**Increasing retirement age and mental health of older workers: the role of working conditions**

**Extended abstract**

**Introduction**

The aging population poses a significant challenge, threatening the long-term viability of pension systems across the EU. Over the last decades, many countries have introduced reforms extending the working lifespan, thereby decreasing the financial burden on pension systems. However, an often-overlooked aspect is the well-being of senior workers, whose mental and physical health can deteriorate towards the end of their careers, linked to the strenuousness and quality of their jobs (Miranti & Li, 2020). Delaying retirement age would, therefore, allow more time for workers' health to decline, placing an additional burden on social protection systems (health insurance, unemployment insurance) (Serrano-Alarcón, et al., 2023; Li, 2018), although the long-term positive effect on government income may still outweigh a short to medium-term rise in expenditures (Hagen, 2018). Moreover, these reforms underscore the societal value placed on preserving retirement years, implying that retirement is eagerly anticipated by a significant portion of the population.

Several studies have attempted to analyze the effects of pension reforms on the mental health of older workers, with most suggesting adverse effects that escalate with a greater work horizon increase (Bertoni, Brunello, & Da Re, 2023; Serrano-Alarcón, et al., 2023; Carrino, Glaser, & Avendano, 2020; de Grip, Lindeboom, & Montizaan, 2009). Reducing the work horizon may also lead to a deterioration in mental health, as shown by Bauer & Eichenberger (2021) on the example of a Swiss reform that lowered the legal retirement age in the construction sector from 65 to 60 leading to a 33% increase in sick leave between ages 56 and 60. Conversely, an extended retirement horizon may encourage businesses to invest in skills of senior workers to retain them in employment (Hairault, Sopraseuth, & Langot, 2010) and adapt jobs to their skills (Miranti & Li, 2020), potentially benefiting their mental health. Older workers may also adopt healthier behaviors anticipating a longer work horizon, as found by Bertoni et al. (2018) for the 2004 Italian pension reform.

The literature debate on well-being and mental health throughout the life cycle reveals diverse patterns – U-shape, inverse U-shape, and other relationships (Bell, 2014; Frijters & Beatton, 2012; Blanchflower & Oswald, 2008), suggesting that the end of the career is not universally understood across countries, depending on retirement systems and senior employment policies. However, to the best of our knowledge, multi-country studies on the effects of pension reforms on mental health are scarce, with Bertoni, Brunello, & Da Re (2023) being a notable exception.

Notably, many authors find heterogeneous effects depending on working conditions, such as elevated depression for women in lower-skilled high-strain jobs (Carrino, Glaser, & Avendano, 2020) and a decline in mental health caused by job insecurity in occupations with a high risk of automation (Bertoni, Brunello, & Da Re, 2023). Other authors have also demonstrated this relationship between working conditions and mental health, highlighting lower-skilled high-strain, and physically demanding occupations as at-risk groups (Belloni, Carrino, & Meschi, 2022; Shai, 2018; Henseke, 2018).

Building upon the work of Bertoni et al. (2023) and Carrino et al. (2020), we explore heterogeneous effects of reforms delaying the retirement age on late-career mental health as a function of working conditions. By combining repeated cross-sectional data on working conditions from the European Working Conditions Survey (EWCS), aggregated at the level of 4-digit ISCO codes, with microdata from 12 EU countries from the Survey of Health, Ageing and Retirement in Europe (SHARE), we control for endogeneity of job quality data and provide a comprehensive analysis of the relationship between retirement policies and mental health depending on diverse job quality dimensions.

**Data**

Our study uses release 8.0.0 of SHARE. The survey provides comprehensive longitudinal information on socio-economic status, health, and social and family networks for nationally representative samples of individuals aged 50 and above residing in 28 European countries and Israel. We extract individual-level demographic and health data for 2011 and 2015 for 12 European countries that participated in the corresponding waves 4 and 6 of the survey, and add data on employment history from the retrospective module of wave 7 (Sharelife).

We use data on working conditions from waves 5 and 6 (2010 and 2015) of EWCS. The survey covers diverse occupations, sectors, and age groups of 35 countries, describing the work landscape in the form of 7 comprehensive job quality indices - skills and discretion, working time quality, physical environment, social environment, intensity, prospects, and monthly earnings – that we aggregate by country, year, and 4-digit ISCO codes. We don’t use the monthly earnings index as SHARE provides the information on household income. To ensure the concordance between the two surveys, we approximate job quality indices for 2011 with the values available for 2010.

Merging SHARE data with job quality indices from EWCS requires the identification of the occupation of each individual in the form of a 4-digit ISCO code. These codes were gradually recorded by the SHARE working groups since 2015. The majority of codes, covering around 47 thousand individuals, were registered during the Sharelife module of wave 7, and another 2 thousand - during the regular SHARE modules of waves 6,7, and 8. We recover all the available codes, which leaves us with a sample of around 49 thousand individuals.

Finally, we turn to the Mutual Information System on Social Protection (MISSOC) to identify detailed information on pension systems and their reforms across European Union countries. This information allows us to estimate the statutory retirement age and its changes induced by reforms for each individual within our dataset.

**Methods**

*Sample*

Our study covers data from 12 European countries that participated in waves 4 and 6 of SHARE: Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, Slovenia, Spain, Sweden, and Switzerland. To ensure our sample is representative of individuals potentially impacted by pension reforms, we implement several filters. We narrow our focus to individuals aged 50 or above, having continuous employment status between 2011 and 2015, and not working beyond the statutory retirement age. Using retrospective employment data from Sharelife, we further exclude individuals with less than 10 years of social security contributions, as they are likely to be detached from work. Finally, some observations are lost due to missing values.

