eurofound (Eurofound 2012), with the limitation that our indicator does not includes pay, due to the lack of information about wages in the ECS. In this regard, the SIJQ should be considered more as an indicator of the non-monetary attributes of job quality than a complete job quality indicator.[2] The first three dimensions are weighted by 30%, while participation contributes to the aggregate index with the remaining 10% (Equation 1). The lower weight attached to the last dimension is explained by two different considerations. The first is that it is a dimension composed by only one indicator, thus giving it the same weighting would give to the indicator used a much higher impact on the final aggregate index compared to the other dimensions, built with four variables in the first two cases, and with two in the remaining one. The second is that we only want to consider here the positive impact on job quality of participation *per se*, as the indirect implications of participation in other realms (in terms of facilitating better working conditions) are largely accounted for in the other dimensions of the index. In any case, a simple

[2] In comparison with the five dimensions model proposed by Muñoz de Bustillo et al. (2011a), our SIJQ does not include the pay dimension and the health and safety dimension (due to the lack of information on wages and health and safety in the CES). Furthermore, in the index proposed by Muñoz de Bustillo et al. (2011a), intrinsic quality is composed by skills, autonomy, powerfulness, meaningfulness, social support and self-fulfillment, while in our SIJQ, the dimension of intrinsic quality is much more parsimonious due to the limitations of the questionnaire and includes variables on autonomy, sickness' level and employees' motivation (as perceived by the manager). For a full account of the different indicators of job quality used in the literature see Muñoz der Bustillo et al. (2011b).

sensitivity exercise made with equal weighting of the four dimensions (available from the authors) shows that the results are robust ($R^2 = 0.919$).

(1) *SIJQ = (Dimension 1 x 0.3) + (Dimension 2 x 0.3) + (Dimension 3 x 0.3) + (Dimension 4 x 0.10)*

Table 1 reproduces de indicators used to construct each of the dimensions of the SIJQ. It is convenient to stress that the SIJQ has an interpretation that is different from job quality indexes such as the IJQ presented by Muñoz de Bustillo et al. (2011a), which was built from individual data (i.e. data regarding the characteristics of individual jobs/workers). In this case, the data (the units of analysis) refers to companies, not individual employees, and in that respect each individual SIJQ should be interpreted *as an approximation to the average job quality of all workers in the company interviewed*, not a representation of the job quality of a given job or employee.

Table 1. Indicators of the Summary Index of Job Quality, SIJQ

Dimension	Indicator	Question of ECS2013
(1) Employment quality	% of employees with a permanent contract	Q33A
	% employees work in jobs which require at least one year of on the job learning	Q16
	Employees are hired with the intention to employ them for a long time	H11B
	Does the management encounter difficulties in retaining employees	P1C
(2) Intrinsic quality	Who normally decides on the planning and execution of the daily work tasks of the employees at this establishment?	Q27 (Employees 1; Managers 0; Both 0,5)
	Does the management encounter high level of sickness leave x (-1)	P1A
	Does the management encounter low motivation of employees (-1)	P1E
(3) Work-life balance	Approximately what percentage of employees have the possibility to adapt – within certain limits – the time when they begin or finish their daily work according to their personal needs or wishes?	H14
	Is it possible for employees to use accumulated overtime for days off? This can be full or half days	H16 (Yes, for all employees: 1; Yes, for some employees 0.5. – No: 0)
(4) Participation	Workplace trade union representative exist in establishment?	ER1A
	Statutory employee representation forum exist in establishment?	ER1B

Source: Author´s analysis from ECS2013.

Table A.1 of the appendix reproduces some basic results of the SIJQ and its dimensions for the 28 Member States of the European Union plus Iceland, Macedonia, Montenegro and Turkey.

In spite of the limited number of variables used in the construction of the SIJQ, with relevant variables such as wages missing from the index, the results obtained are reasonably consistent with the results obtained from individual-based larger sets of indicators such as the Index of Job Quality, IJQ, developed by Muñoz de Bustillo *et al.* (2011) and Fernández-Macías *et al.* (2016)[3] (see Figure A.1 of the appendix). That is the case, for example, when we look at the ranking of countries, with the Scandinavian countries occupying the top positions, and the Eastern and Southern countries the lower positions. A major difference in this respect is the position of the UK, which usually occupies higher positions in these types of rankings. This difference is probably related to the lack of the wage dimension in this SIJQ, which has typically tended to favor the UK in international comparisons (Muñoz de Bustillo et al., 2011).

Those familiar with the literature of Varieties of Capitalism will notice that the ranking of countries according to the SIJQ follow closely the two varieties modeled by Hall and Soskice (2001), with the upper positions taken by the so called *Coordinated market economies*, CME, while the *Liberal market economies*, LME, locate around the middle of the distribution[4]. Together with these two models, the countries allocated to the so-called *Mediterranean market economies* (France Spain, Italy, Portugal or Greece), are more dispersed, with France and Spain placed close to the CME, while Portugal and Greece are at the lower end. Unfortunately, with the exception of Slovenia and Estonia, considered by Feldman (2006) CME and LME respectively, and holding the expected places in the SIJQ index, the rest of the transition countries show special characteristics (Myant and Drahokopoupik, 2015, Leszcynski, 2015) that make it difficult to allocate them to the Coordinated/Liberal/Mediterranean varieties[5].

