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The mediating role of working conditions in the analysis of the links between offshoring and health of European workers.

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Abstract

The study presents an analysis of the effect of offshoring at the sectoral level on European workers' health in terms of musculoskeletal disorders and mental health. The focus is on the period 2000-2010. Using European Working Conditions Surveys [EWCS] conducted by the Eurofound and an international database provided by the OECD, we examine the links between offshoring and workers' health through its action on working conditions using a Generalized Structural Equation Model. Our findings reveal that intermediate import competition, a recognized measure of offshoring; is indirectly and positively associated with musculoskeletal disorders and mental health problems through its effects on work intensity for the period 2000-2010.

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1. Introduction

The consequences of globalization in developed countries have mostly been investigated in terms of wage and employment levels, leading to diverse results from one decade to the next: from no effects in the 1980's to inequalities between low and high skilled workers and between activity sectors in the 1990's (Grossman, 1987; Revenga, 1992; Sachs and Shatz, 1994; Richardson, 1995). During the 2000's, Bernard et al. (2006) identify different effects of international exposure, characterized by pressure from "low-wage countries" on the manufacturing sector from 1977 to 1997. Their results show that the growth and survival of firms exposed to this pressure are jeopardized, with the effect being stronger on labor-intensive firms. This part of the literature highlights the vulnerable situation of manual workers, especially the unskilled ones. Nowadays, those commonly referred to as blue-collar workers are not the only group affected by job loss, feelings of insecurity about employment, and wage reductions due to offshoring, mergers, acquisitions or firm closures. Many workers are now concerned by the consequences of globalization in the labor market: white- and blue-collar, skilled and unskilled. And as globalization affects any workers, analyses run over representative samples of developed countries population are needed. Globalization put pressure on workers' in developed countries as it implies changes in the way the work is done, in other words it implies changes in working conditions. Competition has turned global. Work rhythms must be adapted. Mergers and acquisitions are likely to change firms' ways of doing and values. Work practices are evolving. Customer satisfaction increases work intensity for workers.

Those working conditions are inherently linked to the health status of individuals. The literature identifies many precise determinants of workers' health. Repetitive work, rotating tasks, standing position, long working hours, the need to meet quality standards, high work intensity, low complexity, dependence upon external demands, lack of autonomy… these types of working conditions affect health psychologically and physically. Askenazy's seminal article (2001) exposes the correlation between the new work practices (Total Quality Management, job rotation, autonomous work teams) introduced in the 1980/1990's in the United States and rates of occupational injuries and illnesses. Drawing on bibliographic databases, surveys of companies and microeconomic databases, he shows a strong correlation between new work practices in sectors and occupational illness and injuries rates. This strong correlation is observed both in the manufacturing sector (+20%) and in the tertiary sector (+15%). These results also illustrate the need to work on databases comprising several sectors of activity in order to show the universality and the diversity of work-related constraints and their consequences. It is interesting to note that this study based on American data prefigures the European case where new practices are disseminated within a delay. In the European case, precisely, a study based on the European Working Conditions Surveys conducted in 1995, 2000 and 2005 shows that the experience of adverse working conditions such as high work intensity and long working hours are strongly correlated with poor mental health – proxied by self-declared irritability, stress, anxiety - among European workers (Cottini and Lucifora, 2013). The causal relationship is even confirmed between working conditions and health through the use of instrumental variables. The authors also show the particularly vulnerable status of male workers, with high responsibilities in the service sector, confirming the need to rely on large and representative databases of the working population when possible.

National and international inquiries allow for the investigation of self-declared health status among large sets of individuals (Eurofound, 2017). While many studies have investigated and validated

the question of the correlation between working conditions and individual health, we are still a long way from reaching a consensus on the influence of macro-level factors. Some studies have considered the meta- and macro-level determinants of workers' health. Daniels et al. (2007) find a positive effect of national level of research and development on occupational health of Europeans. Welfare regimes influence quality of work and health outcomes such as depressive symptoms (Dragano et al., 2011). Benach et al. (2007) offer an interesting theoretical framework to explore the multilevel factors affecting health in the workplace, and macro-level factors are of major importance. Main macroeconomic indicators have been used in such studies: unemployment rates, women's participation in the labor force, gross domestic product (GDP) and employees' participation in trade unions; however, less attention has been paid to globalization effects. The consequences of globalization in terms of well-being and health have only recently become a research topic. Colantone et al. (2019) provide a very interesting study on the effects of import competition on mental distress among British workers. They identify several mechanisms through which a rise in import competition negatively affects workers' mental health: an increase in job displacement probability, lower wage growth, reduced job satisfaction, worsening expectations about the future in terms of career progression and financial prospects. Hummels et al. (2015) examine the effect of exogenous export shocks on the physical health of Danish workers and find that, when exports rise, workers increase their efforts and, therefore, rates of job injury and the number of sick days also increase. Some results of this study are specific to women: among this sub-group, higher rates of severe depression and cardiovascular diseases are recorded. Globalization not only affects wages and employment but also working conditions, the mediating effect of the latter on individual health should be tested. The successive waves of the European Working Conditions Surveys constitute a very useful basis to test those relationships on a representative sample of the population.

A 2005 Eurobarometer opinion poll (European Commission, 2005) delivered the following: 46% of respondents had a negative view of globalization. The main reason for this view was the offshoring of jobs to low-wage countries (Organization for Economic Co-operation and Development [OECD], 2007). Globalization is still a main concern for workers, the successive European opinion polls show that 36 to 42% of the Europeans have a negative view of globalization over the years (European Commission, 2017). Even if a job loss is regarded as temporary or due to workers' characteristics, people's fear of losing their job is increasingly becoming firmly embedded in their minds. Studies also demonstrate that people are indirectly affected by job loss when their siblings, friends or colleagues are out of work (Bohle et al., 2001). Repeated restructuring leaves employees demotivated, risk adverse, less involved and less healthy (Cascio et al., 1997).

