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TRENDS IN QUALITY OF WORK IN THE EU-15: EVIDENCE FROM THE EUROPEAN WORKING CONDITIONS SURVEY (1995-2005)

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Abstract

This paper has three main objectives: to provide a mapping of quality of work across European countries, to measure its evolution between 1995 and 2005 and to explain the observed trends. This general assessment of quality of work is based on three waves of European Working Conditions Surveys carried out with employed persons in 1995, 2000 and 2005. We analyze the quality of work by measuring the working conditions as well as the intensity and complexity of the work. We find evidence of a decreasing trend in the quality of work in the EU-15 over the 1995-2005 period. Over that period, quality of working conditions has deteriorated, while at the same time, technical and market constraints have become more intense and work complexity has decreased. It is known that work contexts that are very demanding, with high work intensity and low decision latitude, generate stress. Thus, we may infer from the work intensity and complexity trends that mental strain has been on the rise in Europe, while physical working conditions have not improved. To understand the observed trends, we investigate country-level and individual-level heterogeneity in quality of work indicators using multilevel modeling. This permits measuring the sensitivity of descriptive trends to composition effects and testing the significance of "country effects".

Key words: quality of work, working conditions, work intensity, work complexity, European comparison, multilevel modeling.

Tendances de la qualité du travail dans l'Europe à 15 : un bilan à partir de l'enquête européenne Conditions de travail *(1995-2005)*

Résumé

Ce papier a trois principaux objectifs : établir une carte de la qualité du travail en Europe, mesurer son évolution entre 1995 et 2005 et expliquer les tendances observées. Ce bilan général sur la qualité du travail s'appuie sur trois vagues de l'enquête européenne sur les conditions de travail, réalisées auprès des personnes en emploi en 1995, 2000 et 2005. Nous appréhendons la qualité du travail à travers des mesures des conditions de travail, de l'intensité et de la complexité du travail. Nous montrons que la qualité du travail décroît dans l'Europe à 15 entre 1995 et 2005. Sur cette période, la qualité des conditions de travail s'est détériorée tandis que l'intensité des contraintes pesant sur le rythme de travail s'est accrue et que le travail devenait moins complexe. Les contextes de demandes fortes pesant sur le travail, avec un travail intense et peu de latitude décisionnelle génèrent du stress. Les tendances de l'intensité et de la complexité du travail impliquent donc une augmentation de la charge mentale engendrée par l'accomplissement des tâches, tandis que les conditions physiques de travail ne s'améliorent pas. Pour comprendre les évolutions observées, nous examinons les déterminants au niveau national et individuel de l'hétérogénéité des indicateurs de qualité du travail en mobilisant des modélisations multi-niveaux. Nous évaluons ainsi la sensibilité des évolutions mesurées aux effets de composition et nous testons la significativité des effets « pays ».

Mots-clefs : *qualité du travail, conditions de travail, intensité du travail, complexité du travail, comparaisons européennes, modèles multi-niveaux.*

INTRODUCTION[1]

Promoting employment and improving living and working conditions are central objectives of the Lisbon growth and jobs strategy launched in 2000. To achieve this aim, it is necessary to be able to monitor and assess progress in this field. Two official reports have proposed indicators of job quality and assessed their trends across recent decades. A first report by the European Foundation for the Improvement of Living and Working Conditions (2008) asks whether the impressive amount of job creation in Europe towards the end of the 1990s took place at the expense of job quality. In this report, job quality is measured by the median hourly wage, and data are taken from the European Labour Force Survey. Rather than using the individual as the unit of analysis, responses are aggregated over "jobs", which are defined as a given occupation in a given sector. Overall employment growth in each country over 1995-2006 is then broken up into five "job quality quintiles", which permit the researchers to determine whether job expansion has taken place at the top, bottom or middle of the employment structure. The report concludes that, overall, most member states generated more and better jobs in the decade after 1995, especially in the EU-15 area. The second report, by the European Commission (2008), identifies job quality regimes at the macroeconomic level. The method used is inspired by Davoine and Erhel (2007). First, a principal components analysis is carried out on a large set of country-level indicators, including dimensions such as socio-economic security, education and training, gender balance, working conditions and socio-economic context. Then, a smaller set of variables is included in the assessment of job quality trends over 1995-2004 for the EU-15 using Kohonen maps and synthetic indices. Results suggest a slight overall improvement from 1994 to 2004.

Even though the quality of jobs is an umbrella concept that comprises all dimensions of jobs, the indicators that we have discussed capture quality of employment more than quality of work. In other words, the nature of the membership of the employee in an employer unit is described in greater detail than are the employee's responsibilities and work organization. This is clear for the first report, which uses wages as a proxy for job quality. It is also the case for the second report, where only two variables out of the twelve used to compute trends in the synthetic indicator are related to work: non-standard hours and work accidents. Our assessment of trends in quality of work rests on a European harmonized survey: the European Working Conditions Survey (EWCS) produced by the European Foundation for the Improvement of Living and Working Conditions (EFILWC). We use three waves of the survey, 1995, 2000 and 2005, covering the same time period as the previous assessments of job quality. In this survey, employees describe their work by answering a long series of questions that are formulated in a simple and objective way. Even though the information collected is subjective, as employees self-report on their work experiences, the questions are formulated to de-emphasize individual opinions and enable international comparisons. The characteristics of the work environment, the way work is structured in time and the way work is divided and coordinated are analyzed separately and contribute to the construction of four synthetic

[1] Since June 2004, the Centre d'études de l'emploi (CEE) has been involved in the FP6 European integrated project called WORKS (Work Organisation and Restructuring in a Knowledge Society). This paper is an extension of a report from the quantitative pillar of the WORKS project (Greenan, Kalugina and Walkowiak, 2007) that can be accessed at the following address: (http://www.worksproject.be/documents/006193_WORKS_D9.2.2_CEE_updated_001.pdf).

indicators: one indicator of the quality of working conditions, two indicators of work intensity and an indicator of work complexity.

In terms of policy issues, quality of work is important because it directly relates to health and safety risks. Workers exposed to poor quality of work face increased hazards in the forms of work accidents and work-related illnesses. In economic downturns, the quality of work is affected by restructuring processes, which have long-term health implications for both displaced employees and those who remain employed (Kieselbach [coord], 2008). Monitoring work trends is also important in the context of an aging workforce with increased participation by women. Active aging policies stress the need to adapt professional training and conditions of work to older workers. The progressive replacement of the "male breadwinner" model by the "dual wage earner" model implies that work-life balance issues are becoming more strongly connected to work characteristics. Finally, the quality of work is a central feature of job satisfaction, and it tends to become more central over time as the educational attainment of the workforce increases (Clark, 2009).

Economic analysis has fewer tools to investigate and understand work characteristics as compared to employment characteristics. However, an active strand of the economic literature focuses on organizational design. This area of investigation is also very active in management sciences, ergonomics, sociology and psycho-sociology. Most of the literature seeking to understand determinants of working conditions, work intensity and complexity focuses on micro-organizational factors. A strong assumption in this literature is that new management concepts have a significant influence on work organization and employee outcomes. As summarized by Kalmi and Kauhanen (2008), empirical results on the impact of workplace innovations on work organization and employee outcomes have been somewhat conflicting, with one view arguing for mutual gains for employers and employees and another one being more critical. The mutual gain literature emphasizes the increase in discretion connected with workplace innovation and the resulting monetary and psychological benefits (Black *et al*., 2004; Freeman and Kleiner, 2000). In contrast, the critical view argues that the limited gains accrued by employees are outweighed by increased stress, workload intensification and work injury (Askenazy *et al*., 2002; Godard, 2001; Gollac and Volkoff, 1996; Green, 2004, 2006; Ramsay *et al*., 2000). Furthermore, it is now largely accepted that the way in which workplaces are coordinated has some important consequences in terms of learning processes (Cohen and Levinthal, 1990; Winter and Zollo, 2002). We also know that patterns of work coordination differ substantially across employers, sectors and countries (Lorenz and Valeyre, 2005). A widespread idea is to adapt the Fordist and the Taylorist models of production, where coordination rests on standardization of products and processes, to more rapid changes in the environment of firms through a movement towards a model where coordination rests on mutual adjustments. Such adaptation would allow for a learning process that is more widespread and less concentrated on a small fraction of the workforce (Lorenz and Lundvall (eds), 2006). As a result, bureaucratic structures involving complex organizations and simple jobs should evolve towards simpler structures with more complex jobs (de Sitter *et al*., 1997). Thus, in the view of this literature, we would expect increased quality of working conditions, work intensity and work complexity. Our findings corroborate the prediction on work intensity, and we find the opposite result for working conditions and work complexity in the EU-15 over 1995-2005: we observe an average increase in work intensity and an average decrease in the quality of working conditions and work complexity. Our general assessment is less encouraging than recent job quality reviews as we observe that overall quality of work decreased in the EU-15 over 1995-2005.

To move one step further into the analysis of the observed trends, we have investigated country-level and individual-level heterogeneity in quality of work indicators using multilevel modeling. This allows measuring the sensitivity of descriptive trends to composition effects, testing the significance of "country effects" and explaining it by common factors.

The paper is organized as follows. We first present our measurement strategy and map European trends in working conditions and work organization (section 1). Then, we investigate EU-15 and country-level heterogeneity in quality of work using multi-level modeling (section 2). Section 3 concludes the paper.

1. MAPPING EUROPEAN TRENDS IN WORKING CONDITIONS AND WORK ORGANIZATION OVER 1995-2005

1.1 Data

This study is based on data from the European Working Condition Surveys (EWCS), which are produced by the European Foundation for the Improvement of Living and Working Conditions (EFILWC). The EWCS provides a very rich set of partial indicators about working conditions and work organization. We process three different waves of the survey (1995, 2000 and 2005) for EU-15 countries. The first wave of the survey (1991) is not included in our assessment because the formulation of the core sets of questions for describing work organization changed significantly between the first and second waves. EFILWC prepared the ground for analysis by releasing, with the 2005 wave of the survey, a database in which the formats of prior waves are harmonized over time. This dataset identifies questions that are strictly comparable over time or similar enough to be comparable. In order to improve representativeness across countries and over time, we used harmonized weights provided in the survey according to the recommendations of EFILWC[2].

Approximately 1,500 employed persons in each country were interviewed in face-to-face interviews undertaken at the respondent's principal residence, with the exception of Luxembourg (500 interviews). The survey methodology is based on a multistage random sampling method ("random walk") involving a weighting of the selected sample to secure its representativeness (Merllié and Paoli, 2001). The sample is representative of the total employed population, *i.e.,* persons who were either employees or self-employed workers at the time of the interview. The sample was weighted using the distributions of the population in the Labour Force Survey according to region, city size, gender, age, economic activity (NACE) and occupation (ISCO) as benchmarks. Our sample includes self-employed individuals and private- and public-sector employees from establishments of all sizes across the EU-15. The total survey population is 15,986 persons in 1995, 21,703 persons in 2000 and 14,952 persons in 2005.

In order to characterize working conditions and work organization in Europe, we selected a set of variables capturing the experience of employed persons regarding their work and how it is organized and coordinated. These variables are based on questions that were formulated similarly over the three waves of the survey. They are expressed in a simple and objective way using yes/no responses or frequency scales expressed in terms of share of working time.

[2] A wide range of information on the survey's methodology and quality control processes has been published on the website of the European Working Conditions Observatory (http://www.eurofound.europa.eu/ewco/).