b) Innovation in the European Company Survey 2013

The information about innovation in the ECS2013 is encapsulated in a battery of items asking whether in the last 3 years (since the beginning of 2010) the establishment has introduced innovation in four different areas: marketing, products, production processes and organization (Table 3). In doing so, the survey follows closely the four types of innovation considered in the Oslo Manual (OECD 2005: 165), according to the OECD the "foremost international source of guidelines for the collection and use of data on innovation activities in industry". Nevertheless, although the questionnaire is rich in addressing all different sources of innovation, the answer is binary (yes/no), and thus does not offer indications about the intensity of the innovation. Unfortunately, the data does not allow to further distinguish between types of innovation, such as the Schumpeterian distinction between *creative firms* and *adaptive firms,* depending the type of innovation (internal versus external sources) adopted (Peneder, 2010), *radical versus incremental* innovation (Ettlie at al., 1984), or the distinction between imitative and innovative

[3] See figure A.1 in the Appendix.
[4] According to Hall and Soskice (2001), CME and the LME will have different advantage in supporting innovation, with the first one better at facilitating incremental innovations, and the second radical innovations. However, this assertion it has been called into question by Akkermans, Castaldi and Los (2009).
[5] For other perspectives within the literature of Variables of Capitalism see Coates (2000, 2006) or Amable (2003). For a critical assessment of this literature see Crouch (2005).

products considered by the Community Innovation Survey. Our analysis will consider all the types of innovation shown in Table 2.

Table 2. Variables of Technical Innovation in the ECS

Denomination	Question	N.
Marketing innovation	Any new or significantly improved marketing methods?	Q31
	Any new or significantly improved methods of communicating your activities to the public?	Q32
Product innovation	Any new or significantly changed products or services (either internally or externally)?	Q33
Process innovation	Any new or significantly changed processes, either for producing goods or supplying services?	Q23
Organizational Innovation	Any organizational change? (*New business practices for organizing procedures, new methods of organizing work responsibilities and decision making; New methods of organizing external relations with other firms or public institutions;]*	Q25

Source: ECS2013.

It could be argued that the connection between marketing innovation and job quality is likely to be dimmer and of a different kind *vis a vis* the other types of innovation, for at least two different reasons. Firstly, if successful, the connection between marketing innovation and job quality would be undistinguishable from an exogenous increase in effective demand. Secondly, marketing innovations are to a large extent decoupled from production and organizational technologies and should not affect largely job quality outside of the marketing department itself. Nevertheless, although indirectly, it is possible to think of different mechanisms (although of second order) linking both items (marketing and job quality). Some marketing techniques (or innovations) can impose additional burdens on the worker, for instance by requiring direct interactions with clients. Or alternatively, some companies can make job quality part of their marketing strategy, such as when they brand themselves as "ethical employers". In HRM "employer branding" is a growing field (Edwards, 2009), and can be understood as marketing-led job quality improvements (to the extent that it is not pure window-dressing). In any case, it is useful to consider also the potential relationship between marketing innovation and job quality to have a more complete picture of the main forms of innovation according to the literature.

Before getting into the heart of the matter, it is important to acknowledge that, as stressed by Kleinknecht, Montfort and Brouwer (2000), the selection of the type of indicator used to measure innovation is far from trivial, as different indicators might look at different aspects of innovation, leading to different conclusions and ordering of countries/firms. In this occasion, the survey only offers one type of indicator of innovation, so there is nothing we can do but to acknowledge the peculiarities of the available information. It is also worth noting that the concept of organizational innovation, as defined (and measured) in Table 2, can be criticized for being kind of a *hotchpotch* of many different types of changes in the way of organizing the production process, from team production to outsourcing and quality-management systems, with potentially very different (even contradictory) effects on job quality. This could make the association between organizational innovation and job quality appear in the statistical analysis

as less important than it actually is. Unfortunately, the data source used does not allow a specific analysis of different types of organizational innovation.

This paper will analyze the indicators of technical (product and process), organizational and marketing innovation for the 32 countries of the sample, together with an overall Indicator of Innovation (II) at the firm level, constructed as a scale from 0 (no innovation) to 1 (all types of innovation are introduced into the company). A first look at the headline results (see Table A.2. of annex) shows that a large percentage of firms declare to have introduced innovations in the last five years: on average 46 % in the case of product innovation, 42% in the two technical types of innovations and 37% in the case of marketing. The dispersion between country scores is higher in the case of organizational innovation,[6] with a standard deviation of 11, compared to technical innovation, with around 7-8 (Table A.2).

Compared to other innovation indices, such as the EU Innovation Scoreboard, the ECS innovation index places some important countries, like Germany, in lower positions in the classification. Several factors might explain these results. First, the innovation index we are using is of a subjective nature, reflecting the opinion of the managers. The concept of innovation has a positive connotation, related to dynamism, good management, etc. This can result in a social desirability bias. This explanation, though, raises another question, as in order to affect the relative outcome the rate of overestimation among countries has to be different, i.e. in some countries managers have to be more complacent about themselves in this regard than in others. Secondly, it could be argued that the position occupied by some of the Eastern countries, such as Montenegro, quite high in the ranking, might be related to the process of structural restructuring associated with the still relatively recent transition from a planned to a market economy. In the third place, it is important to stress that the index only applies to firms with 10 or more employees; if countries vary, as they do, in the size composition on firms, then the comparison would be affected, as we would be comparing different portions of the economy (in terms of share of total establishment covered by the survey). In any case, it is important to emphasize that the objective of this paper is not to compare the rate of innovation across European companies, but to assess the link between innovation and job quality at the company level. The measure of company-level innovation of the ECS may be problematic for country comparisons, but it does discriminate companies according to their level of innovation in the four mentioned dimensions within each country, and therefore it is perfectly valid for our purposes (to test whether innovation and job quality are empirically correlated at the company level, and how).