Nevertheless, the consequences of globalization could also be positive. Some studies show that offshoring did not lead to major job losses in the service sector in the United States and demonstrate that, in the manufacturing sector, the impact was positive through a rise in productivity (Girma and Gorg, 2003; Amiti and Wei, 2004; Shultze, 2004). The workers, however, did not feel that way. Even if the data extracted from empirical studies do not clearly establish a negative link between offshoring, one of the facets of globalization, and the labor market, workers appear to be highly concerned about this phenomenon.

Among the multiple globalization facets, offshoring appears to frighten European workers. They are afraid of losing their jobs, they feel unsecure because they see the impacts on their siblings, coworkers, or on their activity sectors and even on their national economies through widespread information on this topic. (ERM, 2020). All these observations lead us to take an interest in

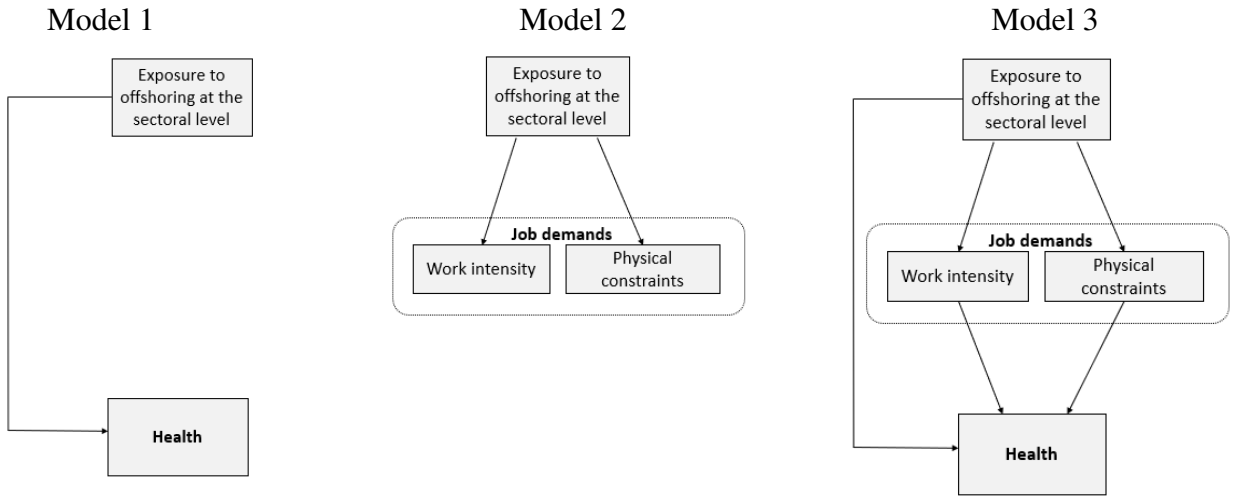
analyzing the effects of relocation abroad on the health of European workers and on their working conditions. To do so, we test the following hypotheses:

> H1: In activity sectors exposed to offshoring, we will observe a degradation of health of European workers, both mentally and physically.
> H2: In activity sectors exposed to offshoring, we will observe a deterioration of working conditions assessed as work intensity and physical constraints.

Finally, we will test hypothesis 3 in order to disentangle the part of the effect of offshoring that goes through working conditions from the one transiting by other – non-identified – factors. By doing so, we will highlight the relative importance of changes in working conditions in the relationship between globalization, understood as offshoring, and health of individuals.

> H3: Job demands will mediate the effects of exposure to offshoring at the sectoral level on health of European workers assessed as musculoskeletal disorders and mental health. A direct effect of offshoring on health will be observed as working conditions may not capture all the mediating effects.

Figure 1. The models



The use of a mediation model appears to be the appropriate tool in this perspective. This model allows for simultaneously testing the direct and indirect relationships between an independent variable (offshoring at the sectoral level) and a dependent variable (health of workers).
In this study, we contribute to the growing literature on the effects of offshoring on health of the working population in European countries, using an original database that merges microeconomics data on European workers and sectoral and national data extracted from international databases.

2 Data

2.1 Measuring offshoring

In this study, offshoring is defined in a broad sense and includes offshore in-house sourcing and outsourcing abroad. The intermediate input ratio captures this trend and is one of the most rigorous

available indicators (OECD, 2007) recognized as a measure of offshoring (Campa and Goldberg, 1997). The rise in offshoring concerns materials, as well as the services sector since the 2000's. The intermediate import ratio is extracted from the OECD STAN Database for Structural Analysis (2012) for fifteen activity sectors.[1]

This ratio is provided for three periods of time: mid-1990, early-2000 and mid-2000. These periods correspond to the years preceding the EWCS data we analyze: 2000, 2005 and 2010. The intermediate input ratio is provided as part of ISIC[2] Revision 3.1 classification, under which activity sectors are registered in the EWCS database used for individual characteristics, working conditions and health. The common classification of the two databases allows them to be matched.

2.2 Individual data

For individual characteristics and work environment variables at the individual level, we use data extracted from the European Working Conditions Surveys, made available by the UK Data Service.[3] We use data extracted from wave 3, wave 4 and wave 5 respectively conducted in 2000, 2005, 2010. In 2000, EU15 member states countries of the EU were surveyed (N=21,703), in 2005 EU27 member states plus Turkey, Croatia, Norway and Switzerland (N=29,680). In 2010 it covered 34 countries – EU27, Norway, Croatia, the former Yugoslav Republic of Macedonia, Turkey, Albania, Montenegro and Kosovo (N=43 816)

For reasons of data availability, we selected the countries of the European Union 15[4] to run our analysis. After deleting missing or incomplete observations we were left with three samples of 10,443 workers for 2000, 7,511 for 2005 and 12,697 for 2010.