The resulting sample is a balanced panel of 3,922 workers observed both in 2011 and 2015. 58% of these workers are female, with an average age of 56.84. On average, they have 1.91 children. 74% work in the private sector, 17% in the public sector, and the remainder are self-employed. Detailed descriptive statistics are presented in Appendix 1.

*Work horizon change*

We define work horizon (YTR) as the residual number of years before an individual achieves the statutory retirement age, and work horizon change (ΔYTR), as the change in this work horizon induced by pension system reforms. The latter is the treatment variable in our setting.

Based on the MISSOC database, we use old age pension eligibility criteria in concerned countries, including age, gender, number of children (for the Czech Republic), sector of employment (for Italy), and years of contribution to social security to define cells and calculate statutory retirement age for each individual (see Appendix 2 for a detailed summary of rules), under the assumption of continuous employment in the future. The average calculated statutory retirement age in our sample is 63.44 years, and the average residual work horizon is 6.60 years.

The MISSOC database also allows us to identify pension system reforms introduced between 2011 and 2015 and calculate the induced changes in the work horizon. 7 out of 12 countries tightened old age pension eligibility criteria, leading to an increase in residual work horizon of up to 5 years over the study period. In total, 42% of individuals in the sample experienced an increase in work horizon with an average of 0.7 years.

*Mental health*

We measure the mental health of individuals using the Euro-D scale (Beekman, et al., 1999), a clinical measure of depression introduced in 1999 to harmonize data on late-life depression in Europe. This scale measures depression on a 0-12 scale with the score corresponding to the number of depression symptoms revealed. It covers such aspects of depression as depressed mood, pessimism, wishing death, guilt, lack of sleep, lack of interest, irritability, lack of appetite, fatigue, lack of concentration, lack of enjoyment, and tearfulness. Generally, clinical depression is confirmed if the individual has 4 or more symptoms of the scale (Beekman, et al., 1999; Beekman, et al., 2005). In our sample, the average Euro-D score is 2.26 with 24% of individuals showing evidence of clinical depression.

*Job quality indices*

Our study explores 6 job quality indices provided by EWCS: skills and discretion, working time quality, physical environment, social environment, intensity, and prospects. These indices reflect the multidimensional nature of job quality, and each dimension has an independent influence on the health and well-being of workers (Fishta & Backé, 2015; Theorell, et al., 2015). Each index consists of a set of indicators covering different aspects of the corresponding job quality dimension. These indices are measured on a scale from 0 to 100, where the higher the index score, the better the job quality.

As the structure of surveys slightly varies across waves, we had to recalculate some of these indices to achieve the maximum concordance between the editions of 2010 and 2015. We also reverse the intensity index, originally indicating worse job quality with higher values, to ensure the same interpretation of the scale for all indices. We aggregate the indices by 4-digit ISCO codes, country, and year. In addition, we calculate an overall index of job quality by summing the six individual indices. Detailed compositions and descriptive statistics for obtained indices are presented in Appendix 3.

*Empirical approach*

To assess the effect of reforms extending the work horizon on mental health of older workers, we use a difference-in-differences design. Our treatment variable is Δ𝑌𝑇𝑅, the reforms-induced work horizon change. Within cells, defined by old age pension eligibility criteria in a given country, we consider this change exogenous. Our outcome variable is the Euro-D score on a 0-12 scale, representing the number of depression symptoms. We control the validity of the parallel trend assumption, by comparing the trends in mental health using data from previous waves of SHARE. We compare changes in Euro-D score between 2011 and 2015 across individuals with different values of ΔYTR by estimating the following model by ordinary least squares:

(1)

In Equation (1), , , and stand for individual, cell, and wave, respectively. is the Euro-D score. is a dummy indicator for 2015. We isolate the effect of pension reforms by including fixed effects at the cell level (). Singleton cells are removed from our sample (12 observations). The coefficient of interest is , which represents the difference-in-differences effect of a 1-year increase in work horizon on mental health. ​ represents a vector of individual-level control variables, including respondents’ gender, residual work horizon, number of children and grandchildren, years of full-time education, household income (in log), perceived general health level on a 5-point Likert scale, number of chronic diseases, job quality indices, and binary indicators for living as a couple, having life insurance and having savings, as well as fixed effects for the industry of employment. is an error term. Standard errors are clustered at the cell level.

To explore the effects of reforms on depression based on different working conditions, we run a series of models on reduced samples. Specifically, we focus on each of the six job quality indices by splitting our sample into two groups - those above and below the median of each respective index.

Moreover, to account for gender dynamics found in the literature on the effects of reforms extending working life (Bertoni, Brunello, & Mazzarella, 2018; Carrino, Glaser, & Avendano, 2020; Serrano-Alarcón, et al., 2023), as well as on the relationship between working conditions and mental health (Belloni, Carrino, & Meschi, 2022; Bratberg, Holmås, & Holmås, 2020; Hiesinger & Tophoven, 2019), we explore potential gender-specific variations by running separate analyses for male and female subgroups.