3. Results

After presenting the indicators constructed for measuring job quality and innovation in European companies, in this section we will study the relationship between those two concepts at the firm level. As previously discussed, there are multiple potential links between innovation

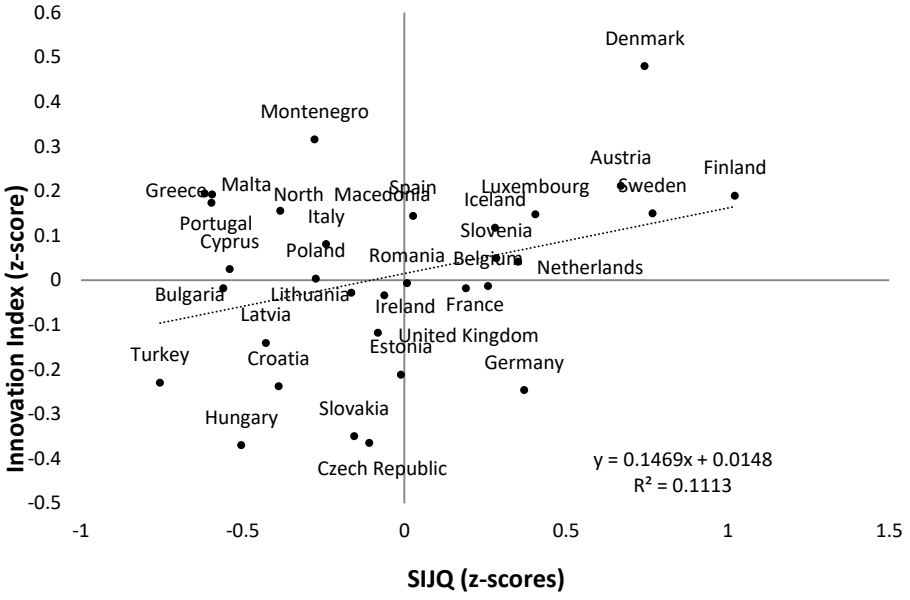
[6] This could be related with the intrinsic difficulties of capturing this dimension in surveys (Armbrustera, et al. 2008)

and job quality, going both from innovation to job quality (through productivity growth, for example) and from job quality to innovation (through higher motivation and collaboration with change, for example). Although the limited availability of information on both job quality and innovation in ECS data does not allow a detailed investigation of such links, nor unearthing the underlying causality, in what follows we will test the existence and intensity of an empirical correlation between innovation and job quality, first graphically at the aggregate country-level and later on by regression analysis at company-level.

Cross country analysis of innovation and job quality

To facilitate the interpretation of results and harmonize the measurement scales of the different indicators, we have standardized them using Z-scores[7]. Figure 1 reproduces the country-level bi-plot of the Z-scores of the SIJQ and the Overall Innovation Index (Figure 1). As we can see, there is an overall positive correlation between job quality and innovation at the country level (R^2= 0.111).

Figure 1. Relations at country level between job quality, SIJQ and overall Index of Innovation



Source: Author´s analysis from ECS2013 microdata.

The role of innovation versus other factors on job quality at the level of the firm

In order to study in more detail the links between innovation and job quality, we have conducted a linear regression analysis at the company level, with job quality as the dependent variable,

[7] As is well known, Z-scores allow expressing the variables in terms of standard deviations from their means. We use such a transformation of the variables to make sure that all the variables have comparable scales when items are added together. The formula for calculating z-scores is the value of the element, *x*, less the population mean, *m*, divided by the standard deviation, *sd* (Equation 2). As result, these z-scores have a distribution with a mean of 0 and a standard deviation of 1.

(2) Z-score = (*x*-m)/*sd*.

and all the different types of innovations considered in the ECS2013 as independent variables, together with a limited number of other independent variables potentially related with job quality acting as covariates.

The independent variables are grouped in the following three different models (table 3). Model 1 incorporates exclusively the variables related to innovation (product, process, organizational and marketing innovation). Model 2 considers only variables related to the firm and its workforce available in the ECS2013: size, rate of feminization (% of female employees), share of workers older than 50 years of age, share of employees with university degree, productive activity of the firm, outsourcing of production, public or private nature of the firm and type of firm (single, headquarter or subsidiary). Model 2 also adds variables related to the employment history of the firm and the system of industrial relations in place: membership of the firm in employers´ associations and collective bargaining. Model 3 brings together the four indicators of innovation and the other independent variables related to the firm and industrial relation system. In addition, as an important control variable, in all three models we used dummies for the countries included in the survey to control the effect of the socio-cultural context that cannot be measured by the rest of the variables about the company.