The EWCSs provide cross-sectional data on individual workers' employment conditions, working conditions, working environment and individual health in the EU15. The high quality of the database is recognized among academics (Muñoz de Bustillo, 2011; Greenan et al., 2013; Cottini and Lucifora., 2013). Individual samples are representative of the European employed population aged 15 or over (according to the Labor Force Survey definition: EWCS reports 2000, 2005, 2010). Between 500 and 1,500 individuals are interviewed in each country, in each survey. Samples are weighted according to region, city size, gender, sex, age, activity sector (under ISIC[5,6] Revision 3.1) and job (International Job Standard Classification). The ISIC Revision 3 classification allows matching between the international trade database and the EWCS database.

The individual characteristics we include in the regressions are: age[7], gender, income quartile, socio-professional categories[8], employed or self-employed. The variables relating to the work environment are: the size of the firm, permanent contract or not, long working hours per week[9], private or public sector[10][11]. We include a measure of job satisfaction in the regression in order to

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[1] see Table 1.1, Appendix 1.

[2] International Standard Classification of Occupations (ISCO-88) 1-digit classification.

[3] See: http://discover.ukdataservice.ac.uk/.

[4] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom. Moreover, the Eurofound provides weights for this group of countries.

[5] See Table 1.1, Appendix 1.

[6] International Standard Industry Classification.

[7] We use the following age classes: 15-24, 25-34, 35-44, 45-54 and 55 or older.

[8] International Standard Classification of Occupations (ISCO-88) 1-digit classification.

[9] > 40 hours per week.

[10] Summary statistics available in Table 1.2, Appendix 1

[11] Table 1.2: Summary statistics of control variables (weighted)

Table 1.3. Differences in exposure to working conditions and health between groups.

capture factors that could influence workers' health, but which are not necessarily directly related to specific working conditions. This variable is used in Cottini and Lucifora (2013) to control for the general satisfaction of the worker.
The EWCS surveys provide additional information about individuals' health along the waves. Several health conditions are examined in this survey, we use musculoskeletal disorders and mental health items. Firstly, the individual is said to suffer from musculoskeletal disorders - the msd variable is then coded (1) - if he or she declares to feel muscular pain in lower and/or upper limbs and/or neck and/or shoulders. Msd relates to physical pain. We also test the validity of our hypotheses for non-psychotic mental health symptoms. In that case, if the individual declares to suffer from anxiety, sleeping problems, fatigue (Guérin and Raoult, 2013; Leclerc et al., 2010) the mental health variable is then coded (1).
Sampling plans were designed for each country (Eurofound, 2018) and post-stratification weightings have been implemented to ensure that the sample reflects the socio-demographic structure of the population (individual weights) and the size of the in-work population of each country (cross-national weights). The weights are included in the summary statistics.

2.3 Job demands

We strongly rely on the work done by Greenan et al (2013) who provide a very detailed paper on the building of synthetic indicators of working conditions.
Work intensity is measured using 7 items. The index was built as follows, we add 1 to the indicator every time an individual has to: 1) perform repetitive tasks of less than 10 minutes 2) work at very high speed; 3) reach numerical targets; 4) work under the speed of a machine; 5) meet tight deadlines 6) work under the direct control of his/her boss; 7) be dependent of the work of his/her colleagues. Physical constraints index is measured using 6 items. The index was built as follows, we add 1 to the indicator every time an individual has to: 1) carry heavy load; 2) perform repetitive movements; 3) be in painful or tiring positions; 4) is exposed to vibrations; 5) noise; 6) extreme temperatures.
The variables have been normalized.

The question of endogeneity must be addressed as the work environment may not be exogenous to health of workers. On one side, if individuals in better shape turn to arduous jobs or if employers hire workers presenting the best health status, estimates would be biased downward. On the other side, sick workers would then have fewer job opportunities and be more likely to accept adverse working conditions, estimates would be biased upward. However, studies show that the first hypothesis would tend to supplant the second, and estimates are more likely to be biased downward. Indeed, the literature puts the inverse causality between health and working conditions into perspective by showing that when biases can be handled, the effects of working conditions on health are greater. Findings of Cottini and Lucifora (2013) after the implementation of an instrumental variable strategy go in that sense. Longitudinal datasets allow for increased control of those biases through control of initial and lagged health status. Many of these studies show that endogeneity bias does not explain the demonstrated link between difficult working conditions and health. Thus, Fletcher et al. (2011) show the detrimental of cumulative harsh working conditions on the global health status of US individuals. Based on the waves of the Whitehall longitudinal study in the UK, Chandola et al. (2003) show that occupational position influences health status, whereas the inverse relationship is not true. In a study relying on panel data, Defebvre (2018) concludes on the causal effects of work strains exposure on self-declared chronic diseases of French

workers. In his article, the empirical strategy implemented allowed to eliminate the traditional biases associated with this kind of analysis. So, when potential biases are taken into account, the results do not call into question the relationship between working conditions and health. Moreover, they tend to push the estimates upward. Consequently, the coefficients found in the current analysis are likely to be underestimated.

In this study, we include numerous control variable at the individual level, as well as a dummy country variable, to control for biases. Regarding the relationship between the offshoring variable and the individual health status, any reverse causality is unlikely to occur as the health of an individual cannot cause offshoring at the sectoral level. For the relationship between working conditions and health, we will carefully use the term association and not causal effect.

3 Methodology

In this study, the direct and indirect influences of activity sectors' exposure to offshoring on health of European workers are tested for the decade 2000-2010. Mediation models allow to test direct effect of an independent variable -IV- (import penetration ratio) on a dependent variable -DV- (health measures) and the indirect effect of IV on DV through the effect on mediating variables -MV- (working conditions). The methodology proposed by Preacher et al. (2007) updated in Hayes (2013) that allows to run moderated mediation using SPSS macro, has been adapted to STATA, a software that permits to use Structural Equation Modelling for binary outcomes. The Structural Equation Models are multiple regression model in which the response variable (working conditions here) in one regression can be an explanatory variable in another equation.