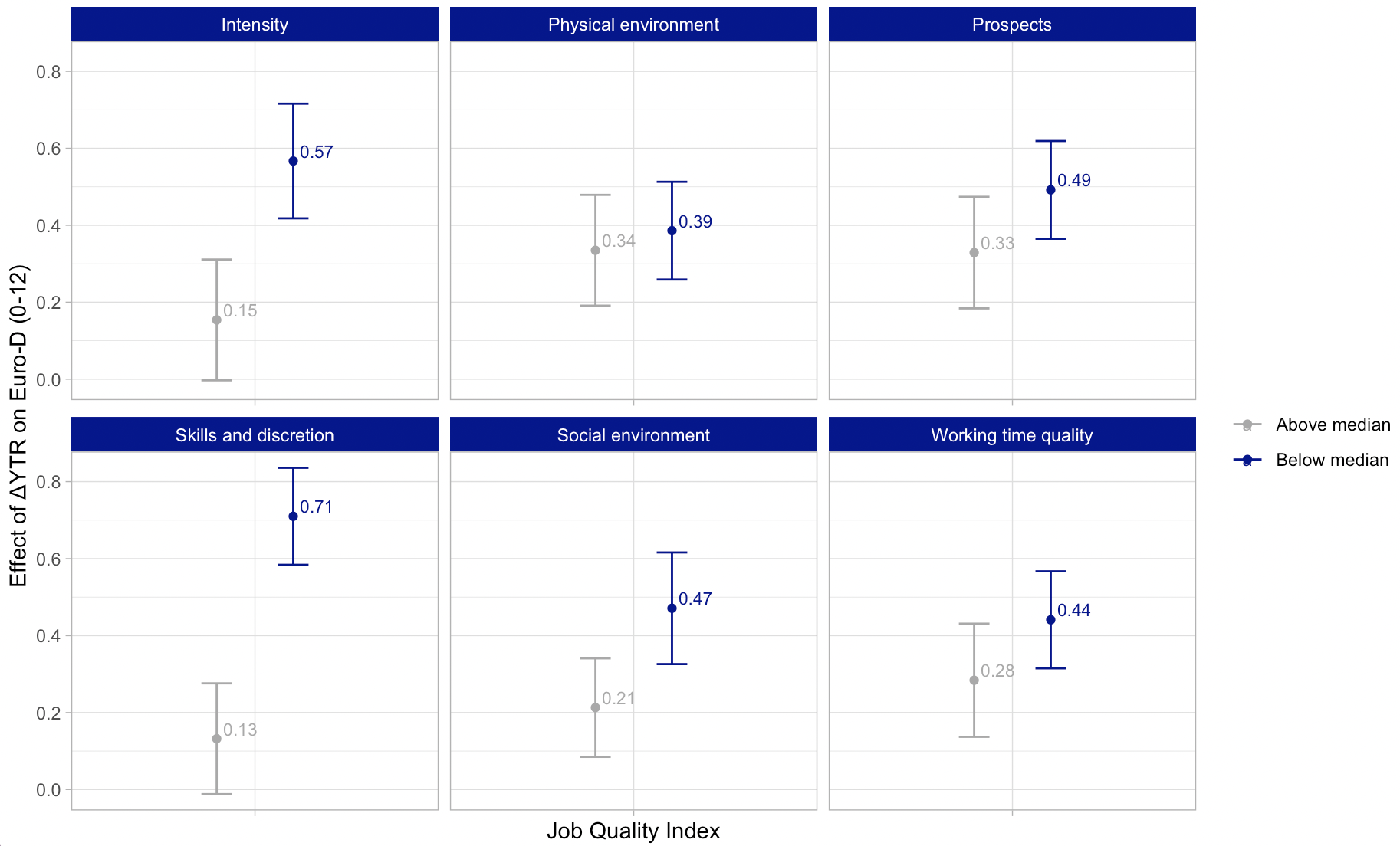
We also foresee several additional steps of the analysis that are not yet presented in the results section, as this study is still a work in progress. First, in addition to the continuous specification of the outcome variable, we will estimate the likelihood of passing above the threshold of clinical depression (Euro-D>3) with a linear probability model. Following the approach of (Banerjee, et al., 2007), we will also analyze the effects on two distinct orthogonal factors from the set of twelve depression symptoms that we obtained with a principal component analysis and identified as affective suffering and lack of motivation.

Moreover, for both specifications of the outcome variable, we will consider a binary treatment variable, equal to 1 if ∆YTR>0, and a non-linear specification that compares respondents having 𝛥𝑌𝑇𝑅=0 with those having 0<∆YTR≤1, 1<∆YTR≤2, and ∆YTR>2, allowing an exploration of the effects contingent upon the dose of treatment or, in other words, the scope of the reform. Finally, we anticipate conducting a series of sensitivity tests, such as extending our analysis to the early retirement schemes, focusing only on individuals who remain in the same occupation (to address the potential endogeneity of occupational change over time), iterative dropping out of countries from the sample (to account for the heterogeneity of pension systems and labor markets), and a random permutation of ∆YTR.

**Preliminary results**

Preliminary results show that the overall effect of an increased work horizon on depression symptoms was positive across all individuals (β = 0.350, p < 0.001). A closer examination of gender differences showed that the impact was more pronounced among females (β = 0.390, p < 0.01) compared to males (β = 0.310, p < 0.05), with greater inequalities found between sub-samples composed according to working conditions.

In general, our results indicate significant relationships between job quality and variations in the mental health of older workers in response to pension reforms. Figure 1 compares the effects of an extended work horizon on the Euro-D score depending on different working conditions. A detailed summary of results, including gender dynamics, can be found in Appendix 4.

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**Figure 1** - Heterogeneous effects of work horizon increase (ΔYTR) on depression (EuroD (0-12)) depending on working conditions

Individuals in lower-skilled jobs with less autonomy and decision-making power experienced a greater increase in depression symptoms (β = 0.710, p < 0.001) compared to those in higher-skilled jobs (β = 0.384, p < 0.1). This job quality dimension was more important to female individuals with an increase of 1.067 (p < 0.001) in Euro-D score among females in lower-skilled occupations. The intensity of the job, including the high and dependent pace of work, tight deadlines, and emotional tensions, had a distinct impact only on male individuals, with those employed in high-intensity jobs experiencing a significant increase in depression symptoms (β = 0.698, p < 0.001).