Before being absorbed in the details, it is worth mentioning that keeping in mind the proxy nature of the SIJQ, the complete model shows a certain capacity of explanation, with an adjusted R^2 of 0,271. The regression analysis shows a positive and significant association between the four different types of innovation and job quality at the company level. However, when controlling by elements related to the firm and the industrial relations system (Model 3), the results at the company level change quite significantly. Although the four beta coefficients of the variables related to innovation have the expected positive sign, only process innovation and, with a lower statistical significance, product and marketing innovation are relevant independent variables in the complete model with controls.

Table 3. Determinants of Job Quality in 32 European countries (2013)

		Model 1			*Model 2*			*Model 3*		
		Beta	(Std.Err.)	Sig.	Beta	(Std.Err.)	Sig.	Beta	(Std.Err.)	Sig.
Product Innovation		0.023	(0.002)	***				0.016	(0.002)	**
Process Innovation		0.013	(0.002)	***				0.034	(0.002)	***
Organizational Innovation		0.041	(0.002)	***				0.007	(0.002)	
Marketing Innovation		0.027	(0.002)	***				0.013	(0.002)	*
Outsourcing production					0.025	(0.002)	***	0.018	(0.002)	***
Establishment company organization	Single company				0.015	(0.003)		0.016	(0.004)	*
	Subsidiary site				ref.			ref.		
	Headquarters				-0.037	(0.003)	***	-0.031	(0.003)	***
Private sector firm (Public sector firm)					-0.037	(0.003)	***	-0.037	(0.003)	***
Employers' organization					0.043	(0.002)	***	0.041	(0.002)	***
Collective bargaining					0.081	(0.002)	***	0.079	(0.002)	***
Number of employees since 2010	Increased				0.008	(0.002)		-0.002	(0.002)	
	Stayed about the same				ref.			ref.		
	Decreased				-0.028	(0.002)	***	-0.032	(0.002)	***
Number of obs.		21,798			21,798			21,798		
Adj. R-squared		0.225			0.268			0.271		
Root MSE		0.136			0.133			0.132		

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level

Control variable Model 1: dummies for the countries included in the ECS. Control variable Model 2 and 3: establishment size, % female, % older than 50 years of age, % university degree, sector (NACE) and dummies for the countries included in the ECS.

Source: author's elaboration from European Company Survey (2013) microdata.

As innovation strongly depends on the interaction between institutional and industrial structure of countries (Freeman and Louca 2001) we have extended our analysis in order to see whether the impact of innovation on the quality of jobs changes depends on the idiosyncratic institutional features and the industry. In order to do so, we estimate an additional model where we include interactions between a binary variable capturing if the firm has carried out any type of innovation and the groups of European countries according to the classification of varieties of capitalism –VofC–[8] (Model 4)[9]. In the Table 4, we present the estimates of model searching

[8] The classification used is adapted from Amable (2003), including Cyprus (Pegasiou, 2013) and Malta (Farkas, 2016) in the Mediterranean capitalism group, Estonia in the Market based capitalism group and Slovenia in the Continental European Capitalism group. The five groups of countries are as follows: Market-based capitalism (Ireland, United Kingdom, Estonia) Social-democratic capitalism (Denmark, Finland, Sweden, Iceland), Continental European Capitalism (Germany, France, the Netherlands, Belgium, Slovenia, Luxemburgo, Austria), Mediterranean capitalism (Italy, Spain, Portugal, Greece, Cyprus, Malta) and transition countries (rest of countries).

[9] Innovation also depend the degree of "cumulativeness of knowledge" of the different sectors of activity (Peneder 2010). Unfortunately, because of anonymity reasons, we can only identify six sectors in our database. The taxonomies mentioned for classifying the different industries are much more disaggregated than the 6 sectors we have here, which, for instance, comprise industries identified by those criteria which are very heterogeneous in their knowledge intensity. Despite this, a model was estimated with the interaction of the sectors of activity according to the NACE classification available in our database, but we do not find any significant difference in the strength between innovation and job quality across sectors. These estimates should be interpreted with caution because of two reasons. Firstly, we have few degrees of freedom for countries and, particularly, sectors. In the second place, it would be desirable to test directly the effect of institutional features using several waves of data, given that one cannot include fixed-effects at the same time as country-level or sector-level variables in a single

for heterogeneous effects across country groups, where we omit the control covariates and just focus on the dummies for innovation and the interactions[10].

The results concerning the variables of innovation remain very similar to the ones presented above, though affected by the inclusion of new variables not statistically significant. Focusing on the interaction between VofC and presence of innovation (any type), we only find a statistically significant relation in European Transition Countries where we observe that the effect of innovation on job quality is less intense than in the countries of continental Europe. This result could be related with the higher profit-absorbing capacity of the companies within a more liberal labour market, with less social protection and, in short, weaker institutions in the countries in transition.

Table 4. Determinants of Job Quality in 32 European countries: interaction of varieties of capitalism by to innovation or non-innovation

	Model 4		
	Beta	(Std.Err.)	Sig.
Product Innovation	0.018	(0.003)	**
Process Innovation	0.035	(0.002)	***
Organizational Innovation	0.008	(0.002)	
Marketing Innovation	0.012	(0.002)	*
Varieties of Capitalism*Innovation			
Continental European	ref.		
Market-based*Innovation	-0.003	(0.007)	
Social-democratic*Innovation	-0.016	(0.007)	
Mediterranean*Innovation	-0.009	(0.005)	
Transition countries*Innovation	-0.029	(0.005)	**
Number of obs.	21,798		
Adj. R-squared	0.271		
Root MSE	0.132		

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level

Control variables: establishment size, % female, % older than 50 years of age, % university degree, outsourcing production, establishment company organization, private or public, employers' organization, collective bargaining, number of employees since 2010 and dummies for the countries and sectors included in the ECS.