We consider two ill health conditions as dependent variables in this study: musculoskeletal disorders and non-psychotic mental health problems. Using self-declared health data necessarily raises the question of subjectivity. Nevertheless, workers are asked precise questions about their potential health problems. In the literature, questions related to specific health conditions tend to be classified as 'objective' compared with questions about overall health status (Dwyer and Mitchell, 1999). The mental health indicator is built using 3 different items allowing to capture several dimensions of this concept. Moreover, a part of the literature shows that subjective measures of health are highly correlated with objective ones (Burströmm and Fredlund, 2001). Even if still controversial, self-assessed health becomes more and more used in occupational health studies (Cottini and Lucifora, 2013). Furthermore, numerous variables are included in the regressions to control for other determinants of health. We also include a country dummy variable because self-declaration of health problems can vary according to differences in perception due to cultural biases.

Our empirical strategy includes three steps. First, we test hypothesis 1 by estimating the effect of exposure to offshoring at the sectoral level on individual health status (Model 1).

$$Msd_i = \alpha_1 + \beta_1 Offshoring + \beta_2 X_i + \gamma_{1c} + \tau_{1y} + \epsilon_{1i} \quad (1)$$

$$Mental_i = \alpha_2 + \beta_{\prime 1} Offshoring + \beta_{\prime 2} X_i + \gamma_{2c} + \tau_{2y} + \epsilon_{2i} \quad (2)$$

Beside the key regressor *Offshoring*, health statuses are regressed on a set of control variables X_i previously described. The regressions also include country γ_c and year τ_y fixed-effects.

We suggest that working conditions may act as mediators in this relationship (H2): we estimate the relationship between exposure to offshoring on work intensity and physical constraints (Model 2).

$$Physical_i = \alpha_3 + \beta_3 Offshoring + \beta_4 X_i + \gamma_{3c} + \tau_{3y} + \epsilon_{3i} \quad (3)$$

$$Intensity_i = \alpha_4 + \beta_{\prime 3} Offshoring + \beta_{\prime 4} X_i + \gamma_{4c} + \tau_{4y} + \epsilon_{4i} \quad (4)$$

To test for hypothesis 3, we simultaneously estimate the relationships between offshoring, working conditions and health status.

By doing so, and even if hypothesis 2 is valid, we cannot identify working conditions as the one and only mediator in the relationship between offshoring and health of workers. Many other channels may exist, and they cannot be all tested. Among others, fear of job loss, feeling helpless in the face of difficulties encountered by colleagues, family or any other individual, changes in firms' organization due to relocation abroad… All of this may affect individual health under the form of mental and physical problems. In the third step of our analysis we will test the relative importance of changes in working conditions towards other non-identified channels (Model 3) in the relationship between offshoring and health. We implement the fully mediated model: IV->Mediators->DV.

Given that the dependent variables related to health are dichotomic, the econometric method used for step 1 is a logit regression including the variable of interest, exposure to offshoring at the sectoral level, a set of individual characteristics, a country dummy variable and a time dummy variable. We first run the analyses over the waves of 2000 and 2005 because the formulation of the question related to health symptoms has changed in 2010. We will use data of this 5th wave in a separate analysis. For step 2, we implement a linear regression to estimate the association between the offshoring indicator and the working conditions indicators which are continuous interval scale variables. To test the final model, we implement a generalized structural equation model using Stata to assess simultaneously the direct and indirect associations between offshoring and individual health.

4 Results

Preliminary results indicate that workers of the activity sectors exposed to offshoring are around 25% less likely to suffer from musculoskeletal disorders (Table B.I in appendix 2, Model 1: OR: .743* SE: -.0954) but no significant association is found for mental health during the first period (2000-2005) (Table B.I, Model 1, OR:.895 SE:-.118). The results invalidate hypothesis 1: exposure to offshoring seems to be beneficial in terms of physical health outcomes for European workers. Then, model 2 (Table 1, columns 1 to 4) partially validates hypothesis 2 as it shows the positive relationships between exposure to offshoring at the sectoral level and high job demand in terms of work intensity (OR=1.107*** SE=-.0134). Workers exposed to international competition are 10.7% more likely to experience high intensity of work. Offshoring constitutes a source of increasing pressure for workers. International competition raises work intensity as firms must increase or maintain productivity to remain competitive. As international competition jeopardizes the survival of less competitive firms, workers may fear job loss as they are now more informed about the consequences of open trade for the labor market. For this reason, they may be more likely to intensify their work rhythms to secure their individual positions in the firm.

Model 3 (Table 1, columns 5 to 8) provides results for the mediated model for the period 2000-2005. Findings show that exposure to offshoring at the sectoral is positively associated with both mental and physical health problems through the increase in work intensity. The results of the Generalized Structural Equation Model show that offshoring is associated with work intensity (OR=1.107***, SE=-.0134) which is associated with deteriorated physical and mental health. Workers exposed to work intensity are 48.2% more declaring msd and 212.7% more declaring mental health problems. This validates the indirect effect of offshoring on mental and physical health.

Interestingly, the results show that offshoring has a direct negative and significant effect on the declaration of musculoskeletal disorders with an odds ratio of 0.657*** (SE=-.0899). In other

words, exposure to international competition at the sectoral level is associated with better physical health. Several explanations can be put forward to explain this result. International competition can be a vector of good practices by increasing trade between economies, difficult working conditions can then be counterbalanced by these good practices and generate fewer msd type problems. It is also likely that offshoring has primarily affected the least skilled, low wage and often most physically problematic occupations. Those physical tasks are likely to be performed abroad the European Union, in low wage countries. That also explains why no association has been found between offshoring and physical working conditions. This result illustrates the paradoxical consequences of exposure to offshoring: its direct effect is beneficial to individual health whereas its deleterious effects on working conditions deteriorate physical and mental health of workers.