Among those in work environments with poor physical conditions, the impact of an extended work horizon on depression was significantly greater only for females (β = 701, p < 0.001). In contrast, the aspects of the social environment were more important for male individuals, with an increase in Euro-D score of 0.578 (p < 0.05) for those with the social environment index below the median, while not creating any significant difference for females.

Finally, we find no significant inequalities in the effect of pension reforms on workers’ mental health for the dimensions of working time quality, including long, irregular, and inflexible working hours, and job prospects, including opportunities for career growth and job insecurity. The latter can probably be explained by the age of targeted individuals, approaching retirement.

**Conclusion**

By combining data for 2011 and 2015 from 12 EU countries from the Survey of Health, Ageing and Retirement in Europe and the European Working Conditions Survey, we explore heterogeneous effects of reforms delaying the retirement age on late-career mental health as a function of working conditions. Similarly to Bertoni et al. (2023), Serrano-Alarcón et al. (2023), Carrino et al. (2020), and De Grip et al. (2012), we find that extending work horizons increases depression among older workers. We also confirm the presence of gender dynamics, with women being more sensitive to prolonged work horizons, as shown previously by Serrano-Alarcón et al. (2023) and Carrino et al. (2020). Our main contribution is that we extend their work by specifically exploring the heterogeneity of these effects depending on working conditions using exogenous job quality data.

In line with the findings of Carrino et al. (2020) for the UK pension reform, our preliminary results show that workers suffer a greater increase in the depression outcome when employed in lower-skilled jobs with less autonomy and decision-making power, with females being more impacted (β = 1.067, p < 0.001) than males (β = 0.450, p < 0.001). However, we find that the intensity of the job is more important for male workers, causing a rise of the Euro-D score of 0.698 (p < 0.001) when the job intensity index is below the median.

Contrary to the conclusions of Bertoni et al. (2023), demonstrating that the effects of the reforms are stronger for individuals employed in jobs with high automation risk due to greater job insecurity, our results show no significant heterogeneity of the effects for individuals in jobs with the job prospects index below the median. Although this index does not include specifically the presence of the automation risk, one of its two components speaks about the risk of losing the job within the next 6 months.

In addition, our results bring to light new relationships. First, we show that women are sensitive to poor physical environments at work, with an increase of 0.701 (p < 0.001) in the Euro-D score in response to a delay of the retirement age. Second, we find that men are significantly more impacted by the prolonged work horizon when they are working in poor social environments (β = 0.578, p < 0.01).

The potential adverse consequences of pension reforms on late-career mental health go beyond the loss of individual well-being, impacting labor market productivity (Bubonya, Cobb-Clark, & Wooden, 2017) and public budgets (Prince, et al., 2007) due to increased absenteeism, healthcare and disability costs, and decreased job retention. The mental health implications, including gender inequalities, should, therefore, be carefully considered when implementing policies aimed at extending working life. Flexible early retirement options, coupled with initiatives promoting lifelong learning, could serve as preventive measures to mitigate the negative effects on productivity. Policies extending state pension ages must also account for occupational inequalities, especially in demanding occupations, and consider inclusive labor market strategies, such as partial and gradual retirement schemes, to facilitate smoother transitions to retirement for individuals in lower-skilled jobs with poor environments.

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**Appendix 1 - Summary descriptive statistics for the final SHARE sample**

|  |  |  |
| --- | --- | --- |
|  | **Mean** | **SD** |
| *Outcome*  Euro-D score (from 0=no depression to 12=very depressed)  Euro-D score > 3 (yes/no)  Motivation lack (yes/no)  Affective suffering (yes/no) | 2.26  0.24  0.12  0.29 | 2.08  0.43  0.33  0.45 |
| *Treatment*  ΔYTR  ΔYTR > 0 (yes/no) | 0.70  0.42 | 1.10  0.49 |
| *Covariates determining cell*  Gender (1=female, 0=male)  Age  Number of children  Years of contribution to social security  Sector of employment  Private (yes/no)  Public (yes/no)  Self-employed (yes/no) | 0.58  56.84  1.91  36.37  0.74  0.17  0.09 | 0.49  3.81  1.35  6.14  0.44  0.38  0.28 |
| *Additional covariates*  Number of grandchildren  Living as a couple (yes/no)  Years of full-time education  Net household income  Savings (yes/no)  Life insurance (yes/no)  Self-perceived general health (from 0=excellent to 5=poor)  Number of chronic diseases  Residual work horizon | 1.25  0.77  11.84  56,526.85  0.50  0.31  3.10  1.25  6.60 | 2.01  0.42  4.69  98,813.05  0.50  0.46  1.05  1.32  3.44 |
| N observations | 7,675 | |