Source: author's elaboration from European Company Survey (2013) microdata.

a) Industrial relations, innovation and job quality

According to the regression analysis, the variables related to industrial relations play an important role in the determination of the average job quality of firms. In both Model 2 and 3, the existence of collective agreements is clearly related to better working conditions. A similar effect is also found (although with less intensity) regarding the participation of the firm in

cross-section (and removing the fixed-effects will probably lead to biased estimates). Therefore, this issue deserves further attention and should be explored in future work.

[10] We consider just a dummy variable to keep the model parsimonious and make the interpretation easier.

employers' organizations. Since employee participation is one of the five dimensions of our Summary Index of Job Quality (SIJQ), we could not include it as an independent variable in table 3. In a separate regression (not shown here, but available on request), we confirmed that this variable has a strong and significant effect on the other dimensions of job quality, similar to that of collective bargaining shown in table 3. In order to further explore the role played by union representation in the workplace on the nexus between innovation and job quality, we have conducted a separate regression analysis including all variables of Model 3 above but separating companies with and without union representation. These new models (5 and 6) are shown in table 5.

To simplify the analysis and interpretation, in table 4 we only show the beta coefficients of the four innovation indicators. In the firms with employee representation, organizational innovation has a significant positive association with job quality. In contrast, in firms without employee representation, organizational innovation does not have this significant effect (the relationship is similar in both cases with respect to process innovation). These results do not only confirm the importance of having a union representative in the workplace and collective voice to enhance job quality for employees (Hoque *et al.* 2017), but actually suggest that union representation may play an important role for the success of innovation, at least in respect to job quality outcomes. In firms with union representation, the relationship between organizational innovation and job quality is significant and strong, whereas in firms without union representation the relationship is weaker and not even statistically significant.

Table 5. Determinants of Job Quality in 32 European countries by companies with or without union representation (2013)

	Model 5 Companies with union representation			***Model 6 Companies without union representation***		
	Beta	(Std.Err.)	Sig.	Beta	(Std.Err.)	Sig.
Innovation product	-0.002	(0.003)		0.015	(0.003)	
Innovation process	0.026	(0.004)	**	0.023	(0.003)	**
Innovation Organizational	0.027	(0.003)	***	0.007	(0.003)	
Innovation Marketing	0.016	(0.003)		-0.016	(0.003)	
Number of observations	10,894			10,904		
Adjusted R-squared	0.118			0.098		
Root MSE	0.135			0.136		

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level

Control variables: establishment size, % female, % older than 50 years of age, % university degree, Sector (NACE), outsourcing production, establishment company organization, private or public, employers' organization, collective bargaining, number of employees since 2010 and dummies for the countries included in the ECS.

Source: authors' elaboration from European Company Survey (2013) microdata.

b) Innovation, employment and productivity

The recent employment history of the firm has an asymmetric relationship with job quality, depending on whether employment has increased or decreased in the period 2010-2013. According to the results shown in table 3, employment growth in the last three years is not

related with any significant job quality differential. In contrast, those firms with reductions in employment levels in the recent past have lower job quality levels. In other words, downsizing tends to be associated with a lower job quality. This relationship remains after we control for innovation.

To explore this issue in more detail, we have studied whether innovation correlates with differential employment trends in recent years at the workplace level. Table 6 shows a crosstabulation of the evolution of employment (in the columns) and an "innovation intensity" indicator, constructed by simply aggregating how many types of innovation (process, product, organization and marketing) the firm has experienced in recent years (from zero -no innovation- to four -high innovation-). The results do suggest a statistically significant and quite substantial association between the intensity of innovation and employment developments in the last 3 years in the firm, but this association tends to be positive rather than negative. In other words, the most innovative firms have tended to experience employment expansion rather than employment decline in the recent past. As much as 77% of low-innovation firms experienced reduction or stagnated in employment, compared to 57,5% for highly innovative firms (according to the ECS2013 survey, most firms about the same employment level in the period 2010-2013)). In contrast, employment increased only in 23% of the former type of firms, compared to 42.5% among high-innovation firms. Since innovation and employment declines are much less frequent than the opposite, the positive association of innovation and job quality is unlikely to be significantly affected by contradictory employment effects.

Table 6 also reproduces information about the evolution of productivity in the last 3 years according to managers' perception. In this regard, it is interesting to note the positive relation between innovation and productivity, as productivity increased in 63% of the highly innovative firms, compared to 50% average and 38% in firms with no innovation. Moreover, there seems to be a positive relation between innovation, employment and productivity at the firm level, in terms of innovative firms having both higher productivity and higher employment creation.