The estimations over the 2010's sample provide similar results: the indirect effect of offshoring on mental health and msd is confirmed through work intensity as a mediating variable (Table 1, columns 9 to 16). The direct effect of offshoring on msd is also observed (OR=.627***, SE=-.0844). The formulation of the question related to health problems is different in the 2010's wave. The question is now based on the health problems encountered, whether work-related or not. This change may explain the higher percentages found in the descriptive analysis. Nevertheless, we observe the same set of significant covariates that are associated with self-declared health problems showing that some elements of the work environment still explain the workers' health status (long hours, satisfaction with the job, firm size). The increase in the declaration of health problems can also be partly attributed to the economic crisis of 2008. Non work-related problems may rise following such an event as well as work-related ones as the work environment and work features may deteriorate. To test for robustness, macroeconomic features following the crisis, GDP and unemployment rates by countries have been included in the regressions but they showed no significance. In line with those results, some authors have pointed out the existence of lags in the relationship between labor market data and physical diseases (Brenner and Mooney, 1983) and others obtained mixed results with both positive and negative correlations (Navarro et al., 2006).

5 Conclusion

This study provides evidence that exposure to international competition – proxied by a measure of offshoring – has paradoxical consequences on health of European workers for 2000's decade. On the one hand, we observe that the import penetration ratio at the sectoral level, a widely recognized measure of offshoring, is associated with higher job demands and through it, with the prevalence of musculoskeletal disorders and mental health problems. On the other hand, the indicator of offshoring is associated with better health in terms of musculoskeletal disorders when the direct effect is considered. Those findings may reconcile the literature on the non-pecuniary impacts of globalization on individual health in developed countries: it can have positive consequences through enhanced productivity or diffusion of better practices, but still be a source of increased pressure with negative effects on health for workers.

The matching of the EWCS and OECD databases gives rise to a source of useful information that is not explored yet in the literature. The Organizational and Safety Health Organization [OSHA] regularly reports the social and economic costs of degraded health at work and this study shows that there is a room for improvement. It is necessary to recognize that the process of globalization has negative consequences for workers, even those who are still employed. Layoffs and wage inequalities are only one aspect of the negative consequences of international competition. The recognition of harmful effects on workers' health is a first step towards the implementation of

measures to combat them. These preliminary results lead to the identification of a series of stakeholders able to act on the issue of occupational health: thus, alongside companies that can take concrete and direct action on working conditions if clear information is provided on the consequences of globalization. They could benefit from lower absenteeism and increased productivity. There is also potential room for action by governments in regulating the globalization process.

There are several limitations for this study. The cross-sectional nature of the European Working Conditions Survey prevents us to fully control the series of biases often encountered in studies dealing with work features and individual health. Rather than causal relationships, we've highlighted associations and those preliminary results should be handled carefully. However, many studies show that those relationships are biased downwards when potential biases are not considered. This leads to strongly nuance the previous limitation. Then, the choice of the offshoring indicator could be discussed as it only captures vertical offshoring but the data available makes it impossible to explore the impact of the offshoring of the complete supply chain by activity sector.

This preliminary study offers perspectives in terms of future research. First, mediation models allow for the introduction of moderators in the relationships between independent variables and mediators and between mediators and independent variables. Resources at work could be tested to check for their moderating effect in the framework of the Job-Demand Resources model. Then, great disparities are observed among countries, this calls for further investigation to identify national good practices. Further analyses should be made to identify groups at risk. New workplace policies could be targeted to these groups.