Frequency scales have been dichotomized into yes/no scales as comparable data were not always available over all three waves of the survey. Furthermore, the set of questions indicating whether the individual was subjected to different forms of violence and discrimination at work has been transformed into a single dummy indicating the existence of at least one "yes" answer. This simplification contributes to the international comparability by reducing country differences in the way questions are understood and answered. However, this does not reduce the heterogeneity in legal and cultural norms across countries that contributes to the generation of country-level patterns or effects.

1.2 Measurement strategy

Working conditions and work organization are latent multidimensional variables that are not directly observable. Each of the selected variables contributes to the construction of an overall picture of work experience, but none of them alone is sufficient to describe work experience effectively. Multiple Correspondence Analysis (MCA) is a useful technique in this situation as it aims at producing a simplified low-dimensional representation of the information in a large frequency table (Greenacre and Blasius, 2006). First, each item response of the qualitative work experience variables is coded as a dummy. The MCA generates quantitative scores, called dimensions, that maximize the average correlation among these dummy-coded qualitative variables. These dimensions are linear combinations of the dummy variables that play an active role in the analysis. They can be considered as synthetic indicators. Their interpretation relies on the variables that play a prominent part in their construction. The survey weights are used in the analysis to draw an overall picture of work organization in Europe, taking into account the differences in sampling frames across countries[3].

We consider three groups of variables capturing, respectively, the work environment, how work is organized in time and how it is divided up and coordinated. We run a weighted MCA for each group over the year 1995 and select factors that are efficient at synthesizing information. We derive synthetic indicators of the quality of working conditions, work intensity and work complexity, which are good summaries of the work experience of the average European worker in 1995.

The longitudinal dimension of the data is limited, consisting of three cross-sections from 1995, 2000 and 2005. We apply the method proposed by Greenan and Mairesse (2006) to compute trends in our synthetic indicators. We run a MCA for the starting year of the time period, 1995, and retain the first dimension. The linear combination of variables underlying this dimension is then applied to the distribution of individual characteristics measured in 2000 and 2005 to build up indicators that are comparable across time. A core assumption in this method is that it is meaningful to apply the structural relationships observed in 1995 to 2000 and 2005[4].

[3] The survey weights are used in the different steps of our analysis in descriptive statistics, MCA and regressions. This is done to ensure that EU-15 and country-level statistics (whether averages or coefficients) will be representative by controlling for the differences in sampling frames across countries. However, sensitivity analysis to weighing has been systematically conducted.

[4] We have checked that our main results are robust to the choice of the reference year for computing synthetic indicators. As we are dealing with trend analysis, 1995 is a "natural" reference year.

1.3 Three key dimensions of work

1.3.1 Quality of working conditions

In this paper, we focus on the traditional definition of working conditions, which encompasses the only features of working conditions covered by the three waves of the EWCS. Indeed, starting from its first wave, the EWCS provides very rich information on physical working conditions (*e.g.*, exposure to nuisances, dangerous products, radiation, vapors or fumes). Questions about physical working conditions are central to understanding the features of an industrial working environment, but they are more peripheral in the service sector, which is marked by stress and mental strain. We also include in the analysis a variable indicating whether the individual was subjected to different forms of violence or discrimination at work, a topic that was included in the questionnaire in 1995. Table 1 (columns 1 to 3) presents the distribution of variables associated with working conditions. For the EU-15, the great majority of indicators stayed quite stable between 1995 and 2005. However, the percentages of individuals exposed to high temperatures and those whose job involves repetitive hand or arm movements and wearing personal protective equipment have increased. On the contrary, the proportion of individuals exposed to breathing in vapors, fumes, dust or dangerous substances at work has decreased (22.3% in 1995 and 17.5% in 2005).

The first factor of the working conditions MCA for 1995, accounting for 31% of inertia[5], results from a linear combination for which the coefficients are given in column 5. The bold coefficients indicate that the item response has a high contribution to the inertia of the dimension, which can easily be interpreted as measuring the quality of working conditions. Physical nuisances are especially important in the construction of this indicator: being exposed to vibrations from hand tools or machinery, to noise so loud that one would have to raise one's voice to talk to people, to high or low temperatures, to breathing in vapors, to handling and touching chemical products or substances or to radiation as well as having to wear personal protective equipment make a large contribution to the synthetic indicator.

Table 2 summarizes the rankings of each country according to the quality of its working conditions. The calculation is based on the comparison of the average values of each indicator in 1995, 2000 and 2005 (Columns 1, 2 and 3 of Table 2). The Netherlands and Denmark are characterized by the best average quality of working conditions in the EU-15. Because our working conditions indicator better captures working conditions in manufacturing-type work environments, the Dutch sector structure may in part explain this result. Much of the heavy manufacturing (*e.g.*, textile, automotive and mining industries) have been offshored, and only about 3% of the working population works in the (labor-extensive) agriculture sector. Most Dutch workers are employed in the public and private service industries.

[5] Inertia in MCA is an indicator of heterogeneity analogous to variance in factor analysis.

Table 1. Quality of working conditions: Synthetic indicator

EU-15 1995 (1)	**2000 (2)**	**2005 (3)**	**(4)**	**Synthetic Indicator (5)**
(%)	(%)	(%)	Intercept	-0.630
			Are you exposed at work to:	
			-Vibrations from hand tools, machinery, *etc.*?	
21.72	22.43	23.03	Yes	**-0,123**
78.28	77.57	76.97	No	0,123
			-Noise so loud that you would have to raise your voice to talk to people?	
26.26	27.46	28.65	Yes	**-0,112**
73.74	72.54	71.35	No	**0,112**
			-High temperatures which make you perspire even when not working?	
18.56	21.83	23.35	Yes	**-0,105**
81.44	78.17	76.65	No	0,105
			-Low temperatures whether indoors or outdoors?	
23.17	20.37	20.29	Yes	**-0,100**
76.83	79.63	79.71	No	0,100
			-Breathing in smoke, fumes, powder or dust, *etc*?	
22.3	21.36	17.49	Yes	**-0,125**
77.7	78.64	82.51	No	0,125
			-Handling or being in skin contact with chemical products or substances?	
13.68	14.78	13.82	Yes	**-0,127**
86.32	85.22	86.18	No	0,127
			-Radiation such as W rays, radioactive radiation, welding light, laser beams?	
5.23	5.22	4.64	Yes	**-0,121**
94.77	94.78	95.36	No	0,121
			Does your main job involve	
			-Painful or tiring positions	
43.55	45.24	44.27	Yes	**-0,083**
56.45	54.76	55.73	No	**0,083**
			-Carrying or moving heavy loads	
32.34	36.29	33.76	Yes	**-0,099**
67.66	63.71	66.24	No	**0,099**
			-Repetitive hand or arm movements	
55.59	56.47	61.19	Yes	-0,066
44.41	43.53	38.81	No	0,066
			-Wearing personal protective equipment	
23.87	27.88	31.83	Yes	**-0,104**
76.13	72.12	68.17	No	0,104
			Individual has been subjected to some forms of violence or discrimination	
12.43	13.3	12.42	Yes	-0,032
87.57	86.7	87.58	No	0,032

Note: In Column 5, coefficients are computed so that their sum over item responses of each variable equals to zero. A coefficient in bold indicates a high contribution of the item response to the inertia of the synthetic indicator. The underlying multiple correspondences analyses has been conducted using the 1995 wave of the survey.

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

Table 2. Change in the quality of working conditions between 1995 and 2005

	1995	2000	2005	Variation I2000-I1995		Variation I2005-I2000		Variation I2005-I1995	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Rank 1995	Rank 2000	Rank 2005	V 1	V 2	V 1	V 2	V 1	V 2
EU-15 average				-***		-		-***	
Scandinavian countries									
Denmark	4	2	3	+	+**	-**	-**	-	-
Finland	14	14	14	-***	-***	+	+	-*	-***
Sweden	9	10	9	-	+	+	+	+	+
British Isles									
Ireland	7	9	4	-	-	+***	+***	+***	+***
United Kingdom	13	11	2	+	+	+***	+***	+***	+***
Western Europe									
Austria	12	7	8	+**	+***	-	-	+*	+**
Belgium	2	5	5	-***	-**	-	+	-**	-*
Germany	5	6	10	-**	-	-***	-***	-***	-***
France	11	12	11	-	-	+	-**	-	-
Luxembourg	6	3	6	+	+	-	-	-	-
Netherlands	3	1	1	+	+	+	-	+	+
Mediterranean countries									
Greece	15	15	15	+***	+***	-	-	+***	+***
Italy	1	4	7	-***	-**	-	-***	-***	-***
Portugal	8	8	13	+	+***	-***	-***	-***	-***
Spain	10	13	12	-***	-**	+	+	-**	-

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

On the other hand, the quality of working conditions was low compared to other countries in Greece and Finland during the analyzed period. Once again, the Finnish and Greek sector structures may in part explain this result. The directions and significances of their evolution over time are given in columns 4 to 9. Trends in the quality of working conditions indicator are computed in two different ways. Columns V1 (variation 1) give the signs of the variation of the EU-15 or country average quality of working conditions indicator over 1995-2000 (column 4), 2000-2005 (column 6) and 1995-2005 (column 8). Columns V2 (variation 2) give the signs of the variation once the values given in V1 have been purged of the structural effects of sectors and occupations. More precisely, we run regressions at the individual level in which the quality of working conditions is explained by occupation, sector and year dummies. Then, we retrieve the residuals, which provide the value of each indicator when the occupation and the sector are controlled for, and we test the significance of their average variation over 1995-2000 (column 5), 2000-2005 (column 7) and 1995-2005 (column 9). In the EU-15, the average quality of working conditions has decreased between 1995 and 2005. This decrease is significant in Finland, Belgium, Germany, Italy, Portugal and Spain.

However, some countries are characterized by an improvement over the studied period. This is especially true for the United Kingdom, where the increase in the quality of working conditions is concentrated between 2000 and 2005 (the UK moved from rank 11 in 2000 to rank 2 in 2005, just behind the Netherlands). Ireland, Austria and Greece are other countries with positive developments in the quality of working conditions. The improved performance of the Anglo-Saxon countries is also observed by Peña-Casas and Pochet (2009). They stress that this upwardly converging trend echoes the noticeable progress in health and safety indicators over the period as well as improved knowledge about workers' rights and declining discrimination indicators. As argued by Brynin (2008), these changes could be connected with the end of Thatcher's time as Prime Minister (1995). When the trends are purged of sector and occupational structure effects, the decrease in the quality of working conditions becomes more significant in Finland, while in Spain it is no longer significant.

Quality of work is an umbrella concept that includes other dimensions of work environment besides physical working conditions. Psychosocial risks at work and their consequences in terms of health and safety are another important piece of the puzzle, as are work organization, learning and development opportunities, and work-life balance (Parent-Thirion *et al.*, 2007). The longitudinal dimension of the EWCS does not allow these different dimensions to be covered thoroughly. However, two important dimensions of work experience connected with work organization can be approached in an effective way: work intensity and work complexity.

1.3.2 Work intensity

Despite its centrality in the determination of work quality, work intensity is not among the social indicators that the European Union collects in its synthesis of work quality indicators (Green, 2006), perhaps due to problems with its definition and measurement. The concept of work intensity is complex. It generally refers to labor effort expended while at work. More precisely, Green (2006) defines work effort as the rate of physical and/or mental input to work tasks during the working day. He also notes that while the definition and measurement of working hours, for example, is normally unproblematic, work intensity requires careful attention to keep it conceptually distinct from organizational efficiency, individual performance and skill. Two types of intensity measures can be distinguished. Work effort can be measured through exposure to high working speeds or to tight deadlines (Green and McIntosh, 2001; Green, 2004). The weakness of this measure is the absence of information on the source of intensity. It is also possible to use questions about factors on which the pace of work depends (Amossé and Gollac, 2008). This kind of measure has the advantage of capturing the variety of constraints that influence the work rhythm, such as demands from colleagues, demands from customers, speed of machines, numerical production targets or direct control by a manager.