**Appendix 2 – Statutory retirement age and full pension eligibility rules**

|  |  |  |
| --- | --- | --- |
| **Country** | **2011** | **2015** |
| **Austria** | *Age:* 65 for males and 60 for females  *Contributions:* 45 years | *Age:* 65 for males and 60 for females  *Contributions:* 45 years |
| **Belgium** | *Age:* 65  *Contributions:* 45 years | *Age:* 65  *Contributions:* 45 years |
| **Czech Republic\*** | *Age:* 62 and 2 months for males, depends upon the number of children for females (61 if no children, 60 if 1 child, 59 if 2 children, 58 if 3 or 4 children, 57 if 5 or more children  *Contributions:* 27 years (17 years if age of 65) | *Age:* 62 and 10 months for males, depends upon the number of children for females (62 if no children, 61 if 1 child, 60 if 2 children, 59 if 3 or 4 children, 58 if 5 or more children  *Contributions:* 31 years (20 years if age of 67 and 10 months) |
| **Denmark** | *Age*: 65 (67 for those who had reached the age of 60 on 1.7.1999)  *Contributions:* - | *Age*: 65 (67 for those who had reached the age of 60 on 1.7.1999)  *Contributions:* - |
| **Estonia\*** | *Age:* 63 for males and 61 for females  *Contributions:* 15 years | *Age:* 63 for males and 62 and 6 months for females  *Contributions:* 15 years |
| **France\*** | *Age:*  If minimum period of contributions completed: 60 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by four months per birth year to reach 62 for persons born in 1956 or later.  If minimum period of contributions not completed: 65 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by 4 month per birth year to reach 67 for persons born in 1956 or later.  *Contributions:*  Determined according to the birth year of the person concerned - 1949: 160 quarters, 1952: 164 quarters | *Age:*  If minimum period of contributions completed: 60 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by four months per birth year to reach 62 for persons born in 1955 or later.  If minimum period of contributions not completed: 65 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by 5 month per birth year to reach 67 for persons born in 1955 or later.  *Contributions:*  Determined according to the birth year of the person concerned - 1952: 164 quarters; 1953 and 1954: 165 quarters, 1955 and 1956: 166 quarters |
| **Germany\*** | *Age:* 65  *Contributions:* 5 years | *Age:* 67 if born after 1963;65 and 2 months if born after 1947  *Contributions:* 5 years |
| **Italy\*** | *Age:* 66 for males, 61 only for females working in the public sector, 60 for the other females  *Contributions:* 40 years (5 if retiring at age of 70 for those first insured after 1996) | *Age:* 66 and 3 months for males, 66 and 3 months for females working in the public sector, 64 and 9 months for self-employed females, 63 and 9 months for other females  *Contributions:* 42 years and 6 months for males, 41 years and 6 months for females |
| **Slovenia\*** | *Age and contributions:* 63 for males and females if 15 years of contributions, 63 for males and 61 for females if 20 years of contributions, 58 for males if 40 years of contributions, 58 for females if 38 years of contributions | *Age and contributions:* 65 if 15 years of contributions, 60 if 40 years of contributions |
| **Spain\*** | *Age:* 65  *Contributions:* 35 years | *Age and contributions:* 65 if 35 years and 9 months of contributions, 65 years and 3 months if less contributions |
| **Sweden** | *Age:* 65 | *Age:* 65 |
| **Switzerland** | *Age:* 65 for males and 63 for females | *Age:* 65 for males and 63 for females |

\*Rules changed between 2011 and 2015

**Appendix 3 – Composition and summary descriptive statistics of job quality indices for the final SHARE sample**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | **Dimension** | **Components** | **Mean (SD)** | |
| **2010** | **2015** |
| **Physical environment** | *Ambient* | Exposure to vibrations from hand tools, machinery  Exposure to noise so loud that you would have to raise your voice to talk to people  Exposure to high temperatures that make you perspire even when not working  Exposure to low temperatures whether indoors or outdoors  Exposure to breathing in smoke, fumes, powder or dust | 87.66  (20.91) | 84.35 (17.54) |
| *Posture related* | Posture-related painful or tiring positions  Carrying or moving heavy loads  Repetitive hand or arm movements |
| *Biological, chemical conditions* | Handling or being in direct contact with dangerous substances such as chemicals or infectious materials |
| **Social environment** | *Adverse social behaviour* | *In the last month:*  Exposure to verbal abuse  Exposure to unwanted sexual attention  Exposure to threats  *In the last year:*  Exposure to physical violence  Exposure to sexual harassment  Exposure to bullying/harassment | 86.51  (20.59) | 80.97  (17.29) |
| *Social support* | *Management quality:*  Your immediate boss respects you as a person  Your immediate boss provides useful feedback in your work  *Social support:*  Help and support from colleagues (most of the time/always)  Help and support from your manager (most of the time/always) |
| **Intensity** | *Quantitative demands* | Working at very high speed (three-quarters of the time or more)  Working to tight deadlines (three-quarters of the time or more)  Enough time to get the job done (never or rarely)  Frequent disruptive interruptions | 60.33  (16.28) | 48.06  (13.22) |
| *Pace determinants and interdependency* | Interdependency: three or more pace determinants  Work pace dependent on: the work done by colleagues  Work pace dependent on: direct demands from people such as customers, passengers, pupils, patients, etc  Work pace dependent on: numerical production targets or performance targets  Work pace dependent on: automatic speed of a machine or movement of a product  Work pace dependent on: the direct control of your boss |
| *Emotional demands* | Hiding your feelings at work (most of the time or always)  Handling angry clients, customers, patients, pupils, etc. (three-quarters of the time or more) |
| **Working time quality** | *Duration* | Long working hours (48 h or more a week)  Long working days (10h or more a day) | 91.98  (22.95) | 87.11  (18.03) |
| *Atypical working time* | Night work  Saturday work  Sunday work  Shift work |
| *Working time arrangements* | Set by the company  Can choose between different schedules  Can adapt working hours  Entirely determined by self  Change in working time arrangements  No regular change  Change the same day  Change the day before  Change several days in advance  Change several weeks in advance |
| **Skills and discretion** | *Cognitive dimension* | Solving unforeseen problems  Carrying out complex tasks  Learning new things  Working with computers, smartphones and laptops, etc. (at least a quarter of the time)  Ability to apply your own ideas in work | 61.37  (21.80) | 60.23  (19.24) |
| *Decision latitude* | Ability to choose or change order of tasks  Ability to choose or change speed or rate of work  Ability to choose or change methods of work  Having a say in choice of work colleagues |
| *Organisational participation* | Consulted before objectives are set for own work (‘always’ or ‘most of the time’)  Involved in improving the work organisation or work processes of own department or organisation (‘always’ or ‘most of the time’)  Ability to influence decisions that are important for your work (‘always’ or ‘most of the time’) |
| *Training* | Training paid for or provided by employer over the past 12 months (or paid by oneself if self-employed)  On-the-job training over the past 12 months Trend index score (maximum 100) |
| **Prospects** | *Career prospects* | Job offers good prospects for career advancement | 60.47  (21.0) | 62.41  (16.5) |
| *Job security* | Might lose job in the next six months |
| **Overall job quality (sum of indices)** | | | **451.83**  **(117.29)** | **430.75**  **(109.96)** |