Table 1. Results of models 2 and 3 (Odds ratios).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	2000-2005 Pooled data (Waves 3 and 4)								2010 (Wave 5)							
	Mediators Linear regressions (Model 2)				Dependent variables Logit regressions (Model 3)				Mediators Linear regressions (Model 2)				Dependent variables Logit regressions (Model 3)			
	Physical constraints		Work intensity		Mental		MSD		Physical constraints		Work intensity		Mental		MSD	
	OR	S.E	OR	S.E	OR	S.E			OR	S.E	OR	S.E	OR	S.E		
Offshoring (intermediate input ratio)	1.011	-0.0135	1.107***	-0.0134	0.786	-0.108	0.657**	-0.0899	0.987	-0.0152	1.091***	-0.0159	0.912	-0.125	0.627***	-0.0844
Working conditions																
Physical constraints					6.198***	-0.484	17.38***	-1.368					3.666***	-0.303	7.327***	-0.615
Work intensity					2.127***	-0.185	1.482***	-0.126					1.862***	-0.161	1.337***	-0.115
Individual characteristics and work environment																
Women	0.970***	-0.00427	0.993	-0.00395	1.351***	-0.0596	1.747***	-0.0775	0.965***	-0.00489	0.984***	-0.00474	1.552***	-0.0693	1.515***	-0.0667
Age class (ref 15-24)									1	(.)	1	(.)	1	(.)	1	(.)
25-34	0.99	-0.00674	0.975***	-0.006	1.356***	-0.0982	1.352***	-0.0935	0.981*	-0.00882	0.980*	-0.00837	1.423***	-0.115	1.532***	-0.12
35-44	0.989	-0.0068	0.956***	-0.00594	1.509***	-0.11	1.664***	-0.116	0.980*	-0.00877	0.968***	-0.00823	1.634***	-0.132	1.942***	-0.152
45-54	0.976***	-0.00694	0.931***	-0.00599	1.589***	-0.119	1.914***	-0.137	0.969***	-0.00877	0.952***	-0.00818	1.816***	-0.148	2.857***	-0.228
55 and more	0.944***	-0.00839	0.903***	-0.00726	1.454***	-0.136	1.635***	-0.147	0.947***	-0.00965	0.923***	-0.00894	2.026***	-0.185	2.823***	-0.253
Isco categories (Ref High-skilled white collars)									1	(.)	1	(.)	1	(.)	1	(.)
Low-skilled white collars	1.041***	-0.00512	1.024***	-0.00456	0.703***	-0.0345	1.065	-0.0527	1.077***	-0.00613	1.009	-0.00546	0.847***	-0.0424	1.088	-0.0536
High-skilled blue collars	1.430***	-0.00982	1.132***	-0.00702	0.612***	-0.0444	1.033	-0.0727	1.502***	-0.0125	1.130***	-0.00891	0.558***	-0.0447	0.954	-0.075
Low-skilled blue collars	1.235***	-0.00768	1.059***	-0.00596	0.654***	-0.0417	1.157*	-0.0721	1.283***	-0.00935	1.046***	-0.00725	0.702***	-0.0472	1.086	-0.0718
Income quartile (ref first quartile)									1	(.)	1	(.)	1	(.)	1	(.)
2nd quartile	1.011*	-0.00555	1.026***	-0.00509	1.158*	-0.0663	1.117*	-0.0601	1.017*	-0.0073	1.022**	-0.00697	0.975	-0.0618	0.862*	-0.0539
3rd quartile	0.989	-0.00598	1.022***	-0.00559	1.351***	-0.0834	1.108	-0.0659	1.002	-0.00813	1.020*	-0.00786	0.963	-0.0687	0.837*	-0.0591
4th quartile	0.952***	-0.00642	1.031***	-0.00629	1.517***	-0.103	1.099	-0.0735	0.988	-0.00709	1.019**	-0.00696	0.881*	-0.0558	0.748***	-0.0467
Firm size (ref 2-4 employees)											0.887***	-0.0119	1.363*	-0.166	1.409**	-0.173
1 employee	0.949***	-0.0128	0.905***	-0.011	0.873	-0.125	0.922	-0.126	0.947***	-0.0133	1	(.)	1	(.)	1	(.)
5-9 employees	1.019*	-0.00746	1.050***	-0.00696	0.918	-0.0697	1.003	-0.0734	1.031***	-0.00869	1.050***	-0.00842	0.981	-0.073	1.114	-0.0813
10-49 employees	1.033***	-0.00677	1.071***	-0.00635	1.021	-0.0687	1.098	-0.0716	1.018*	-0.00782	1.078***	-0.00787	1.079	-0.0731	1.07	-0.0714
50-99 employees	1.033***	-0.00828	1.094***	-0.00793	0.992	-0.0806	1.101	-0.0871	1.033***	-0.00983	1.093***	-0.00989	1.179*	-0.0985	1.161	-0.0961
100-249 employees	1.028***	-0.00861	1.102***	-0.00834	0.986	-0.0836	1.115	-0.0928	1.008	-0.0101	1.101***	-0.0105	0.993	-0.0877	1.024	-0.0889
250-499 employees	1.043***	-0.0106	1.110***	-0.0102	0.996	-0.101	1.121	-0.113	1.009	-0.0124	1.129***	-0.0132	1.06	-0.115	1.139	-0.122
500 and more employees	1.044***	-0.00914	1.122***	-0.00888	1.330***	-0.114	1.369***	-0.118	1.018	-0.0108	1.136***	-0.0115	1.175	-0.11	1.269*	-0.117
Working more than 40 hours per week	1.037***	-0.00559	1.030***	-0.00502	1.701***	-0.0858	1.267***	-0.0653	1.015*	-0.00642	1.036***	-0.00622	1.524***	-0.0838	1.156**	-0.0634
Permanent contract	1.008	-0.00497	1.016***	-0.00453	1.127*	-0.0564	1.087	-0.0527	0.997	-0.00601	0.999	-0.00573	0.941	-0.0499	1.003	-0.0527
Private sector	1.007	-0.00456	1.052***	-0.00431	0.737***	-0.0331	0.957	-0.0429	0.999	-0.00529	1.049***	-0.00528	0.913*	-0.0423	1.021	-0.0469
Job satisfaction	0.885***	-0.00477	0.922***	-0.00449	0.314***	-0.0151	0.444***	-0.0218	0.886***	-0.00579	0.915***	-0.00569	0.385***	-0.0226	0.524***	-0.0315