The EWCS provides information on constraints that workers face when performing their tasks and on their work rhythm. Using information about a worker's exposure to high working speed or to tight deadlines, we can measure his or her work intensity. The main advantage of self-report is that the workers themselves are likely to have the best understanding of the demands of their jobs. However, the potential for biased reporting of contested features like work effort is clear. The replies to these questions clearly depend on what employees regard as "high" speed or "tight" deadlines. However, these are measurements of psychological comfort or suffering, and as such, their subjective nature is not necessarily a defect.

Table 3. Work intensity: synthetic indicators

EU-15				Synthetic indicators	
1995	2000	2005		Technical	Market
(1)	(2)	(3)	(4)	(5)	(6)
(%)	(%)	(%)	Intercept	0.249	-0.241
			Does your job involve?		
			-Short repetitive tasks of less than 10 minutes		
35.46	45.61	39.28	Yes	**0,110**	0,036
64.54	54.39	60.72	No	-0,110	-0,036
			-Working at very high speed		
53.39	55.26	60.66	Yes	**0,141**	**0,161**
46.61	44.74	39.34	No	**-0,141**	**-0,161**
			-Working to tight deadlines		
55.28	58.64	61.87	Yes	**0,136**	**0,171**
44.72	41.36	38.13	No	**-0,136**	**-0,171**
			On the whole, is your pace of work dependent, or not on…		
			-The work done by colleagues?		
36.95	42.15	41.71	Yes	**0,133**	-0,052
63.05	57.85	58.29	No	-0,133	0,052
			-Direct demands from people such as customers, passengers, pupils, patients, *etc.?*		
68.77	69.66	70.4	Yes	-0,022	**0,206**
31.23	30.34	29.6	No	0,022	**-0,206**
			-Numerical production targets?		
33.98	30.11	42.09	Yes	**0,163**	-0,073
66.02	69.89	57.91	No	**-0,163**	0,073
			-Automatic speed of a machine or movement of a product?		
20.83	19.15	18.27	Yes	**0,190**	-0,111
79.17	80.85	81.73	No	-0,190	0,111
			-The direct control of your boss?		
34.41	31.39	33.45	Yes	**0,112**	**-0,140**
65.59	68.61	66.55	No	-0,112	0,140

Note: In Columns 5 and 6, coefficients are computed so that their sum over item responses of each variable equals to zero. A coefficient in bold indicates a high contribution of the item response to the inertia of the synthetic indicator. The underlying multiple correspondences analyses has been conducted using the 1995 wave of the survey.

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

Table 3 (columns 1, 2 and 3) provides the distributions in 1995, 2000 and 2005 for the EU-15 of the questions used to construct synthetic indicators of work intensity. The percentage of workers whose job involves short repetitive tasks of less than ten minutes considerably increased between 1995 and 2000, then decreased between 2000 and 2005. The proportion of workers working at very high speed and to tight deadlines increased in the EU-15 over this ten-year time period (from 53% to 61% and from 55% to 62%, respectively, between 1995 and 2005). Compared to 1995, in 2005 the pace of work was more dependent on direct demands from customers and less dependent on the automatic speed of machines. However, the percentage of workers responding that their pace of work depends on numerical

production targets significantly increased between 2000 and 2005 (from 30% to 42%[6]; this percentage was 34% in 1995).

Our analysis shows that work intensity has two main components: the intensity of technical constraints and the intensity of market constraints. The intensity of technical constraints is the first dimension of our MCA and accounts for 26% of inertia (column 5). This component is driven by the automatic speed of machines or movement of products, the existence of numerical production targets and dependence on work done by colleagues. It also reflects the hierarchical organization of work, with direct control by the boss exerting pressure to maintain a rapid pace of work. The intensity of market constraints (column 6), the second dimension of our MCA accounting for 15% of inertia, reflects the dependence of the pace of work on direct demands from people such as customers, passengers, pupils, patients, *etc.*, as well as the absence of direct supervision. Intensity of technical constraints and of market constraints are both strongly and positively correlated with working at a very high speed and with tight deadlines. Thus, they represent two different sources of work intensity.

Table 4 displays levels of and changes in work intensity synthetic indicators for EU-15 countries. The highest intensity of technical constraints is observed in Finland and Greece. The relative ranks of countries are rather changeable during the analyzed period. For example, Ireland and Spain are the countries with the weakest technical constraints in 2005, but in 2000, Ireland was ranked fourth and Spain fifth. Work organization in Europe is still very much structured around the presence or absence of industry-specific constraints stemming from equipment or from work organization. Results are stable over time for the intensity of market constraints. The highest intensity of market constraints was observed in Scandinavian countries (in particular, Sweden ranked first during the whole analyzed period) and in the Netherlands (third position in 2000 and fourth in 2005). On the other hand, in Portugal, Spain (especially in 1995 and 2000) and the United Kingdom (in 2005), these constraints are not prevalent.

The average European worker experienced a significant increase in market and technical constraints over the study period. Market constraints significantly increased between 1995 and 2000 but stayed stable between 2000 and 2005. This result suggests that work intensification in Europe is not only market driven; technical or industrial constraints remain important. Indeed, one would expect that with the development of the services sector in Europe, direct demand from people would drive work intensity more strongly than technical constraints. However, on one hand, demands from people were already high at the beginning of the period, with around 70% of the workforce facing such constraints (Table 3, column 1); on the other hand, forms of work organization characterizing the manufacturing sector have been spreading to the services sector with the diffusion of ICTs and of management concepts like High Performance Work Systems (HPWS).

[6] EFILWC considers this question as harmonized over time. However, some differences in formulation are worth noting. In 1995, employees were asked about "production norms". This was replaced by the wordings, "numerical production targets" in 2000 and "numerical production targets or performance targets" in 2005. By making the formulation more applicable to the services sector, the addition of the "performance target" terminology in 2005 could be partly responsible for the strong increase between 2000 and 2005.

Table 4. Change in the intensity of technical and market constraints between 1995 and 2005

	1995	2000	2005	Variation I2000-I1995		Variation I2005-I2000		Variation I2005-I1995	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Rank 1995	Rank 2000	Rank 2005	V 1	V2	V 1	V2	V 1	V2
	Intensity of technical constraints								
EU-15 average				+***		+***		+***	
Scandinavian countries									
Denmark	12	15	6	-***	-***	+***	+***	+***	+***
Finland	1	2	1	+	-	+**	-	+***	-
Sweden	5	3	7	+***	+	-	-***	+***	-*
British Isles									
Ireland	6	4	15	+***	+	-***	-***	-***	-***
United Kingdom	2	6	9	-**	-***	-	-**	-**	-***
Western Europe									
Austria	4	8	5	-***	-***	+***	+***	+	-*
Belgium	14	12	8	+***	+***	+***	+**	+***	+***
Germany	9	10	4	+	-	+***	+***	+***	+***
France	8	7	13	+	-	+	-	+*	-
Luxembourg	15	11	11	+***	+***	+**	+	+***	+***
Netherlands	7	13	10	-***	-***	+***	+***	+**	-
Mediterranean countries									
Greece	3	2	2	+***	+**	-	-***	+**	-
Italy	13	9	12	+***	+***	+**	+	+***	+***
Portugal	11	14	3	-	-***	+***	+***	+***	+***
Spain	10	5	14	+***	+***	-***	-***	+**	-*
	Intensity of market constraints								
EU-15 average				+***		+		+***	
Scandinavian countries									
Denmark	3	4	3	+	-	+***	+***	+***	+**
Finland	2	2	2	+***	+	-	-	+***	-
Sweden	1	1	1	+***	+**	+	+	+***	+**
British Isles									
Ireland	11	12	11	+***	-	+	+	+***	-
United Kingdom	5	9	14	-***	-***	-***	-***	-***	-***
Western Europe									
Austria	4	5	6	+**	-	-	-***	+	-***
Belgium	9	11	10	+	-	+	+	+**	-
Germany	7	6	5	+***	+	+	+	+***	+**
France	10	10	13	+***	+	-**	-**	+	-
Luxembourg	15	13	12	+***	+***	+	+	+***	+***
Netherlands	6	3	4	+***	+***	-***	-***	+***	+***
Mediterranean countries									
Greece	8	7	8	+***	+**	-	-**	+***	-
Italy	12	8	7	+***	+***	+***	+	+***	+***
Portugal	13	15	15	-***	-***	+***	+*	-	-***
Spain	14	14	9	-	-***	+***	+***	+***	+***

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

These developments are heterogeneous through Europe. On one hand, a significant decrease in intensity of technical constraints is observed in Ireland and the United Kingdom between 1995 and 2005. In contrast, during the same period, these constraints significantly increased in all countries with the exception of Austria (where they stayed stable). When structures of occupations and sectors are accounted for (column 9 in Table 4), some results change: the intensity of technical constraints significantly (at the 10% level) declines in Sweden, Austria and Spain and remains stable in Finland, France, Netherlands and Greece. However, six European countries still exhibit a significant increase: Denmark, Belgium, Germany, Luxembourg, Italy and Portugal. The United Kingdom is the only country where the intensity of market constraints significantly declined. Controlling for sectors and occupations (column 9) leads to changes in the results for Finland, Ireland, Belgium and Greece, where the increase becomes nonsignificant, and in Austria and Portugal, where a significant decline appears.

These results can be compared to Green's findings for the first sub-period, *i.e.*, between 1995 and 2000 (Green, 2006). Using EWCS for 1991, 1995 and 2000, the author computes an effort index based on the "high speed" and "tight deadlines" questions. Green observes that work intensification was a widespread, but not ubiquitous, phenomenon in Europe during the 1990s. Work intensity rose faster in the United Kingdom over the period from 1991 to 1995 than in all other EU countries (Green and McIntosh, 2001). It persisted in the later period (1995-2000) in Belgium, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands and Sweden. In Denmark and Spain, there was little change in work effort, while it declined in Austria, the United Kingdom, Finland and Portugal.

1.3.3 Work complexity

The EWCS allows analyzing work coordination and learning processes by providing information on the characteristics of tasks, how they are performed, how they are coordinated and the associated learning process. The questions used are reported in Table 5. Columns 1, 2 and 3 provide the weighted distributions in 1995, 2000 and 2005 for the EU-15. Our synthetic indicator, which account for 22% of inertia, shows an opposition between complex jobs involving opportunities for learning and routine jobs. Jobs involving complex tasks also entail discretion in how the work is carried out and learning new things. However, other workers report that their work is simple; that they are unable to change or choose their methods of performing their work and the order in which they complete tasks; that they do not solve unforeseen problems or assess the quality of their own work; that they are not free to take breaks or days off when they wish to; and that they do not feel that they learn new things at work. The fact that complexity, discretion and learning go hand in hand supports the idea of the existence of an organizational learning model. This relationship has already been identified in work based on employee surveys at a national level and connected to economic performance issues at the employer level (Greenan and Guellec, 1998). However, in our analysis, complexity, discretion and learning make up a dimension of their own that is weakly connected with other features of work organization, like quality standards, task monotony, job rotation or support from colleagues. This result echoes findings of Lorenz and Valeyre (2005) based on the previous wave of the EWCS, where teams, job rotation and quality norms can be organized in different models offering different learning opportunities for employees. We label this synthetic indicator "work complexity", where a high work complexity is conducive to more frequent learning opportunities.