**Appendix 4 - Heterogeneous effects of work horizon increase (ΔYTR) on depression (EuroD (0-12)) depending on working conditions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | 0.350 \*\*\*  (0.097) | 0.310 \*  (0.146) | 0.390 \*\*  (0.127) |
| **JQI skills and discretion** | **> median**  **< median**  *p-value for equality* | 0.132  (0.144)  0.710 \*\*\*  (0.126)  *0.000* | 0.384 .  (0.191)  0.450 \*\*  (0.162)  *0.000* | -0.111  (0.211)  1.067 \*\*\*  (0.195)  *0.000* |
| **JQI physical environment** | **> median**  **< median**  *p-value for equality* | 0.335 \*  (0.144)  0.386 \*\*  (0.127)  *0.394* | 0.147  (0.168)  0.445 \*  (0.191)  *0.120* | 0.190  (0.214)  0.701 \*\*\*  (0.194)  *0.038* |
| **JQI social environment** | **> median**  **< median**  *p-value for equality* | 0.213 .  (0.128)  0.471 \*\*  (0.145)  *0.091* | 0.069  (0.161)  0.578 \*\*  (0.204)  *0.025* | 0.377 .  (0.201)  0.458 \*  (0.210)  *0.390* |
| **JQI working time quality** | **> median**  **< median**  *p-value for equality* | 0.284  (0.147)  0.441 \*\*\*  (0.126)  *0.208* | 0.211  (0.199)  0.403 \*  (0.167)  *0.230* | 0.345 .  (0.208)  0.491 \*  (0.195)  *0.305* |
| **JQI intensity** | **> median**  **< median**  *p-value for equality* | 0.154  (0.157)  0.567 \*\*\*  (0.149)  *0.028* | -0.164  (0.185)  0.698 \*\*\*  (0.206)  *0.001* | 0.462 \*  (0.214)  0.592 \*  (0.280)  *0.356* |
| **JQI prospects** | **> median**  **< median**  *p-value for equality* | 0.329 \*  (0.145)  0.492 \*\*\*  (0.127)  *0.200* | 0.254  (0.157)  0.492 \*  (0.206)  *0.179* | 0.086 \*\*\*  (0.211)  0.197  (0.202)  *0.012* |

. p<0.1, \* p < 0.05, \*\*p < 0.01, \*\*\* p < 0.001

**Update 04/03/2024 – What I did since the last version**

1. **Added early retirement reforms**

Now we shift from speaking about the statutory retirement age to the minimum retirement age and, respectively, the work horizon until the minimum retirement age.

By the minimum retirement age, I mean the earliest age at which a person becomes eligible for a state retirement pension (even if at a reduced rate). If there are no early retirement options in a country or a person does not meet the existing eligibility criteria, the minimum retirement age is the statutory one.

As such, the part of individuals touched by reforms in the sample increased from 42% to 57%.