Country (ref Austria)											1	(.)	1	(.)	1	(.)
Belgium	1.021	-0.0109	1.015	-0.00976	3.524***	-0.454	0.931	-0.104	1.066***	-0.0133	1.053***	-0.0125	3.674***	-0.475	1.108	-0.118
Denmark	1.026**	-0.0102	0.992	-0.0089	2.158***	-0.274	2.501***	-0.245	1.011	-0.0149	1.001	-0.014	3.128***	-0.454	2.069***	-0.26
Finland	1.147***	-0.0118	1.107***	-0.0103	3.240***	-0.405	2.718***	-0.273	1.106***	-0.0166	1.123***	-0.016	6.348***	-0.936	2.720***	-0.366
France	1.062***	-0.011	1.011	-0.00948	3.786***	-0.476	0.906	-0.0958	1.074***	-0.0136	1.074***	-0.0129	6.193***	-0.807	1.174	-0.127
Germany	1.016	-0.0106	1.006	-0.00945	1.916***	-0.255	0.884	-0.0959	1.025	-0.0135	1.062***	-0.0132	2.055***	-0.277	1.006	-0.112
Greece	1.063***	-0.0119	1.091***	-0.0111	11.80***	-1.53	1.745***	-0.192	1.024	-0.0163	1.129***	-0.0171	4.594***	-0.71	0.740*	-0.102
Ireland	0.999	-0.0111	0.988	-0.0099	1.939***	-0.273	0.572***	-0.073	1.012	-0.0154	1.110***	-0.016	1.106	-0.177	0.412***	-0.0562
Italy	0.98	-0.0112	1.001	-0.0103	3.524***	-0.472	1.207	-0.14	0.967*	-0.0141	1.02	-0.0142	3.133***	-0.452	1.381**	-0.171
Luxembourg	0.974	-0.0131	0.959***	-0.0117	3.764***	-0.574	1.596***	-0.216	1.072***	-0.0171	1.035*	-0.0157	4.297***	-0.662	1.163	-0.16
Netherlands	0.993	-0.0104	0.979*	-0.00931	2.631***	-0.346	1.149	-0.124	0.967*	-0.0156	0.996	-0.0153	3.211***	-0.502	1.498**	-0.205
Portugal	1	-0.0105	1.002	-0.00953	2.530***	-0.329	1.032	-0.111	1.056***	-0.0164	1.015	-0.0149	6.527***	-0.985	1.760***	-0.237
Spain	1.029*	-0.0113	1	-0.00995	4.710***	-0.61	1.279*	-0.141	1.021	-0.0158	1.041**	-0.0153	3.331***	-0.503	1.207	-0.159
Sweden	1.086***	-0.0109	1.046***	-0.0095	3.415***	-0.42	2.666***	-0.263	1.089***	-0.0167	1.068***	-0.0156	2.228***	-0.335	1.316*	-0.172
Uk	1.040***	-0.0113	1.066***	-0.0105	1.972***	-0.268	0.600***	-0.071	1.015	-0.014	1.107***	-0.0146	1.890***	-0.267	0.701**	-0.0831
Year (ref 2000)																-0.172
2005	1.007	-0.00395	1.037***	-0.00368	0.745***	-0.0294	0.585***	-0.0229								
N	**17,954**								**12,697**							

*p<0.05,**p<0.01,***p<0.001

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Appendix 1. Data details

Table 1.1: List of activity sectors, ISIC Revision 3.1

Agriculture and fishing	A01-02-05
Mining and carrying	C10-14
Manufacturing	D15-37
Gas Electricity Water	E40-41
Construction	F45
Wholesale and retail Trade	G50-52
Hotel and restaurant	H55
Transport, storage, and communications	I60-63
Post and telecommunication	I64
Financial Intermediation	J65-67
Public administration	L75
Education	M80
Health and social work	N85
Services	O90-93
Activities of private households	P95

Table 1.2: Summary statistics of control variables (weighted)

Individual variables	**2000**	**2005**	**2010**
Female	50%	50%	49%
Age class			
15-24-year-old	14%	14%	11%
25-34-year-old	27%	22%	23%
35-44-year-old	27%	29%	28%
45-54-year-old	25%	25%	27%
55-year-old and more	7%	10%	11%
Isco category			
High-skilled white collars	32%	37%	38%
Low-skilled white collars	34%	31%	32%
High-skilled blue collars	16%	13%	14%
Low-skilled blue collars	18%	18%	16%
Income quartiles			
Income quartile 1	24%	26%	21%
Income quartile 2	30%	25%	24%
Income quartile 3	26%	27%	17%
Income quartile 4	20%	22%	38%
Firm size			
1 employee	2%	2%	2%
2-4 employees	12%	11%	12%
5-9 employees	16%	16%	19%
10-49 employees	33%	33%	34%
50-99 employees	11%	12%	11%
100-249 employees	10%	10%	9%
250-499 employees	6%	6%	5%
500 and more employees	11%	10%	8%
Working more than 40 hours per week (yes)	17%	17%	18%
Permanent contract (yes)	82%	78%	80%
Private sector (yes)	34%	34%	33%
Job satisfaction (yes)	84%	84%	86%
Health			
Msd	29%	20%	50%
Mental health problems (at least 1)	29%	21%	40%
Anxiety	8%	8%	9%
Sleeping problems	8%	8%	19%
Fatigue	24%	18%	32%

Working conditions variables	**2000**	**2005**	**2010**
Intensity of work			
Repetitive tasks of less than 10 minutes	47%	42%	42%
Working at very high speed	56%	63%	62%
Meet tight deadlines	58%	62%	63%
Reach numerical targets	26%	42%	40%
Work under the automatic speed of a machine	16%	16%	17%
Work under the dirct control of a boss	36%	37%	39%
Be dependent of work done by colleagues	47%	46%	44%
Physical constraints			
Caring heavy loads	37%	34%	33%
Repetitive movements	57%	63%	63%
Painful or tiring positions	46%	46%	46%
Exposure to vibrations	19%	21%	20%
Exposure to noise	26%	28%	28%
Exposure to extreme temperatures	32%	33%	32%
N	**10,443**	**7,511**	**12,697**

Source: EWCS waves 3, 4 and 5.

Table 1.3. Differences in exposure to working conditions and health between groups.

	2000-2005		2010		2000-2005		2010	
Indicator of working conditions	Men	Women	Men	Women	Blue Collars	White Collars	Blue Collars	White Collars
Intensity of work (mean)	0.43	**0.36*** **	0.45	0.38***	0.47	0.36***	0.49	0.39***
Physical constraints (mean)	0.44	0.29***	0.44	0.31***	0.27	0.57***	0.6	0.28***
Health								
Musculoskeletal disorders	26%	24%ns	49%	51%ns	20%	36%***	59%	46%***
Mental health (at least one item)	27%	25%*	37%	43%***	24%	29%***	39%	40% ns

ns: non significant
Stars indicate the level of significance of the differences between the two groups tested
Example: 0.36 is the mean observed in the sample for the degree of exposure to work intensity for female, the difference is significant at 1% with male (mean=0.43)
*p<0.05,**p<0.01,***p<0.001