Table 5. Work complexity: synthetic indicator

EU-15 1995 (1) (%)	2000 (2) (%)	2005 (3) (%)	(4)	Synthetic indicators (5)
			Intercept	-0.411
			Does your main paid job involve…?	
			-Meeting precise quality standards	
71.07	68.23	73.52	Yes	0.066
28.93	31.77	26.48	No	-0.066
			-Assessing yourself the quality of your own work	
75.58	74.04	71.44	Yes	0.089
24.42	25.96	28.56	No	**-0.089**
			-Solving unforeseen problems on your own	
83.77	81.97	80.93	Yes	0.145
16.23	18.03	19.07	No	**-0.145**
			-Monotonous tasks	
43.72	38.78	41.39	Yes	-0.019
56.28	61.22	58.61	No	0.019
			-Complex tasks	
58.55	55.51	58.18	Yes	**0.101**
41.45	44.49	41.82	No	**-0.101**
			-Learning new things	
75.79	70.41	69.56	Yes	**0.122**
24.21	29.59	30.44	No	**-0.122**
			-Rotating tasks between yourself and colleagues	
54.68	43.23	42.87	Yes	0.049
45.32	56.77	57.13	No	-0.049
			Are you able, or not, to choose or change…?	
			-Order of tasks	
65.7	64.17	63.44	Yes	**0.123**
34.3	35.83	36.56	No	**-0.123**
			-Methods of work	
72.09	70.4	67.71	Yes	**0.128**
27.91	29.6	32.29	No	**-0.128**
			For each of the following statements, please answer yes or no:	
			-You can get assistance from colleagues if you ask for it	
83.48	82.45	81.63	Yes	0.039
16.52	17.55	18.37	No	-0.039
			-You can take your break when you wish	
63.12	60.46	63.34	Yes	0.081
36.88	39.54	36.66	No	**-0.081**
			-You are free to decide when to take holidays or day off	
56.97	55.35	66.91	Yes	0.072
43.03	44.65	33.09	No	**-0.072**

Note: In Columns 5, coefficients are computed so that their sum over item responses of each variable equals to zero. A coefficient in bold indicates a high contribution of the item response to the inertia of the synthetic indicator. The underlying multiple correspondences analyses has been conducted using the 1995 wave of the survey.

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

Table 6. Change in work complexity between 1995 and 2005

	1995	2000	2005	Variation I2000-I1995		Variation I2005-I2000		Variation I2005-I1995	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Rank 1995	Rank 2000	Rank 2005	V1	V2	V1	V2	V1	V2
EU-15 average				-***		+***		-***	
Scandinavian countries									
Denmark	2	1	1	-	+**	+***	+	+***	+***
Finland	5	4	4	-***	-**	+***	+***	+	+
Sweden	1	3	2	-***	-***	+***	+***	+	+
British Isles									
Ireland	11	9	9	-	+	+***	+	+***	+**
United Kingdom	4	5	10	-***	-***	-***	-***	-***	-***
Western Europe									
Austria	10	6	5	+***	+***	+**	-	+***	+***
Belgium	7	8	7	-	+	+***	+	+**	+
Germany	9	10	13	-**	+	-	-***	-***	-***
France	6	7	8	-*	+	+**	-	+	+
Luxembourg	12	12	6	-	+	+***	+*	+***	+***
Netherlands	3	2	3	-	+**	+*	-	+	+
Mediterranean countries									
Greece	15	15	14	-***	-	+***	+***	+***	+**
Italy	8	11	11	-***	-*	+***	-	-	-**
Portugal	13	14	12	-***	-***	+***	+***	-	+
Spain	14	13	15	-**	+	-	-***	-***	-***

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

According to Lorenz and Lundvall (eds) (2005), the level of development of a country corresponds to its investment in knowledge and complex work. This is confirmed by our results. Table 6, columns 1, 2 and 3, gives the rank of each EU-15 country in terms of its average level of work complexity in 1995, 2000 and 2005. In Scandinavian countries (especially in Denmark and Sweden), workers frequently perform complex tasks, but other countries also offer many learning opportunities and complex tasks. Indeed, the Netherlands is ranked in the third position in 1995 and 2005. Routine jobs are more frequent in Mediterranean countries, but they are also frequent in the British Isles (with the UK ranking 10th and Ireland 9th in 2005) and in Germany (ranking 13th in 2005). These results are in line with the spread across countries of the "discretionary learning" form of work organization described by Lorenz and Valeyre (2005).

In Table 5, columns 1, 2 and 3 give the weighted distributions for the EU-15 of the twelve primary variables used in the MCA in 1995, 2000 and 2005. These descriptive statistics are somewhat surprising: most of the variables under scrutiny show a slight downward trend over the ten-year time period. For example, the percentage of employed individuals in the EU-15 reporting that their jobs involved learning new things decreased from 76% in 1995 to

70% in 2005; for task rotation, the percentage decreased from 55% to 43%; and for discretion in the choice of methods of work, the percentage decreased from 72% to 68%. There are only two exceptions to this general picture: a small increase in quality standards (71% in 1995 versus 74% in 2005) and a large increase in freedom to take holidays or days off (57% in 1995 versus 67% in 2005[7]). How do these trends translate in the work complexity indicator? In the EU-15, average work complexity first decreased significantly over 1995-2000, then increased over 2000-2005 without compensating for the initial decrease; thus, a significant overall decrease is observed over the ten-year period (Table 6, column 8). However, work complexity significantly decreased over 1995-2005 in only three countries, the United Kingdom, Spain and Germany, which have strong influences on EU-15 average trends[8]. Conversely, work complexity significantly increased over the ten-year study period in Denmark, Ireland, Austria, Belgium, Luxembourg and Greece. These results are robust to the inclusion of occupation and sector structures (Table 6, column 9). Belgium and Italy are the only countries for which a change in the significance of the variation is observed. In Belgium, the increase in work complexity becomes nonsignificant, which indicates that the proportion of sectors and/or occupations offering more complex jobs increased, but the degree of work complexity within jobs did not change. In Italy, shifts in occupations and sector structures obscured a general decreasing trend in job complexity. The negative average work complexity trend in the EU-15 is puzzling as the knowledge base of the core of the European economy is most often described as expanding. How can an increased dependency of the economy on the generation of new knowledge fit with an average decreasing trend of work complexity experienced by EU-15 workers? Before trying to resolve this paradox, we will organize our main results into a general assessment of the quality of work across EU-15 countries.

1.3.4 A general assessment of quality of work across EU-15 countries

We have provided a picture of working conditions and work organization in the EU-15 countries in 1995, 2000 and 2005 by mapping four key synthetic indicators of work experience: quality of working conditions, intensity of technical constraints, intensity of market constraints and work complexity. Table 7 summarizes our main findings. We observe significant variety in the models of work organization in Europe. National groupings are quite difficult to discern. These results are at odds with the literatures on the variety of capitalism (Amable, 2003) and "welfare regimes" (Esping-Andersen, 1990).

More generally, in section 2, we demonstrated that the quality of working conditions is an important dimension of the quality of work. However, we know that the assessment through our synthetic indicator is limited by the fact that we focus on physical working conditions, with no information on stress and mental strain. However, the job demand-control model (Karasek and Theorell, 1990) indicates that a high level of job demand associated with a low level of decision latitude is a good predictor of stressful work experiences and subsequent physical illness. If we refer to our synthetic indicators of work organization, this kind of work

[7] The modalities of answers to questions about assistance, breaks and holidays changed in 2005. In 1995 and 2000, the possible answers were yes and no, while in 2005 the answers varied from "Almost never" to "Almost always". The trends for these questions should be analyzed with caution.

[8] Sensivity analysis shows that the average variation in Europe between 1995 and 2005 is sensitive to weighing. The overall average during this period is significantly negative when weighted and significantly positive when unweighted. However, no change in sign is noted in the country-level averages over that period, and results are very similar when the structures of sectors and occupations are taken into account (V2). These results are available upon request.

experience would be characterized by high work intensity combined with low work complexity. In Table 7, the average EU-15 trends over 1995-2005 combine decreasing quality of working conditions with increased intensity and decreased degree of work complexity. This is a rather negative general assessment with some implications in terms of health at work.

Table 7. Quality of work in EU15 between 1995 and 2005: a summary

	Quality of working conditions		Intensity of technical constraints		Intensity of market constraints		Degree of work complexity	
	Rank 2005	**Trend 95-05**	**Rank 2005**	**Trend 95-05**	**Rank 2005**	**Trend 95-05**	**Rank 2005**	**Trend 95-05**
EU-15 average		(-)		(+)		(+)		(-)
Scandinavian countries								
Denmark	3	0	6	(+)	3	(+)	1	(+)
Finland	14	(-)	1	0	2	0	4	0
Sweden	9	0	7	(-)	1	(+)	2	0
British Isles								
Ireland	4	(+)	15	(-)	11	0	9	(+)
United Kingdom	2	(+)	9	(-)	14	(-)	10	(-)
Western Europe								
Austria	8	(+)	5	(-)	6	(-)	5	(+)
Belgium	5	(-)	8	(+)	10	0	7	0
Germany	10	(-)	4	(+)	5	(+)	13	(-)
France	11	0	13	0	13	0	8	0
Luxembourg	6	0	11	(+)	12	(+)	6	(+)
Netherlands	1	0	10	0	4	(+)	3	0
Mediterranean countries								
Greece	15	(+)	2	0	8	0	14	(+)
Italy	7	(-)	12	(+)	7	(+)	11	(-)
Portugal	13	(-)	3	(+)	15	(-)	12	0
Spain	12	(0)	14	(-)	9	(+)	15	(-)

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

Interpretation: significant changes (at least at 10% level) are indicated in brackets.

What about country situations? It is interesting to examine both levels in 2005 and trends over 1995-2005. A country which is a leader in terms of work intensity and which lags behind in terms of quality of working conditions and of work complexity would be characterized by a low level of work quality compared with other European countries. Greece and Portugal are the only countries that combine all of these features. In other countries, evidence is more mixed as the different dimensions tend to compensate for each other in determining work quality. For example, in the United Kingdom, the quality of working conditions was high in 2005, and it was combined with low intensities of technical and market constraints in particular. The most negative feature in this general assessment for the United Kingdom is the low level of work complexity. In terms of trends, two countries seem to be moving in the wrong direction: Germany and Italy. In these countries, there is a decrease in the quality of working conditions combined with an increase in the intensities of technical and market constraints and a decrease in work complexity. In other European countries, trends tend to counterbalance each other in the general assessment of changes in

quality of work. In section 3, we will seek to move one step further in the analysis by analyzing the heterogeneity in our indicators across individuals and countries.

2. INVESTIGATING EU-15 AND COUNTRY-LEVEL HETEROGENEITY IN QUALITY OF WORK

Table 7 describes the situation and the changes experienced in recent decades by the average EU-15 worker and the average worker in each country, taking into account sector and occupational shifts. In section 3, we move a step further in two directions. First, we take into account composition effects besides shifts in sectors and occupations: sociodemographic and employment relationship characteristics as well as the spread of ICT may play roles in changing self-reports of work quality. Second, we would like to better understand the "country effects" in Table 7. To do so, we must take into account the nested or clustered structure of our data: individuals' self-reports about their work experience in 15 different European countries across three different years. Are the answers given by workers within a single country more similar to one another than the answers given by workers across all countries? If the answer is yes, multilevel modeling allows measuring and explaining the "country effect". Moreover, in the presence of "country effects", multilevel modeling provides better estimates of individual effects. The section is organized as follows. We first analyze shifts over time in the decomposition of variance within and between countries and develop an empirical strategy to measure individual and country effects (section 2.1). Then, we present and discuss the results (section 2.2).