**Appendix 2 – Retirement age and pension eligibility rules (updated with early retirement)**

|  |  |  |
| --- | --- | --- |
| **Country** | **2011** | **2015** |
| **Austria\*** | *Standard pension*  *Age:* 65 for males; 60 for females  *Contributions:* 15 years  *Early pension*  *Age:* 62 for males; 57 for females  *Contributions:* 15 years | *Standard pension*  *Age:* 65 for males; 60 for females  *Contributions:* 15 years  *Early pension*  *Age:* 64 for males; 59 for females  *Contributions:* 15 years |
| **Belgium\*** | *Standard pension*  *Age:* 65  *Early pension*  *Age:* 60  *Contributions:* 35 years | *Standard pension*  *Age:* 65  *Early pension*  *Age and contributions:* 61 and 6 months if 40 years of contributions; 60 if 41 years of contributions |
| **Czech Republic\*** | *Standard pension*  *Age:* 62 and 2 months for males; depends upon the number of children for females (61 if no children, 60 if 1 child, 59 if 2 children, 58 if 3 or 4 children, 57 if 5 or more children)  *Contributions:* 27 years (17 years if age of 65)  *Early pension*  *Age:* up to 3 years before standard pension age  *Contributions:* 27 years | *Standard pension*  *Age:* 62 and 10 months for males; depends upon the number of children for females (62 if no children, 61 if 1 child, 60 if 2 children, 59 if 3 or 4 children, 58 if 5 or more children)  *Contributions:* 31 years (20 years if age of 67 and 10 months)  *Early pension*  *Age:* up to 3 years before the standard pension age if it is less than 63 (up to 5 years before if it is 63 or more), 60 is the minimum  *Contributions:* 31 years |
| **Denmark** | *Standard pension*  *Age*: 65 (67 for those who had reached the age of 60 on 1.7.1999)  *Early pension*  Not applicable | *Standard pension*  *Age*: 65 (67 for those who had reached the age of 60 on 1.7.1999)  *Early pension*  Not applicable |
| **Estonia\*** | *Standard pension*  *Age:* 63 for males; 61 for females  *Contributions:* 15 years  *Early pension*  *Age:* up to 3 years before the standard pension age  *Contributions:* 15 years | *Standard pension*  *Age:* 63 for males; 62 and 6 months for females  *Contributions:* 15 years  *Early pension*  *Age:* up to 3 years before the standard pension age  *Contributions:* 15 years |
| **France\*** | *Standard pension*  *Age:*  If minimum period of contributions completed: 60 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by four months per birth year to reach 62 for persons born in 1956 or later.  If minimum period of contributions not completed: 65 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by 4 month per birth year to reach 67 for persons born in 1956 or later.  *Contributions:*  Determined according to the birth year of the person concerned - 1949: 160 quarters, 1952: 164 quarters  *Early pension*  *Age:* 55-57 according to a range of conditions, including the applicable scheme, the year of birth, the age at commencement of activity, the duration of contributions | *Standard pension*  *Age:*  If minimum period of contributions completed: 60 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by four months per birth year to reach 62 for persons born in 1955 or later.  If minimum period of contributions not completed: 65 for persons born before 1 July 1951. As of 1 July 2011, gradual increase by 5 month per birth year to reach 67 for persons born in 1955 or later.  *Contributions:*  Determined according to the birth year of the person concerned - 1952: 164 quarters; 1953 and 1954: 165 quarters, 1955 and 1956: 166 quarters  *Early pension*  *Age:* 55-57 according to a range of conditions, including the applicable scheme, the year of birth, the age at commencement of activity, the duration of contributions |
| **Germany\*** | *Standard pension*  *Age:* 65  *Contributions:* 5 years  *Early pension*  *Age and contributions:* 63 if 35 years of contributions; 60 for women born before 1952 if 15 years of contributions | *Standard pension*  *Age:* 67 if born after 1963;65 and 2 months if born after 1947  *Contributions:* 5 years  *Early pension*  *Age and contributions:* 63 if 35 years of contributions; 60 for women born before 1952 if 15 years of contributions |
| **Italy\*** | *Standard pension*  *Age:* 66 for males; 61 for females working in the public sector; 60 for the other females  *Contributions:* 20 years (5 if retiring at age of 70 for those first insured after 1996)  *Early pension*  *Age and contributions:* 60 for employed (61 for self-employed) if 36 years of contributions; any age if 40 years of contributions | *Standard pension*  *Age:* 66 and 3 months for males; 66 and 3 months for females working in the public sector; 64 and 9 months for self-employed females; 63 and 9 months for other females  *Contributions:* 20 years (5 if retiring at age of 70)  *Early pension*  *Age and contributions:* 63 and 3 months for those first insured since 1996 if 20 years of contributions; any age for males if 42 years and 6 months of contributions; any age for females if 41 years and 6 months of contributions |
| **Slovenia\*** | *Standard pension*  *Age:* 63  *Contributions:* 15 years  *Early pension*  *Age and contributions:* 63 for males and 61 for females if 20 years of contributions; 58 for males if 40 years of contributions; 58 for females if 38 years of contributions | *Standard pension*  *Age:* 65  *Contributions:* 15 years  *Early pension*  *Age:* 60  *Contributions:* 40 years |
| **Spain\*** | *Standard pension*  *Age:* 65  *Contributions: 1*5 years  *Early pension*  Not applicable | *Standard pension*  *Age:* 65 and 3 months  *Contributions: 1*5 years  *Early pension*  *Age:* up to 2 years before the standard pension age  *Contributions:* 35 years |
| **Sweden** | *Standard pension*  *Age:* 65  *Early pension*  *Age:* 61 | *Standard pension*  *Age:* 65  *Early pension*  *Age:* 61 |
| **Switzerland** | *Standard pension*  *Age:* 65 for males; 63 for females  *Early pension*  *Age:* 63 for males; 62 for females | *Standard pension*  *Age:* 65 for males; 63 for females  *Early pension*  *Age:* 63 for males; 62 for females |

1. **Added individuals who changed jobs between 2011 and 2015 when it was possible to extract historic ISCO codes**

Such situations are not very common though -> 182 individuals in the final sample.

1. **Allowed unbalanced sample**

Now we additionally have individuals who participated only in one of the waves. This allowed me to bring data from 6 additional countries that only participated in wave 6: Hungary, Netherlands, Poland, Portugal, Greece, and Luxembourg. Knowing the retirement rules in all countries, I was able to impute the work horizon change induced by reforms for such cases even though we don’t have data for wave 4.

1. **Introduced more restrictions to the data and sample**

Due to the last two steps, the sample increased. However, after exploring the data and experimenting with models, I saw that the results became more reasonable when introducing stricter rules of sample selection. So, in addition to the main filters (age of 50+, status of employed or self-employed, not working beyond the predicted minimum retirement age, no missing values), I kept only individuals with at least 10 years of work experience as of 2011 and with a work horizon before the minimum retirement age of no more than 10 years. I also strictly deleted individuals benefiting from any kind of state pension.

Moreover, I have changed the treatment of job quality data: I have aggregated the indices by year and by country, allowing for more precision. However, I also chose to leave 3-digit ISCO codes in order not to lose too many observations. I ran regression analyses both with 4-digit (less data) and 3-digit codes, and the latter showed better results.

The resulting new sample is as follows.