Table 6. Evolution of employment and productivity from 2010 to 2013 in firms according to their innovation intensity in the period

Innovation intensity	Evolution of employment				Evolution of productivity			
	Increased	About the same	Decreased	Total	Increased	About the same	Decreased	Total
No innovation	23.1	53.3	23.6	100	37.72	48.6	13.68	100
Mild innovation	30.1	41.8	28.1	100	48.28	39.47	12.25	100
Moderate innovation	36.4	35.9	27.7	100	56.24	32.65	11.1	100
High innovation	42.5	28.2	29.3	100	63.24	27.08	9.68	100
Total	31.7	41.5	26.7	100	49.66	38.41	11.93	100
Correlation statistics	Pearson chi2(6) = 1.1e+03 Pr = 0.000 / Cramér's V = 0.1446				Pearson chi2(6) = 1.0e+03 Pr = 0.000 / Cramér's V = 0.1416			

Source: Authors' analysis from ECS2013 microdata.

A closer look at the different components of job quality

All the analysis so far has focused on the relationship between the four types of innovation and overall job quality at the firm level, as measured by our Summary Job Quality Index. But our job quality index is also multidimensional, and therefore it can be used to explore whether each type of innovation has a different association with each different aspect of job quality. Table 7 reproduces a battery of ceteris paribus correlation analyses resulting from successive regression models, exploring the relationship between the different types of innovation and the different dimensions of job quality, once the characteristics of the company and industrial relations systems are controlled for.

The first column and row in the table shows the ceteris paribus correlation between overall innovation and job quality in European firms, which is positive and significant as we have been discussing. We can also see in the first column how this association is strongest and most significant for process innovation, much less for product and marketing innovation, and not significant at all for organizational innovation once firm characteristics and industrial relations systems are controlled for.

But the most interesting part of table 7 is the other columns, which replicate the analysis for each of the job quality dimensions separately. The differences are very significant and, in some cases, quite striking. If we look at the first row (overall innovation index) we can see positive coefficients in three job quality dimensions (particularly strong in the case of work-life balance and participation), but strikingly, a significant *negative* coefficient in the case of intrinsic quality of work. In other words, the overall coefficient linking innovation and job quality does conceal some very significant differences at the level of the individual dimensions of job quality (and we can also see in table 7 where do these differences come from).

The strong positive correlation between innovation and work-life balance is linked to process, organizational and product innovation in particular, while the also strong correlation between participation and innovation mostly comes from organizational and process innovations. The mild positive association between innovation and employment quality is linked to process and product innovation. And finally, the mild but surprisingly (and significantly) negative correlation with intrinsic quality of work is entirely due to a negative correlation between organizational innovation and intrinsic job quality.

Table 7. Correlation ceteris paribus between innovation and Index of Job Quality (and its dimensions)

	Job Quality Index	Employment quality	Intrinsic quality	Work-life balance	Participation
Innovation Index	0.021 *** (.0026)	0.011 *** (.0028)	-0.009 ** (.0042)	0.052 *** (.0057)	0.044 *** (.0076)
Product Innovation	0.005 ** (.0022)	0.005 ** (.0024)	0.001 (.0035)	0.014 *** (.0048)	-0.012 * (.0064)
Process Innovation	0.011*** (.0023)	0.008 *** (.0025)	-0.004 (.0036)	0.021 *** (.0049)	0.021 *** (.0066)
Organizational Innovation	0.002 (.0021)	-0.004 (.0023)	-0.013 *** (.0034)	0.013 *** (.0455)	0.034 *** (.0031)
Marketing Innovation	0.004 * (.0022)	-0.001 (.0023)	0.010 *** (.0035)	0.003 (.0047)	0.004 (.0063)

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level

Note: The margins are displayed, and the standard error appears in brackets.

Control variables: establishment size, % female, % older than 50 years of age, % university degree, outsourcing production, establishment company organization, private or public, employers' organization, collective bargaining, number of employees since 2010 and dummies of the 32 countries included in the ECS.

Source: authors' elaboration from European Company Survey (2013) microdata.

Summing up, the analysis of the firm data of the ECS confirms the existence of a clear positive relation between process and product innovation (in this order, highest first) and job quality (as measured by the aggregate SIJQ). Looking now at the level of the different components of job quality, on the one hand, the effect of innovation and its different types is more intense in the dimensions of quality of employment, participation and, most strongly, work-life balance. On the other hand, innovation is negatively correlated with intrinsic quality of work, in particular organizational innovation.

Collective bargaining and union representation at the firm seem to play an important mediating role in the translation of innovation into good outcomes in terms of job quality. And finally, the recent employment history of the firm tends to reinforce rather than contradict the association between innovation and job quality, since innovation is often positively associated with employment growth and employment growth is also positively associated with job quality.

4. Discussion and Conclusions

Along with the usual measurement issues, one of the main problems of establishing an empirical link between innovation and job quality at the firm level is the lack of suitable data covering both aspects simultaneously. This paper has tried to increase our knowledge of this question by exploring the microdata of the 2013 European Company Survey. This survey includes a limited number of variables measuring the aggregate job quality level at firms, as well as items

measuring innovation of the four types identified in the Oslo Manual (product, process, organizational and marketing). The analysis of these variables, along with other potentially mediating or confounding factors at the firm level, suggests the following main conclusions.

First, according to the ECS data used, the implications of firm-level innovation for job quality are quite different depending on the type of innovation. The types of innovation that show a greater (and most positive) association with job quality are process and product innovation (in this order) and to a lesser extent marketing innovation, while organizational innovation, after controlling for other variables affecting job quality, does not seem to have any statistically significant impact on job quality. This result is coherent with the results obtained with employee data (European Working Condition Survey) and a much richer index of job quality by Muñoz de Bustillo *et al.* (2016).