At the individual level, the key question is whether our four dimensions of work quality have changed because of changes in the type of people sorting into particular jobs, in the nature of the relationships between job holders and employers, or in the type of technology used while performing the job. At the country level, the key question is whether differences between countries exist when individual factors are taken into account and whether these differences are purely idiosyncratic or can be explained by common factors such as the state of economic development or the characteristics of the labor market. This analysis aims to contribute to the policy debate by identifying channels by which policy may influence quality of work.

Respondents in the EWCS are employed persons from each EU country. Thus, the dataset is hierarchical, with a level 1 (the individual, indexed by i) nested in a level 2 (the country, indexed by j). Multilevel modeling is adequate for that type of data structure, in particular when there is a "level 2 effect"; that is, when the answers given by individuals at level 1 are correlated. In our case, the "level 2 effect" is a country effect.

The first step in multi-level modeling is to identify within-country and between-country variance through a benchmark regression: the intercept-only model. If there are no explanatory variables at level 1, the model equation can be formulated as follows:

$$Y_{ij} = \beta_{0j} + r_{ij}, \text{ where } r_{ij} \sim N\left(0, \sigma^2\right) \quad (1)$$

In traditional models, β_{0j} is an intercept and r_{ij} a random term. In the presence of a country effect, there is a correlation between observations within countries, resulting in differences in country intercepts that may be expressed as follows:

$$\beta_{0j} = \gamma_{00} + u_{0j}, \qquad \text{where } u_{0j} \sim N\left(0, \tau_{00}\right) \quad (2)$$

The full model is specified by substituting (2) in (1):

$$Y_{ij} = \gamma_{00} + u_{0j} + r_{ij} \quad \text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } \quad r_{ij} \sim N(0, \sigma^2) \qquad (3)$$

This model allows decomposing the total variance into two independent components: the variance ($\hat{\sigma}^2$) of individual-level errors (r_{ij}) and the variance ($\hat{\tau}_{00}$) of the country-level errors (u_{0j}). The intra-country correlation can be expressed as:

$$\hat{\rho} = \frac{\hat{\tau}_{00}}{\hat{\tau}_{00} + \hat{\sigma}^2} \qquad (4)$$

This correlation indicates the proportion of the variance explained by the grouping structure in the sample. It can also be interpreted as the expected correlation between two randomly chosen units that are in the same country. In other words, this intra-country correlation measures the share of the total variance that occurs between countries. In Table 8, the EU-15 intra-country correlations are reported for our four quality of work indicators over each wave of the EWCS (1995, 2000 and 2005).

Table 8. Analysis of random components within and between countries

	1995	2000	2005
Quality of working conditions			
Intercept	-0.018	-0.03	-0.03
Random part			
Variance of the country level residual errors	0.011***	0.008***	0.008***
Variance of the individual level residual errors	0.3***	0.33***	0.33***
Intra country correlation in percentage	3.6%	2.45%	2.49%
Intensity of technical constraints			
Intercept	0.002	0.029	0.77***
Random part			
Variance of the country level residual errors	0.006***	0.005***	0.003***
Variance of the individual level residual errors	0.256***	0.264***	0,263***
Intra country correlation in percentage	2.3%	2.03%	1.23%
Intensity of market constraints			
Intercept	0.007	0.054*	0.07**
Random part			
Variance of the country level residual errors	0.007***	0.012***	0.009***
Variance of the individual level residual errors	0.145***	0.141***	0.141***
Intra country correlation in percentage	4.7%	7.7%	6,16%
Degree in complexity in work			
Intercept	-0.001	-0.049*	0,012
Random part			
Variance of the country level residual errors	0.015***	0.017***	0.017***
Variance of the individual level residual errors	0.206***	0.217***	0.22***
Intra country correlation in percentage	7%	7.1%	7.1%

Source: European working conditions survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

First, we observe a significant country effect for all four quality of work indicators, but the variance among individuals is considerably higher. This is not surprising considering the difference in sample size between the individual level (n=52,248) and the country level (n=45; 15 countries sampled during 3 years). The highest intra-country correlations are observed for intensity of market constraints (7.7% in 2000) and work complexity (7.1% in 2005). There is a clear country effect for these two indicators. The intra-country correlation is lowest for quality of working conditions (2.5% in 2005) and intensity of technical constraints (1.2% in 2005). Furthermore, we note that between 1995 and 2005, the intra-country correlations of the intensity of market constraint increased, especially between 1995 and 2000[9]. European countries became more heterogeneous or diverged in terms of intensity of market constraints during the study period. The intra-country correlation of the degree of work complexity remained stable but relatively high (7% for all three analyzed years). Comparatively, the intra-country correlation for the intensity of technical constraints and the quality of working conditions declined, moving from 2.3% in 1995 to 1.2% in 2005 for intensity of technical constraints and from 3.6% in 1995 to 2.5% in 2005 for quality of working conditions.

2.1 Taking into account structural factors in a multilevel model

Four different models are estimated, with gradual increases in complexity (Box). The first model is the benchmark intercept-only model. As the regressions are run on the pooled data from the three survey waves, results differ from the ones displayed in Table 8.

Model 2 includes year 2000 and 2005 dummies. As 1995 is the reference date, the coefficient associated with the year 2000 gives the 1995-2000 trend, while the one associated with 2005 gives the 1995-2005 trend. A central objective in the model is to identify the sensitivity of these coefficients to the inclusion of individual-level and country-level variables. Thus, Model 3 includes year dummies and individual-level variables, and Model 4 includes year dummies, individual-level variables and country-level variables.

At the individual level, the need for variables that are consistently measured over the three waves of the EWCS imposes strong constraints on the information. Hence, we are able to measure demographic information (gender and age), occupation (nine categories), and employment status (fixed term or open-ended contract, self-employment or salaried work). As the EWCS is an employee-level survey only, it carries little information on employer characteristics. Sector of the workplace is the only information on the employer that is available over all three waves of the survey. Finally, two features of the employee's job description are measured: use of a computer and supervisory role. Indeed, all of these characteristics may influence quality of work. We would have liked to explicitly take into account educational attainment and work experience as proxies for skills, in reference to human capital theory, but this information is not available over all three waves of the survey[10]. However, a broader conception of skills in which they develop through work experience, learning by doing and on-the-job training is now widely accepted. This broader

[9] The intra-country correlations between any two years should be compared with caution as the samples are different. To check if our results are robust, we calculated the intra-country correlation in 2000 using the random sample with the same number of observations as in 1995. The values of intra-country correlations change slightly in 2000, but the conclusions remain the same.

[10] Only work experience within the company or organization is available for all three waves, but there are many missing values. General work experience is available only for 2005. Educational attainment is not available in 2000.

conception highlights the relevance of the occupational dimension in the measurement of human capital. Furthermore, age, management position and computer use complement occupation in the indirect assessment of skills. In model 3, the meaning of the intercept changes when individual variables are introduced. In model 2, the intercept gives the average EU-15 level of each synthetic indicator in 1995. In model 3, it becomes the average EU-15 level of each synthetic indicator for a reference individual with the following characteristics: he is a young (between 15 and 24 years old) plant and machine operator working in the manufacturing sector on an unlimited contract, using no computer and with no supervisory role. In 1995, this reference employee experiences low-quality working conditions, high intensity of technical constraints, low intensity of market constraints and low degree of work complexity (cf. Tables A1 – A4 in the Appendix).

Four models

Model 1. Intercept-only model

$$Y_{ij} = \beta_{0j} + r_{ij} \quad \text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad \text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + u_{0j} + r_{ij} \quad \text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Model 2. Inclusion of time dummies

$$Y_{ij} = \beta_{0j} + T_1 Year2000 + T_2 Year2005 + r_{ij} \quad \text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad \text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + T_1 Year2000 + T_2 Year2005 + u_{0j} + r_{ij} \quad \text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Model 3. Inclusion of time dummies and individual-level variables

$$Y_{ij} = \beta_{0j} + T_1 Year2000 + T_2 Year2005 + \beta_{ij} Ind_{ij} + r_{ij} \quad \text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad \text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + T_1 Year2000 + T_2 Year2005 + \beta_{ij} Ind_{ij} + u_{0j} + r_{ij}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Model 4. Full model with time dummies and individual- and country-level variables

$$Y_{ij} = \beta_{0j} + T_1 Year2000 + T_2 Year2005 + \beta_{ij} Ind_{ij} + r_{ij} \quad \text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + \gamma_{0j} Country_j + u_{0j} \quad \text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + \gamma_{0j} Country_j + T_1 Year2000 + T_2 Year2005 + \beta_{ij} Ind_{ij} + u_{0j} + r_{ij}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Table 9. Correlations between country level variables

	% Females in economically active population	% Part-time employment in total employment	Ln of number of patent applications to the EPO per million inhabitants	% Tertiary attainment for age group 24-64
% Females in economically active population	1			
% Part-time employment in total employment	0,24	1		
Ln of number of patent applications to the EPO per million inhabitants	**0,59****	**0,51****	1	
% Tertiary attainment for age group 24-64	**0,54****	**0,37****	**0,58****	**1**
% Services sector in civil employment	**0,37****	**0,60****	**0,72****	**0,66****
	% Trade in goods and services in GDP	**Unemployment rate**	**% Aged 50 and more in economically active population**	**Real annual GDP growth**
% Females in economically active population	-0,17	-0,21	**0,66****	-0,20
% Part-time employment in total employment	0,23	**-0,44****	-0,04	-0,11
Ln of number of patent applications to the EPO per million inhabitants	0,23	**-0,30****	0,07	-0,03
% Tertiary attainment for age group 24-64	0,16	-0,05	**0,39****	0,06
% Services sector in civil employment	**0,46****	**-0,35****	0,04	-0,05
% Trade in goods and services in GDP	1			
Unemployment rate	**-0,48****	1		
% Aged 50 and more in economically active population	**-0,37****	-0,09	1	
Real annual GDP growth	**0,42****	-0,06	-0,16	1

Note: Bold coefficients with stars are significant at 5% level.

Source: OECD and Eurostat.

Coverage: EU-15 in 1995, 2000 and 2005.

The availability of time series for the EU-15 also imposes strong constraints on what can be measured at the country level. As they provide high quality time series for the EU-15 countries, the OECD and Eurostat databases[11] are our central data sources for country-level variables. We retained ten major country-level variables that may be related to the quality of work. A first variable, which was consistently measured over time, is real annual GDP growth, which gives an indication of the position in the business cycle. International trade in

[11] We used the following publications to collect the country-level data: OECD (2002, 2003, 2004, 2005, 2006), Eurostat (2005).

goods and services as a percentage of GDP is an indicator of globalization. The development of the knowledge base of economic activity is another important country-level dimension that we want to capture. The (log) number of patent applications to the European Patent Office (EPO) is a first indicator. According to the Canberra Manual (OECD and Eurostat, 1995), persons who graduated from the tertiary level of education comprise the available human resources in science and technology. Education levels are not available at the individual level in the EWCS, but they are available at the country level. The share of persons between 25 and 64 years old with tertiary educational attainment is the retained indicator of education. Quality of work could also be influenced by industrial structure, as reflected by the shares of particular industries (ISIC 10-45) and services (ISIC 50-99) in civilian employment. In an aging Europe, where the labor force is also becoming more open to women, gender and age perspectives are needed and are taken into account through the gender and age compositions of the workforce. Finally, two variables characterize the state of the labor market: the unemployment rate and the part-time employment rate in total employment. In model 4, country-level variables are centered on the European average. Thus, the interpretation of the intercept does not vary much when country-level variables enter the model: the intercept gives the average level of each indicator for our reference employee in an "average" EU-15 country, which is a country where macroeconomic variables take the EU-15 average.