	2000-2005		2010		2000-2005		2010	
	White Collars		White Collars		Blue Collars		Blue Collars	
Indicator of working conditions	Men	Women	Men	Women	Men	Women	Men	Women
Intensity of work (mean)	0.38	0.35***	0.41	0.37***	0.49	0.43***	0.5	0.45**
Physical constraints (mean)	0.27	0.57***	0.27	0.60***	0.61	0.45***	0.63	0.47***
Health								
Musculoskeletal disorders	17%	22%***	41%	49%***	36%	36% ns	58%	59% ns
Mental health (at least one item)	24%	23% ns	36%	42%**	29%	28% ns	37%	48%**

ns: non significant
Stars indicate the level of significance of the differences between the two groups tested
*p<0.05,**p<0.01,***p<0.001

Appendix 2. Regression results

Table 2.1: Results of Model 1: Offshoring and health (Logit regressions; Odds ratios).

	2000-2005 Pooled data (Waves 3 and 4)				2010 (Wave 5)			
	Mental		MSD		Mental		MSD	
	OR	S.E	OR	S.E	OR	S.E	OR	S.E
Offshoring (intermediate input ratio)	0.895	-0.118	0.743*	-0.0954	0.942	-0.127	0.641***	-0.0836
Individual characteristics and work environment								
Women	1.248***	-0.0531	1.497***	-0.062	1.451***	-0.0633	1.385***	-0.0589
Age class (ref 15-24)								
25-34	1.313***	-0.0928	1.284***	-0.0843	1.363***	-0.109	1.436***	-0.11
35-44	1.424***	-0.101	1.524***	-0.101	1.540***	-0.122	1.785***	-0.136
45-54	1.431***	-0.105	1.650***	-0.112	1.668***	-0.134	2.498***	-0.193
55 and more	1.221*	-0.111	1.296**	-0.11	1.772***	-0.159	2.347***	-0.203
Isco categories (Ref High-skilled white collars)								
Low-skilled white collars	0.787***	-0.0375	1.206***	-0.0564	0.941	-0.0459	1.249***	-0.0594
High-skilled blue collars	1.296***	-0.0842	2.796***	-0.174	1.029	-0.0735	2.154***	-0.151
Low-skilled blue collars	1.032	-0.0612	2.078***	-0.119	1.003	-0.0628	1.760***	-0.108
Income quartile (ref first quartile)								
2nd quartile	1.193**	-0.0666	1.158**	-0.059	1.008	-0.0626	0.898	-0.0544
3rd quartile	1.324***	-0.0795	1.082	-0.061	0.978	-0.0684	0.853*	-0.0584
4th quartile	1.379***	-0.0913	0.961	-0.0611	0.882*	-0.0548	0.745***	-0.0451
Firm size (ref 2-4 employees)								
1 employee	0.746*	-0.104	0.781	-0.101	1.173	-0.14	1.216	-0.145
5-9 employees	0.997	-0.0734	1.083	-0.0747	1.046	-0.0763	1.188*	-0.084
10-49 employees	1.141*	-0.0745	1.226***	-0.0754	1.147*	-0.076	1.127	-0.0726
50-99 employees	1.125	-0.0886	1.228**	-0.0915	1.287**	-0.105	1.265**	-0.101
100-249 employees	1.112	-0.0913	1.238**	-0.0968	1.059	-0.0915	1.067	-0.0895
250-499 employees	1.156	-0.114	1.290**	-0.123	1.148	-0.122	1.19	-0.123
500 and more employees	1.544***	-0.129	1.570***	-0.127	1.281**	-0.117	1.340**	-0.119
Working more than 40 hours per week	1.789***	-0.0875	1.378***	-0.067	1.568***	-0.0846	1.194***	-0.0634
Permanent contract	1.148**	-0.0559	1.108*	-0.0508	0.939	-0.049	0.999	-0.0509
Private sector	0.789***	-0.0341	0.996	-0.0418	0.942	-0.0427	1.032	-0.0458
Job satisfaction	0.257***	-0.0119	0.342***	-0.0157	0.323***	-0.0185	0.423***	-0.0244
Country (ref Austria)								
Belgium	3.424***	-0.43	0.989	-0.104	3.975***	-0.508	1.257*	-0.13
Denmark	2.111***	-0.262	2.387***	-0.221	3.098***	-0.444	2.024***	-0.247
Finland	4.114***	-0.501	3.605***	-0.34	7.332***	-1.066	3.190***	-0.417
France	3.929***	-0.481	1.084	-0.108	6.710***	-0.864	1.355**	-0.142
Germany	1.906***	-0.247	0.927	-0.0949	2.169***	-0.289	1.073	-0.116
Greece	12.06***	-1.526	1.957***	-0.203	4.890***	-0.744	0.812	-0.108
Ireland	1.868***	-0.256	0.611***	-0.0736	1.193	-0.189	0.450***	-0.0596
Italy	3.121***	-0.408	1.085	-0.119	2.954***	-0.421	1.275*	-0.154
Luxembourg	3.185***	-0.473	1.387*	-0.177	4.625***	-0.703	1.327*	-0.176
Netherlands	2.345***	-0.301	1.065	-0.109	2.970***	-0.459	1.371*	-0.183
Portugal	2.406***	-0.305	1.021	-0.103	6.682***	-0.993	1.887***	-0.246
Spain	4.501***	-0.567	1.327**	-0.138	3.401***	-0.506	1.249	-0.159
Sweden	3.769***	-0.453	3.011***	-0.28	2.531***	-0.375	1.541***	-0.195
Uk	2.105***	-0.279	0.709**	-0.0794	2.025***	-0.282	0.752*	-0.0864
Year (ref 2000)								
2005	0.782***	-0.0299	0.638***	-0.0235				
	17954		17954		12697		12697	

*p<0.05,**p<0.01,***p<0.001