Second, there are also significant differences in the correlation between innovation and each of the dimensions of job quality. Work-life balance, participation and employment quality (in this order) are significantly and positively associated with innovation, whereas intrinsic quality of work is significantly but *negatively* associated to innovation. The latter result is particularly interesting because it contrasts with all the other findings in this paper, and qualifies the generally positive assessment of the link between innovation and job quality. This result is fully driven by a significant negative correlation between organizational innovation and intrinsic quality of work. Looking at the underlying indicators of the intrinsic quality of work dimension, it seems as if organizational innovation negatively affects autonomy and motivation in the firm in many cases. As previously mentioned, the concept and measure of organizational innovation used for this paper (drawn from the European Company Survey) are problematic compared to the other forms of innovation discussed, because it encompasses many different and even contradictory types of organizational change (from outsourcing to an internal reorganization of tasks). The negative association found between organizational innovation and intrinsic quality of work (especially autonomy and motivation) is therefore difficult to interpret, since it can be linked to different forms of work reorganization. However, it is a very interesting finding that merits further analysis in subsequent studies with a finer measure of organizational innovation practices.

Third, as consistently found by literature on this matter (*e.g.* Doellgast et al. 2009; OECD 2018b), industrial relations do matter for job quality; having collective bargaining at the firm has a positive and large impact on the Summary Index of Job Quality. Furthermore, our complementary analysis on the impact of having employee representatives in the firm suggests that union representation plays an important role in facilitating the translation of innovation into higher job quality in the firm. The success of firm-level innovation is crucially dependent upon its acceptance by employees, and therefore it seems obvious that the innovation process can be significantly improved by a well-functioning industrial relations system at the workplace (Antonioli et al. 2011; for the specific case of organizational innovation, see Ortiz Gervasi, 1998). This is an important factor which is often ignored in the current debates on digitalization and its impact on work and employment.

And fourth, the recent evolution of employment in the firm has an asymmetric impact on job quality, as job quality is significantly lower for firms that recently reduced employment (relative to firms where employment remained stable) but it is not significantly higher for firms where employment grew. In this respect, innovations with a labor-saving impact (such as automation technologies) could be expected to have a negative impact on job quality. However, our results also show that *at the company level* innovation tends to be associated with employment growth rather than employment destruction. In any case, it is important to acknowledge that the impact of labor-saving innovations on job quality could be quite different if analyzed at the level of sectors or local labor markets rather than at the level of individual companies: for instance, if automation replaces jobs of high quality, it could lead to a structural decline in the quality of employment for the entire sector, even if within the innovative companies job quality would remain stable or even increase. However, that debate is beyond the scope of this paper, and we leave it for future research.

An exploratory analysis of the differences in the innovation-job quality nexus across different institutional country groups (following the classification suggested by the Varieties of Capitalism literature) suggests that in the Transition Capitalism group (mostly, Eastern European countries) this nexus is weaker than in the rest of Europe (a difference that may result from the weaker labor market and social protection frameworks in the Transition Economies). We do not detect that the link between innovation and job quality differs by sector of activity. Nevertheless, these two issues deserve further research with more appropriate databases.

Although these results can contribute to a better understanding of the relationship between innovation and job quality at the firm level, it is important to stress that nothing has been said about the direction of causality between them. As discussed in the second section of this paper, there are many links between innovation and job quality going in both directions, and although we have shed some light on how some of those links can be empirically observed in European companies, the data used can establish no causality or directionality between them, just their simultaneous occurrence under certain conditions. For an understanding of the mechanisms behind these observed correlations, it would be necessary to explore this issue with a different methodology, such as qualitative observation of actual processes of innovation and their job quality outcomes at the workplace level.

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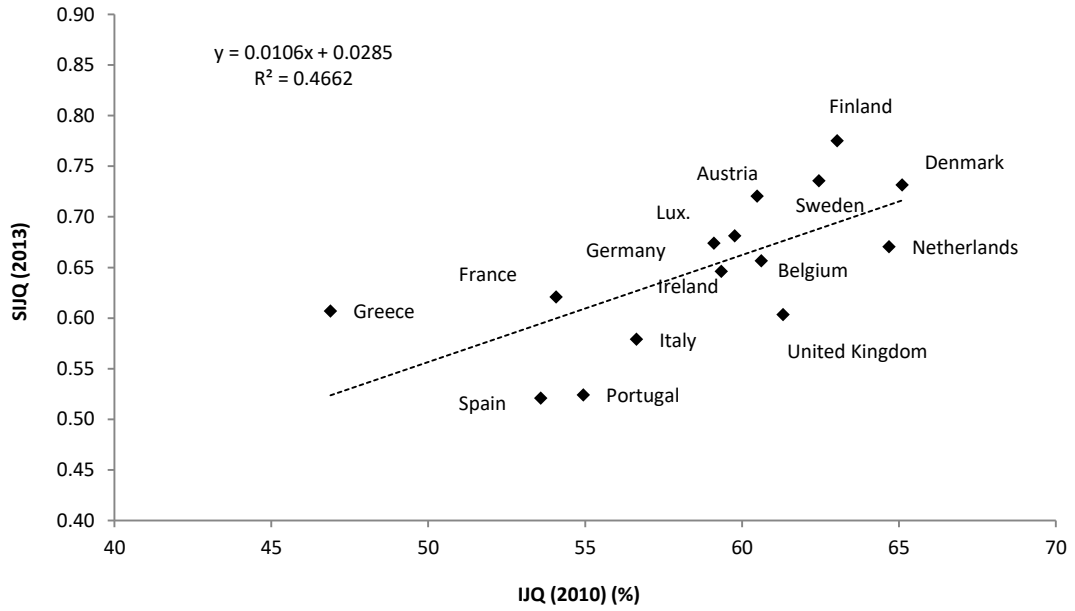
APPENDIX