We rely on limited country-level information: 45 observations in total over the three waves of the EWCS. Moreover, some of the country-level variables that we consider are strongly correlated with one another, as shown in Table 9. This is in particular the case with the variables displayed in the upper part of Table 9: Percentage of females in the economically active population, percent part-time employment, log number of patent applications, percent tertiary educational attainment and percent employed in services sector. These five variables are strongly positively correlated with one another. It is thus not efficient to enter the nine country-level variables at the same time in model 4. We select the combination of country-level variables that minimizes the intra-country correlation in model 4 when we compare it to model 3. We have chosen two different models (model 4 and model 4') for work complexity.

2.2 The results

2.2.1 Multi-level models

Results of the models for the four quality of work indicators are reported synthetically in Table 10, and complete estimations are given in Appendix 1. Table 10 depicts the complete model with the random country effect, year dummies, individual variables and country-level variables (model 4). When more than one model 4 has been estimated, the results for country-level variables in Table 10 pool coefficients from the various regressions.

The first aim of these regressions is to reveal whether quality of work has evolved over time, holding individual-level and country-level variables constant. These results appear in the trend analysis part of Table 10. They confirm the following average trends in the EU-15 over 1995-2005 that we observed in our descriptive statistics (Table 7): a decrease in the quality of working conditions, an increase in the intensity of technical and market constraints and a decrease in the degree of work complexity. The same trends are also observed during the first sub-period (1995-2000) for the four synthetic indicators (Tables 2, 4 and 6). For the second sub-period (2000-2005), the descriptive trends are confirmed for all indicators except the degree of work complexity. Indeed, the comparison of the absolute levels of coefficients of year dummies in the multilevel model (Table 10, first line, last column, or Table A4 in

Appendix 1) suggests that there was a decrease in the degree of work complexity between 2000 and 2005, while the descriptive results show an increase of work complexity during this period (Table 6). Hence, the puzzle of the decrease in work complexity remains when structural factors are controlled for.

By comparing the variance of the individual-level residual errors in models 2 and 3, we are able to identify how much individual variance is explained by the eight individual variables introduced in model 3. Quality of working conditions and degree of work complexity are the best explained synthetic indicators: individual variables explain, respectively, 30% and 25% of total individual variance. Work intensity indicators are more difficult to explain using individual variables. The shares of explained individual variance amount, respectively, to 16% and 11%.

The estimated coefficients at the individual level show that sectors and occupations are marked by strong specificities in terms of quality of work: Construction is characterized by low-quality working conditions and a high degree of work complexity; manufacturing has a high intensity of technical constraints and low intensities both in market constraints and in work complexity; services are characterized by a high intensity of market constraints; and the public sector has high-quality working conditions and a low intensity of technical constraints. The quality of working conditions is the highest for clerks and the lowest for craftspeople and related trade workers. The highest intensity of market constraints is observed for service providers and sales workers, and the highest intensity of technical constraint is observed for plant and machine operators. Lastly, the degree of work complexity is the highest for professionals and the lowest for elementary occupations and plant and machine operators.

Women experience higher-quality working conditions and increased intensity of market constraints compared to men, who experience higher technical constraints and degree of work complexity. Age increases the quality of working conditions and decreases technical and market constraints as well as work complexity after the threshold age of 44. However, the work complexity is the lowest for the youngest workers (between ages 15 and 24), who also experience the highest technical constraints. Compared with employees, self–employed individuals enjoy a higher quality of working conditions, a higher degree of work complexity and lower intensity of technical constraints, but they also face higher market pressures. An employee with a fixed-term contract experiences a higher intensity of technical constraints and a lower intensity of market constraints and degree of work complexity than an employee with an open-ended contract, but there are no significant differences in the quality of working conditions. Finally, the use of a computer has an impact on the quality of work that is similar to that of a supervisory role: a higher intensity of work from both technical and market sources and a higher degree of work complexity. Surprisingly, individuals having a supervisory role experienced lower-quality working conditions.

Country-level variables explain a variable share of country-level variance. At the country level, work intensities are the best explained indicators (unlike what is observed at the individual level): the log number of patents explains 33% of the country-level intensity of market constraints, and the share of manufacturing in employment explains 23% of the intensity of technical constraints. Innovative activity at the country level is a clear and powerful driver of the intensity of market constraints. As it is easier to patent a new product than new processes, we speculate that market constraints at the country level are driven by product innovation.

Table 10. Quality of work in EU15 between 1995 and 2005: a summary of multi-level models

	Quality of working conditions	Intensity of technical constraints	Intensity of market constraints	Degree of work complexity
Trend analysis				
1995-2000:	-0,049	0,029	0,019	-0,051
1995-2005:	-0,047	0,080	0,018	-0,062
Individual level (n=52248)				
Female	+	-	+	-
Age				
Min	25-34	55+	55+	15-24
Max	55+	15-24	25-34	35-44
Self employed	+	-	+	+
Fixed term contract		+	-	-
Computer use	+	+	+	+
Supervisory role	-	+	+	+
Sector				
Min	Construction	Public	Agriculture and manufacturing	Manufacturing
Max	Public	Manufacturing	Services	Construction
Occupation				
Min	Craft and related trades workers	Professionals	Elementary occupations	Plant and machine operators and Elementary occupations
Max	Clerks	Plant and machine operators	Services and sales workers	Professionals
Country level (n=45)				
Ln of number of patents			+	**[+]**
% tertiary attainment				+
% trade in GDP				**[+]**
% manufacturing		-		
% ages 50 and more				-
Unemployment rate	-			+
% part time				**[-]**
% female	-			**[+]**
% intracountry correlation				
Model 1	2,54%	1,18%	5,86%	6,55%
Model 2	2,53%	1,19%	5,92%	6,55%
Model 3	2,70%	1,95%	6,12%	6,52%
Model 4	2,10%	1,50%	4,16%	6,37%
Model 4'				5,94%
% individual variance explained by individual level variables				
Model 3 vs. model 2	30%	16%	11%	25%
% country variance explained by country level variables				
Model 4 vs. model 3	4%	23%	33%	10%

Note: This table summarises results from tables A1 to table A4 in appendix 1. Indicated results correspond to coefficients which are significant at least at a 10% level. When effects are in between brackets, they come from model 4' (only for the degree of work complexity), other results being linked to model 4.

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005. Country level variables are from OECD and Eurostat data bases.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

For the intensity of technical constraints, country-level results are less intuitive because the relationship with the share of the manufacturing sector in civil employment is negative. We need to keep in mind, however, that at the individual level, the highest intensity of technical constraints is observed in manufacturing. Thus, what our model 4 tells us is that in countries with a larger manufacturing sector in terms of employment, employees experience relatively less intense technical constraints than do employees in countries where the manufacturing sector occupies a smaller share of the workforce. One explanation could be that larger manufacturing sectors are specialized in traditional industries with lower capital intensity and less work standardization. Mediterranean countries like Portugal, Italy and Spain are in this situation.

Only 4% of the country-level variance in the quality of working conditions is explained by the country-level variables selected in model 4. The unemployment rate and the share of females in the economically active population are negatively correlated with the quality of working conditions. The relationship between the quality of working conditions and the unemployment rate is quite straightforward, but it is difficult to explain why higher female participation is negatively correlated with the quality of working conditions when the relationship at the individual level is, as we have already stressed, positive. Could this finding be a consequence of the correlation between low participation in the workforce by women and a labor-intensive manufacturing sector?

As far as the degree of work complexity is concerned, the inclusion of country-level variables in model 4 explains about 10% of the country-level variance remaining when individual factors are taken into account. When we look at the trend analysis in Table A4, we see that, overall, the multilevel analysis deepens the complexity paradox: Between model 3 and model 4 or 4', the absolute value of year dummies increases (Table A4 in Annex). Taking into account country-level variables, we find a stronger negative residual trend in work complexity over 1995-2005. As expected, in models 4 and 4', variables that are positively linked to the development of the knowledge base of the economy are positively correlated with the degree of work complexity: tertiary attainments in model 4 and log number of patents in model 4'. In both models, the percentage of international trade in GDP is positively linked to the degree of work complexity, but is only significant in model 4'. Countries that are more opened to international trade seem to specialize in activities that entail more complex work. An aging economically active population implies a lower degree of work complexity, whereas conversely, female participation in the labor market is positively linked with work complexity. Countries with higher unemployment rates have a higher degree of work complexity. This could reflect the fact that less complex jobs are the first to be cut in economic downturns, when unemployment rates become higher. Conversely, when economic activity expands again, the degree of work complexity should fall because less complex jobs are being created; the negative (but nonsignificant) relationship with economic growth could echo such a mechanism. Lastly, countries where work complexity is high have a smaller share of part-time workers in total employment.

2.2.2 Discussion

We have already noted that low-quality working conditions associated with high levels of work intensity and a low degree of work complexity may increase the incidence of work-related health problems. What have we learned from Table 10 about the distribution of such risks across European workers and countries? In terms of occupations, plant and machine operators, craftspeople and related trade workers and unskilled laborers are the most exposed

to low-quality working conditions. The population of young workers also appears to be more exposed to poor working conditions, although the risks tend to be shared between the youngest workers, aged between 15 and 24 years, who experience intense technical constraints, a low degree of work complexity and a rather low quality of work, and the workers aged between 24 and 34 years, who experience low-quality working conditions and high work intensity from market sources. Furthermore, computer use must be closely monitored for its positive impact on both sources of work intensity. We know that computer use is a rather poor indicator of ICT diffusion. It is important to be able to distinguish between varying uses of computers and to identify whether some uses combine high intensity with high standardization, leading to low work complexity. Finally, a gender perspective also proves necessary. At the individual level, women face higher intensity of market constraints and experience lower degrees of work complexity; at the country level, female participation is positively correlated with lower quality of working conditions. As a result, in countries with high female participation, women are more exposed to low-quality working conditions.