Figure A.1. Relation between the SIJQ based on ECS data and the Index of Job Quality, IJQ, based on EWCS data. EU(15)



Source: author's elaboration from European Working Conditions Survey (2010) and European Company Survey (2013) microdata

Table A.1. Summary Index of Job Quality and index´s dimensions in 32 European countries

	SIJQ	Employment quality	Intrinsic quality	Work-life balance	Participation
Finland	0.775	0.856	0.690	0.745	0.880
Sweden	0.735	0.790	0.737	0.694	0.689
Denmark	0.732	0.766	0.715	0.665	0.877
Austria	0.720	0.846	0.702	0.698	0.463
Luxembourg	0.681	0.837	0.565	0.637	0.695
Germany	0.674	0.813	0.652	0.651	0.390
Netherlands	0.670	0.764	0.651	0.585	0.704
Slovenia	0.660	0.771	0.601	0.631	0.595
Iceland	0.660	0.774	0.639	0.465	0.966
Belgium	0.657	0.800	0.597	0.566	0.676
France	0.646	0.781	0.623	0.521	0.683
Spain	0.621	0.781	0.631	0.419	0.714
Romania	0.618	0.745	0.630	0.443	0.722
Estonia	0.615	0.767	0.585	0.556	0.425
Ireland	0.607	0.781	0.655	0.429	0.472
United Kingdom	0.603	0.772	0.706	0.432	0.304
Czech Republic	0.600	0.731	0.624	0.550	0.281
Slovakia	0.593	0.730	0.561	0.514	0.509
Lithuania	0.590	0.685	0.593	0.464	0.682
Italy	0.579	0.760	0.548	0.464	0.471
Poland	0.574	0.695	0.590	0.469	0.477
Montenegro	0.574	0.736	0.634	0.426	0.354
F. Y. R. Macedonia	0.557	0.723	0.633	0.400	0.301
Croatia	0.556	0.738	0.612	0.373	0.396
Latvia	0.549	0.721	0.581	0.459	0.212
Hungary	0.538	0.688	0.580	0.411	0.347
Cyprus	0.533	0.725	0.677	0.246	0.384
Bulgaria	0.530	0.745	0.605	0.255	0.486
Malta	0.524	0.689	0.611	0.375	0.213
Portugal	0.524	0.688	0.579	0.413	0.197
Greece	0.521	0.773	0.656	0.235	0.216
Turkey	0.499	0.720	0.525	0.287	0.396

Source: Author´s analysis from ECS2013 microdata.

Table A.2. Innovation in 32 European countries according to the ECS 2013

	Technological		Organisational	Marketing	Overall
	Product (%)	Process (%)	(%)	(%)	(%)
Belgium	44.6	38.9	45.7	42.2	34.5
Bulgaria	46.9	40.5	35.8	41.4	39.0
Czech Republic	33.1	26.8	30.1	30.2	23.8
Denmark	57.9	59.6	69.2	62.0	48.4
Germany	37.1	37.1	25.6	33.7	31.9
Estonia	41.1	37.8	33.8	37.6	23.8
Ireland	43.2	38.1	42.8	40.9	37.2
Greece	55.2	53.4	48.0	52.1	37.3
Spain	50.7	50.2	46.6	48.9	39.4
France	46.5	36.8	42.7	42.0	38.1
Croatia	35.3	27.1	32.7	32.0	37.1
Italy	49.4	46.0	46.2	47.2	35.6
Cyprus	48.1	44.6	38.4	44.1	39.1
Latvia	37.5	33.3	46.0	40.0	29.4
Lithuania	45.5	47.7	46.0	47.3	23.0
Luxembourg	53.9	44.3	35.5	43.8	55.0
Hungary	36.3	31.8	29.2	32.3	17.0
Malta	51.3	47.3	42.8	46.1	51.6
Netherlands	45.7	40.7	48.5	44.9	37.2
Austria	50.7	50.7	54.6	51.5	40.6
Poland	46.5	43.4	44.7	44.7	32.2
Portugal	53.8	53.0	41.5	49.0	42.9
Romania	48.2	39.7	27.0	39.4	51.3
Slovenia	50.3	41.9	46.8	46.2	34.1
Slovakia	33.7	32.3	24.2	30.8	26.1
Finland	40.1	55.1	62.3	52.8	36.1
Sweden	44.0	41.7	65.3	50.7	36.4
United Kingdom	41.2	35.8	34.6	38.1	39.3
Iceland	61.6	43.3	51.2	53.0	26.6
Montenegro	62.3	50.2	50.7	54.3	46.9
F. Y. R. Macedonia	53.1	47.9	42.7	47.5	45.1
Turkey	38.8	26.2	24.9	31.6	43.8
Standard deviation	7.58	8.26	11.07	7.68	8.88

Source: Author´s analysis from ECS2013 microdata.