The complexity paradox is another result that demands further discussion. Strong structural forces drive an increase in work complexity. At the individual level, occupations with higher educational attainment, age as a proxy of accumulated work experience and computer use are associated with higher levels of work complexity. At the country level, globalization, increasing female participation in the workforce and the development of the knowledge base of the economy tend to favor increased work complexity. Thus, taking into account the evolution of these structural factors, we expected to capture an increase in work complexity instead of the slight decrease we observe in simple descriptive statistics. Looking closely at model 4's results, some possible drivers of a decrease in work complexity can be identified that are connected with gender, part-time work, fixed-term contracts, supervisory roles and aging. A strand of literature on gender and work discusses the ways in which patterns of segregation have recently been reinforced or challenged. Some positive assumptions about changes in work organization to accommodate female employees are made, such as the idea that new career profiles offer more opportunities for women to follow a successful professional trajectory. Traditional forms of organization, particularly bureaucracy, where learning opportunities are weaker, have strictly defined gender roles, while new forms of organization should favor more porous gender roles. However, the empirical research often contradicts this assumption (Greenan and Walkowiak, 2005; Liff and Ward, 2001). Results in Tables 10 and A4 show that, all things being equal, women perform more routine jobs than men. One reason for this finding could be that more stereotypically female jobs have moved to the market sector, where they are often organized in a traditional way with a low level of employee discretion. However, this negative result is mitigated by our positive country-level result on female participation. Countries with greater percentages of part-time employment are characterized by lower degrees of work complexity. This indicator could reflect the degree of flexibility of the labor market and the quality of jobs, but it is also positively correlated with the percentage of females in the economically active population. Like part-time work at the macro level, fixed-term contracts at the micro level are associated with lower levels of work complexity. A precarious employment relationship does not favor work complexity, but routine jobs with fewer opportunities for learning and competence development. Using employee-level data from an Italian nationwide skills survey, Leoni and Gaj (2008) find negative impacts of gender, temporary contracts and part-time contracts on employee-level indicators of competences measured through a job requirement approach, in particular problem-solving skills. They show that these negative impacts reflect three problems: a lack of experience accumulation at the workplace for the temporary contract

effect, a lack of further training for the part-time effect and a lack of access to jobs with innovative organizational characteristics for the gender effect. It is also worth noting that the share of employees with people under their supervision tends to decrease with time in many EU-15 countries. As the work of supervisors and managers is more complex, this decrease could contribute to lower work complexity. Finally, models 3 to 4' in Table A4 show an inverted U-shaped profile for work complexity according to age. The younger workers are employed in the more routine jobs. Then, work complexity increases between ages 24 and 44 and decreases slightly afterwards, remaining at a higher level after 55 than the level for younger workers. This effect finds a country-level counterpart in the negative effect of the share of individuals aged 50 and over in the economically active population. However, as the regression results show, these factors taken together do not exhaust the decrease in work complexity; other forces are at play, which are not captured in our measurement frame.

CONCLUSION

This paper had three main objectives: to provide a general mapping of quality of work across European countries, to analyze trends over 1995-2005 and to test whether results obtained through descriptive statistics hold when controlling for individual-level and country-level structural factors. This general assessment of quality of work is based on three waves of the European Working Conditions Survey (1995, 2000 and 2005).

Two main contributions are made in this paper in terms of methodology. First, quality of work is not measured through a unique indicator but by a set of four synthetic indicators measuring the quality of working conditions, the intensity of technical constraints, the intensity of market constraints and the degree of work complexity. To build these indicators, primary variables from the EWCS were divided up into three sets describing different important dimensions of work: the quality of the work environment, how work is sequenced in time and how it is divided and coordinated. Using MCA, the quality of working conditions synthetic indicator is drawn from the first set of variables, the work intensity indicators from the second set and the work complexity indicator from the third set. The method proposed by Greenan and Mairesse (2006) is then applied to build up synthetic indicators in a way that makes them comparable across all three waves of the survey. We find that the spread of synthetic indicators across individuals and countries and their evolution through time are such that negative and positive aspects of the quality of work tend to balance out each other. This result confirms the usefulness of working with a set of indicators rather than with a single unique indicator. In order to monitor risks at work, it is important to follow up different sources of risks separately to be able to identify both work contexts where one risk becomes more prevalent and work situations where risk factors tend to be cumulative. Second, we use multilevel modeling to analyze observed trends in quality of work. Multilevel analysis has two interesting properties: it allows taking into account composition effects behind the observed trends, and it provides tools to quantify and explain the "country effect" embedded into the individual-level data.

We find evidence of a decreasing trend in the quality of work in the EU-15 over 1995-2005. Over that period, quality of working conditions deteriorated, while at the same time technical and market constraints became more intense and work complexity decreased. We know that work contexts that are very demanding, with high work intensity and low decision latitude, generate stress. Thus, we may infer from the work intensity and complexity trends that mental strain has been on the rise in Europe, while physical working conditions failed to

improve. Green and McIntosh (2001) and Green (2006) analyzed an intensification of the rhythm of work in Europe between 1991 and 1995 as indicated by longer hours spent at work and greater work effort during a given period of time. In this paper, we build on these results by distinguishing two sources of work intensity. The first measures the accumulation of technical constraints (linked to machines and to the production process), and the second measures market constraints (linked to customers' demands).

Our statistical analysis leaves the complexity paradox unresolved. The decrease in work complexity appears to be strongest in the United Kingdom, Germany, Spain and Italy. In the United Kingdom and Germany, increasing polarization of work has also been observed (Goos and Manning, 2007; Spitz-Oener, 2006). The two phenomena could well be connected and indirectly linked to technological progress. As argued by Greenan *et al.* (2009), computer and Internet use are positively correlated with work complexity. However, ICTs also contribute to the global restructuring of the value chain. In this process, outsourced or offshored tasks and work processes are standardized. If these tasks were previously performed by individuals in occupations requiring intermediate skills, global value chain restructuring could play a central role both in work polarization and in decreasing work complexity. This puzzling result requires further investigation.

Varying shares of individual-level variance and country-level variance were explained through multilevel analysis. Our eight individual-level variables more effectively explain the quality of working conditions and the degree of work complexity than work intensity indicators do. Further analysis would require more detailed information. First, employer-level variables were unavailable. It would be very useful to know more about the structure and management practices of the employer unit to assess its impact on the quality of work. Second, to separate "people effects" from "sorting effects" (the fact that employees with certain personal characteristics are selected for or self-select into specific jobs), panel information is required. Multilevel analysis identifies and measures country effects in our four indicators. Unlike at the individual level, work intensity indicators are better explained at the country level than quality of working conditions or degree of work complexity. Indicators of the development of the knowledge base of the economy, demographic trends and the state of the labor market are significantly correlated with our quality of work indicators at the country level. Quality of work is not only a matter of people and jobs. It is also sensitive to the country environment and to the framing effect of institutional settings. It would be interesting to develop indicators of work policies at the country or regional level to assess their influence on quality of work. However, the present research is constrained by the availability of data as well as by the number of countries and available waves of the survey.

Finally, we identified increased risks due to the trends in the quality of work in Germany and Italy (decreasing quality of working conditions and work complexity, increasing intensity of technical and market constraints). Compared to other EU-15 countries, Greece and Portugal are the countries where risks are the highest, combining low-quality working conditions, high work intensity and low work complexity.

REFERENCES

AMABLE B., 2003, *The diversity of modern capitalism*, Oxford, Oxford University Press.

AMOSSE T., GOLLAC M., 2008, "Intensité du travail et trajectoire professionnelle: le travail intense est-il soutenable ? ", *Travail et Emploi,* n° 113, pp. 59-73.

ASKENAZY P., CAROLI E., MARCUS V., 2002, "Organizational innovations and working conditions: An empirical approach", *Recherches Economiques de Louvain*. vol. 68. No 1-2. pp. 91-110.

BLACK S. E., LYNCH L. M., KRIVELYOVA A., 2004, "How Workers Fare When Employers Innovate*", Industrial Relations: A Journal of Economy and Society*, Vol. 43, N°. 1, pp. 44-66.

BRYNIN M., 2008, *The transformation of work? A quantitative evaluation of change in work in Great Britain*, Report for Deliverable 15.2.4.

CLARK A., 2009, "Work, Jobs and Well-Being across the Millenium", *IZA discussion paper*, No 3940.

COHEN W.M., LEVINTHAL D.A., 1990, "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*. Vol. 35. pp. 128-52.

DAVOINE L., ERHEL C., 2007, "La qualité de l'emploi en Europe : une approche comparative et dynamique", *Document de travail du CEE*, n° 86.

DE SITTER L. U., DEN HERTOG J. F. ANDDANKBAAR B., 1997, "From Complex Organizations with Simple Jobs to Simple Organizations with Complex Jobs", *Human Relations*, Vol. 50, No 5, pp. 497-534.

ESPING-ANDERSEN G., 1990, *The Three Worlds of Welfare Capitalism*, Princeton University Press.

EUROPEAN COMMISSION, 2008, *Employment in Europe 2008*.

EUROPEAN FOUNDATION FOR THE IMPROVEMENT OF LIVING AND WORKING CONDITIONS, 2008, *More and better Jobs, Patterns of employment expansion in Europe*.

EUROSTAT, 2005, *Statistics in Focus*. Bruxelles, Eurostat.

FREEMAN R. B., KLEINER M. M, 2000, "Who Benefits Most from Employee Involvement: Firms or Workers?", *American Economic Review*, Vol. 90 N°2, Papers and Proceedings of the One Hundred Twelfth Annual Meeting of the American Economic Association, May, pp. 219-223.

GODARD J., 2001, "High Performance and the Transformation of Work? The Implications of Alternative Work Practices for the Experience and Outcome of Work", *Industrial and Labor Relations Review*, Vol. 54 No 4, pp. 776-805.

GOLLAC M., VOLKOFF S., 1996, "Citius. Altius. Fortius. L'intensification du travail", *Actes de la recherche en sciences sociales,* vol. 1, n° 114.

GOOS M., MANNING A., 2007, "Lousy and Lovely Jobs: The Rising Polarisation of Work in Britain", *The Review of Economics and Statistics*, Vol. 89, No 1, pp. 118-133.

GREEN F., 2004, "Why has work effort become more intense?", *Industrial Relations*, Vol. 43. No 4. pp. 709-741.

GREEN F., 2006, *Demanding work. The paradox of job quality in the affluent economy*, Princeton University Press.

GREEN F., MCINTOSH S., 2001, "The Intensification of Work in Europe", *Labour Economics,* No 8, pp. 291-308.

GREENACRE M., BLASIUS J. (Eds), 2006, *Multiple Correspondence Analysis and Related Methods*, Chapman and Hall/CRC.

GREENAN N., GUELLEC D., 1998, "Firm Organization. Technology and Performance: an empirical Study", *Economics of Innovation and New Technology*, Vol. 6., pp 313-347.

GREENAN N., WALKOWIAK E., 2005, "Informatique. organisation du travail et interactions sociales", *Économie et Statistique*, n° 387. p. 35-64.

GREENAN N., MAIRESS, J., 2006, "Les changements organisationnels, l'informatisation des entreprises et le travail des salariés. Un exercice de mesure à partir de données couplées entreprises/salariés", *Revue Economique*, vol. 57, n° 6, novembre, pp. 1137-1175.

GREENAN N. KALUGINA E., WALKOWIAK E., 2007, "The transformation of work? Trends in work organisation", Deliverable 9.2.2, WORKS project (CIT3-CT-2005-006193).

GREENAN, N., WALKOWIAK E., KOCOGLU, Y., CSIZMADIA P., MAKÓ C., 2009, *The Role of Technology in Value Chain Restructuring*, Leuven, Katholieke Universiteit Leuven, Higher Institute of Labour Studies.

KALMI P., KAUHANEN A., 2008, "Workplace Innovation and Employee Outcomes: Evidence from Finland", *Industrial Relations*, Vol. 47, No 3, pp. 430-459.

KARASEK R.,THEORELL T., 1990, *Healthy work: stress. productivity and the reconstruction of working life*, Basic Books, New York.

KIESELBACH T. (coord.), 2008, *Health in Restructuring. Innovative Approaches and Policy Recommandations*, Report for DG Employment, Social Affairs and Equal Opportunities, Contract N°VS/2007/0515 European Commission.

LEONI R., GAJ A., 2008, "Informal Learning and development of Key Competencies in Workplaces. The Importance of Organisational Design", *Mimeo* University of Bergamo, January.

LIFF S., WARD K., 2001, "Distorted views through the glass ceiling: the construction of women's understandings of promotion and senior management positions", *Gender, Work and Organisation*, *Trends in Quality of Work in EU-15: Evidence from the European Working Conditions Survey (1995-2005)*ol. 8, N°1, pp. 19-36.

LORENZ E., VALEYRE A., 2005, "Organisational innovation. HRM and labour market structure: a comparison of the EU-15", *The Journal of Industrial Relations,*. Vol. 47, p. 424-442.

LORENZ E. LUNDVALL B.-Å. (eds), 2006, *How Europe's Economies Learn.Coordinating Competing Models*, Oxford University Press.

MERLLIÉ D., PAOLI P., 2001, *Third European survey on working conditions, 2000*, Office for the Official Publications of the European Communities, Luxembourg.

OECD, 2002, *Education at a Glance*, Paris, Organisation for Economic Co-operation and Development.

OECD, 2003, *ICT and economic growth: evidence from OECD countries. industries and firms,* OECD, Paris.

OECD, 2004, *OECD Employment Outlook 2004. Chapter 2: Employment protection regulation and labour market performance,* OECD, Paris.

OECD, 2005, *Factbook,* OECD, Paris.

OECD, 2006, *Potential impacts of international sourcing on different occupations,* OECD, Paris. DSTI/ICCP/IE(2006)1/FINAL.

OECD, EUROTAT, 1995, *Manual on the measurement of human resources devoted to Science and Technology: Canberra Manual*, OECD, Paris.

PARENT-THIRION A., MACIAS E.F., HURLEY J., VERMEYLEN G., 2007, *Fourth European Working Conditions Survey*, Office for the Official Publications of the European Communities. Luxembourg.

PEÑA-CASAS R., POCHET P., 2008, *Feefteen years of working conditions in Europe: convergence and divergence over time and within Europe,* European Foundation for the Improvement of Working and Living Conditions, Office for Official Publications of the European communities, Luxembourg.

PEÑA-CASAS R., POCHET P., 2009, *Convergence and divergence of working conditions in Europe: 1990-2005*, Report for Eurofound.

RAMSAY, H., SCHOLARIOS, D., HARLEY B., 2000, "Employees and High Performance Work Systems: Testing inside the Black Box", *British Journal of Industrial Relations*, Vol. 38, No 1. pp. 124-131.

SPITZ-OENER A., 2006, "Technical Change, Job Tasks, and Rising Educational Demands: Looking Outside the Wage Structure", *Journal of Labor Economics*, Vol. 24, No 2, pp. 235-270.

WINTER S., ZOLLO M., 2002, "Deliberate learning and the evolution of dynamic capabilities", *Organization Science.* Vol. 13. No 3. pp. 339-351.

Appendix: Multilevel regressions

Table A1. Quality of working conditions: multilevel analysis

	Model 1	Model 2	Model 3	Model 4
Intercept	-0,026	-0,007	-0,446***	-0,453***
Trend analysis				
Year 1995	*Reference*			
Year 2000		-0,027***	-0,045***	-0,049***
Year 2005		-0,028***	-0,080***	-0,047***
Individual level (n=52248)				
Individual is female			0,093***	0,093***
Individual's age is between 15 and 24	*Reference*			
Individual's age is between 25 and 34			-0,017**	-0,017**
Individual's age is between 35 and 44			0,003	0,002
Individual's age is between 45 and 54			0,018**	0,018**
Individual's age is between 55 and +			0,086***	0,086***
Individual is self-employed			0,035***	0,035***
Individual is on a fixed term contract			-0,002	-0,003
Individual' main job involves working with computers			0,098***	0,099***
Individual has people under his/her supervision			-0,045***	-0,045***
Agriculture			-0,073***	-0,076***
Manufacturing	*Reference*			
Services			0,138***	0,138***
Construction			-0,137***	-0,139***
Public sector			0,147***	0,147***
Legislators (and senior officials) and managers			0,464***	0,463***
Professionals			0,480***	0,480***
Technicians (and associate professionals)			0,420***	0,420***
Clerks			0,528***	0,528***
Service workers and (shop and market) sales workers			0,358***	0,358***
(Skilled) agricultural and fishery workers			-0,025	-0,021
Craft and related trades workers			-0,097***	-0,097***
Plant and machine operators	*Reference*			
Elementary occupations			0,168***	0,169***
Country level (n=45)				
Real annual GDP growth				0,007
Unemployment rate				-0,008***
% Females in economically active population				-0,019***
Random components				
Variance of the country level residual errors	0,008***	0,008***	0,006***	0,006**
Variance of the individual level residual errors	0,323***	0,323***	0,224***	0,224***
Intra country correlation in percentage	**2,54%**	**2,53%**	**2,7%**	**2,10%**

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005, country level variables are from OECD and Eurostat data bases.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

Table A2. Intensity of technical constraints: multilevel analysis

	Model 1	**Model 2**	**Model 3**	**Model 4**
Intercept	0,034**	0,003	0,447***	0,457***
Trend analysis				
Year 1995	*Reference*			
Year 2000		0,024***	0,037***	0,029***
Year 2005		0,076***	0,101***	0,080***
Individual level (n=52248)				
Individual is female			-0,044***	-0,044***
Individual's age is between 15 and 24	*Reference*			
Individual's age is between 25 and 34			-0,037***	-0,037***
Individual's age is between 35 and 44			-0,082***	-0,082***
Individual's age is between 45 and 54			-0,116***	-0,116***
Individual's age is between 55 and +			-0,188***	-0,188***
Individual is self-employed			-0,189***	-0,189***
Individual is on a fixed term contract			0,014*	0,013*
Individual' main job involves working with computers			0,078***	0,078***
Individual has people under his/her supervision			0,123***	0,123***
Agriculture			-0,029	-0,027
Manufacturing	*Reference*			
Services			-0,231***	-0,230***
Construction			-0,070***	-0,069***
Public sector			-0,301***	-0,301***
Legislators (and senior officials) and managers			-0,286***	-0,286***
Professionals			-0,370***	-0,370***
Technicians (and associate professionals)			-0,293***	-0,294***
Clerks			-0,242***	-0,242***
Service workers and (shop and market) sales workers			-0,299***	-0,299***
(Skilled) agricultural and fishery workers			-0,161***	-0,164***
Craft and related trades workers			-0,073***	-0,073***
Plant and machine operators	*Reference*			
Elementary occupations			-0,184***	-0,184***
Country level (n=45)				
Unemployment rate				
% Services sector in civil employment				-0,003
% Manufacturing sector in civil employment				-0,010***
% Females in economically active population				
Random components				
Variance of the country level residual errors	0,003***	0,003***	0,004***	0,003***
Variance of the individual level residual errors	0,264***	0,263***	0,2198***	0,2197***
Intra country correlation in percentage	**1,18%**	**1,19%**	**1,95%**	**1,5%**

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005, country level variables are from OECD and Eurostat data bases.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

Table A3. Intensity of market constraints: multilevel analysis

	Model 1	**Model 2**	**Model 3**	**Model 4**
Intercept	0,042	0,010	-0,243***	-0,225***
Trend analysis				
Year 1995	*Reference*			
Year 2000		0,043***	0,044***	0,019***
Year 2005		0,051***	0,046***	0,018**
Individual level (n=52248)				
Individual is female			0,015***	0,014***
Individual's age is between 15 and 24	*Reference*			
Individual's age is between 25 and 34			0,017***	0,017***
Individual's age is between 35 and 44			0,004	0,004
Individual's age is between 45 and 54			-0,001	-0,001
Individual's age is between 55 and +			-0,036***	-0,036***
Individual is self-employed			0,168***	0,168***
Individual is on a fixed term contract			-0,034***	-0,034***
Individual' main job involves working with computers			0,071***	0,070***
Individual has people under his/her supervision			0,056***	0,056***
Agriculture			0,006	0,006
Manufacturing	*Reference*			
Services			0,152***	0,152***
Construction			0,124***	0,123***
Public sector			0,076***	0,076***
Legislators (and senior officials) and managers			0,106***	0,107***
Professionals			0,097***	0,098***
Technicians (and associate professionals)			0,079***	0,079***
Clerks			0,061***	0,061***
Service workers and (shop and market) sales workers			0,120***	0,120***
(Skilled) agricultural and fishery workers			0,001	0,003
Craft and related trades workers			0,059***	0,059***
Plant and machine operators	*Reference*			
Elementary occupations			-0,030***	-0,030***
Country level (n=45)				
Ln of number of patent applications to the EPO per				0,045***
% Part-time employment in total employment				
% Females in economically active population				
Random components				
Variance of the country level residual errors	0,009***	0,009***	0,008***	0,006***
Variance of the individual level residual errors	0,144***	0,143***	0,127***	0,127**
Intra country correlation in percentage	**5,86%**	**5,92%**	**6,12%**	**4,16%**

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005, country level variables are from OECD and Eurostat data bases.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

Table A4. Degree of work complexity: multilevel analysis

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 4'**
Intercept	-0,017	0,016	-0,425***	-0,415***	-0,395***
Trend analysis					
Year 1995	*Reference*				
Year 2000		-0,055***	-0,048***	-0,051***	-0,089***
Year 2005		-0,038***	-0,038***	-0,062***	-0,079***
Individual level (n=52248)					
Individual is female			-0,066***	-0,066***	-0,066***
Individual's age is between 15 and 24	*Reference*				
Individual's age is between 25 and 34			0,101***	0,101***	0,100***
Individual's age is between 35 and 44			0,102***	0,102***	0,103***
Individual's age is between 45 and 54			0,082***	0,082***	0,082***
Individual's age is between 55 and +			0,058***	0,059***	0,059***
Individual is self-employed			0,171***	0,170***	0,171***
Individual is on a fixed term contract			-0,060***	-0,060***	-0,059***
Individual' main job involves working with computers			0,216***	0,216***	0,215***
Individual has people under his/her supervision			0,174***	0,174***	0,174***
Agriculture			0,027*	0,026*	0,026*
Manufacturing	*Reference*				
Services			0,018***	0,018***	0,018***
Construction			0,064***	0,064***	0,064***
Public sector			0,058***	0,058***	0,058***
Legislators (and senior officials) and managers			0,256***	0,256***	0,257***
Professionals			0,311***	0,311***	0,312***
Technicians (and associate professionals)			0,301***	0,301***	0,301***
Clerks			0,159***	0,159***	0,160***
Service workers and (shop and market) sales workers			0,143***	0,143***	0,143***
(Skilled) agricultural and fishery workers			0,206***	0,206***	0,209***
Craft and related trades workers			0,228***	0,228***	0,228***
Plant and machine operators	*Reference*				
Elementary occupations			0,003	0,003	0,002
Country level (n=45)					
Real annual GDP growth				-0,005	-0,000
% Trade in goods and services in GDP				0,001	0,002***
Ln of number of patent applications to the EPO per million inhabitants					0.046***
% Tertiary attainment for age group 24-64				0,006***	
% Aged 50 and more in economically active population				-0,004**	
Unemployment rate				0,003*	
% Part-time employment in total employment					-0,008***
% Females in economically active population					0,012**
Random components					
Variance of the country level residual errors	0,015***	0,015***	0,011***	0,011***	0,010**
Variance of the individual level residual errors	0,216***	0,216***	0,162****	0,162***	0,162***
Intra country correlation in percentage	**6,55%**	**6,55%**	**6,52%**	**6,37%**	**5,94%**

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, 1995, 2000 and 2005, country level variables are from OECD and Eurostat data bases.

Coverage: salaried and self employed individuals from EU-15 private and public sectors.

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