**Appendix 1 - Summary descriptive statistics for the final SHARE sample (updated)**

|  |  |  |
| --- | --- | --- |
|  | **Mean** | **SD** |
| *Outcome*  Euro-D score  (from 0=no depression to 12=very depressed)  Euro-D score > 3 (yes/no)  Motivation lack (yes/no)  Affective suffering (yes/no) | 1.99  0.20  0.13  0.27 | 1.88  0.40  0.34  0.45 |
| *Treatment*  ΔYTR  ΔYTR > 0 (yes/no) | 1.23  0.57 | 1.51  0.49 |
| *Covariates determining cell*  Gender (1=female, 0=male)  Age  Number of children  Years of contribution to social security  Sector of employment  Private (yes/no)  Public (yes/no)  Self-employed (yes/no) | 0.55  56.24  1.82  35.45  0.59  0.30  0.11 | 0.50  2.97  1.25  5.32  0.49  0.46  0.31 |
| *Additional covariates*  Number of grandchildren  Living as a couple (yes/no)  Years of full-time education  Net household income  Savings (yes/no)  Life insurance (yes/no)  Self-perceived general health  (from 0=excellent to 5=poor)  Number of chronic diseases  Residual work horizon | 0.95  0.80  12.71  52,842.88  0.51  0.35  3.33  0.99  4.84 | 1.64  0.40  4.34  76,034.80  0.50  0.48  0.95  1.09  2.32 |
| N observations | 4,310 | |

The updated job quality indices are as follows.

**Appendix 3 – Composition and summary descriptive statistics of job quality indices for the final SHARE sample (updated)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | **Dimension** | **Components** | **Mean (SD)** | |
| **2010** | **2015** |
| **Physical environment** | *Ambient* | Exposure to vibrations from hand tools, machinery  Exposure to noise so loud that you would have to raise your voice to talk to people  Exposure to high temperatures that make you perspire even when not working  Exposure to low temperatures whether indoors or outdoors  Exposure to breathing in smoke, fumes, powder or dust | 83.50  (9.56) | 86.19 (7.99) |
| *Posture related* | Posture-related painful or tiring positions  Carrying or moving heavy loads  Repetitive hand or arm movements |
| *Biological, chemical conditions* | Handling or being in direct contact with dangerous substances such as chemicals or infectious materials |
| **Social environment** | *Adverse social behaviour* | *In the last month:*  Exposure to verbal abuse  Exposure to unwanted sexual attention  Exposure to threats  *In the last year:*  Exposure to physical violence  Exposure to sexual harassment  Exposure to bullying/harassment | 81.65  (6.49) | 79.24  (6.02) |
| *Social support* | *Management quality:*  Your immediate boss respects you as a person  Your immediate boss provides useful feedback in your work  *Social support:*  Help and support from colleagues (most of the time/always)  Help and support from your manager (most of the time/always) |
| **Intensity** | *Quantitative demands* | Working at very high speed (three-quarters of the time or more)  Working to tight deadlines (three-quarters of the time or more)  Enough time to get the job done (never or rarely)  Frequent disruptive interruptions | 41.15  (11.71) | 40.64  (10.77) |
| *Pace determinants and interdependency* | Interdependency: three or more pace determinants  Work pace dependent on: the work done by colleagues  Work pace dependent on: direct demands from people such as customers, passengers, pupils, patients, etc  Work pace dependent on: numerical production targets or performance targets  Work pace dependent on: automatic speed of a machine or movement of a product  Work pace dependent on: the direct control of your boss |
| *Emotional demands* | Hiding your feelings at work (most of the time or always)  Handling angry clients, customers, patients, pupils, etc. (three-quarters of the time or more) |
| **Working time quality** | *Duration* | Long working hours (48 h or more a week)  Long working days (10h or more a day) | 86.76  (9.84) | 87.57  (9.74) |
| *Atypical working time* | Night work  Saturday work  Sunday work  Shift work |
| *Working time arrangements* | Set by the company  Can choose between different schedules  Can adapt working hours  Entirely determined by self  Change in working time arrangements  No regular change  Change the same day  Change the day before  Change several days in advance  Change several weeks in advance |
| **Skills and discretion** | *Cognitive dimension* | Solving unforeseen problems  Carrying out complex tasks  Learning new things  Working with computers, smartphones and laptops, etc. (at least a quarter of the time)  Ability to apply your own ideas in work | 58.10  (14.70) | 60.50  (13.75) |
| *Decision latitude* | Ability to choose or change order of tasks  Ability to choose or change speed or rate of work  Ability to choose or change methods of work  Having a say in choice of work colleagues |
| *Organisational participation* | Consulted before objectives are set for own work (‘always’ or ‘most of the time’)  Involved in improving the work organisation or work processes of own department or organisation (‘always’ or ‘most of the time’)  Ability to influence decisions that are important for your work (‘always’ or ‘most of the time’) |
| *Training* | Training paid for or provided by employer over the past 12 months (or paid by oneself if self-employed)  On-the-job training over the past 12 months Trend index score (maximum 100) |
| **Prospects** | *Career prospects* | Job offers good prospects for career advancement | 55.35  (12.30) | 62.54  (10.86) |
| *Job security* | Might lose job in the next six months |
| **Overall job quality (sum of indices)** | | | **424.23**  **(38.87)** | **421.33**  **(40.27)** |

1. **Experimented with models**

The best results came from the following model, which I ran as it is and on reduced samples by 1) gender, and 2) job quality indices below/above their mean values + - standard deviation (when taking below/above median the effects were not as visible):

*regress eurod i.did i.treated i.post i.gender age agesq nb\_children nb\_grandchildren i.partnerinhh yrseducation thinclog i.life\_insurance sphus chronic jqi\_skills\_discretion jqi\_physical\_environment jqi\_social\_environment jqi\_working\_time\_quality jqi\_intensity jqi\_prospects [aweight=cciw], vce(cluster cell)*

*Treated* hereis a dummy for work horizon change > 0. *Post* is a dummy for year = 2015. *Did* is *treated\*post*. Among the control variables there are demographic characteristics and job quality indices. Calibrated cross-sectional weights are applied (not the longitudinal ones as they are only available for a balanced panel). The standard errors are clustered at the level of cell, which is defined by country and gender.

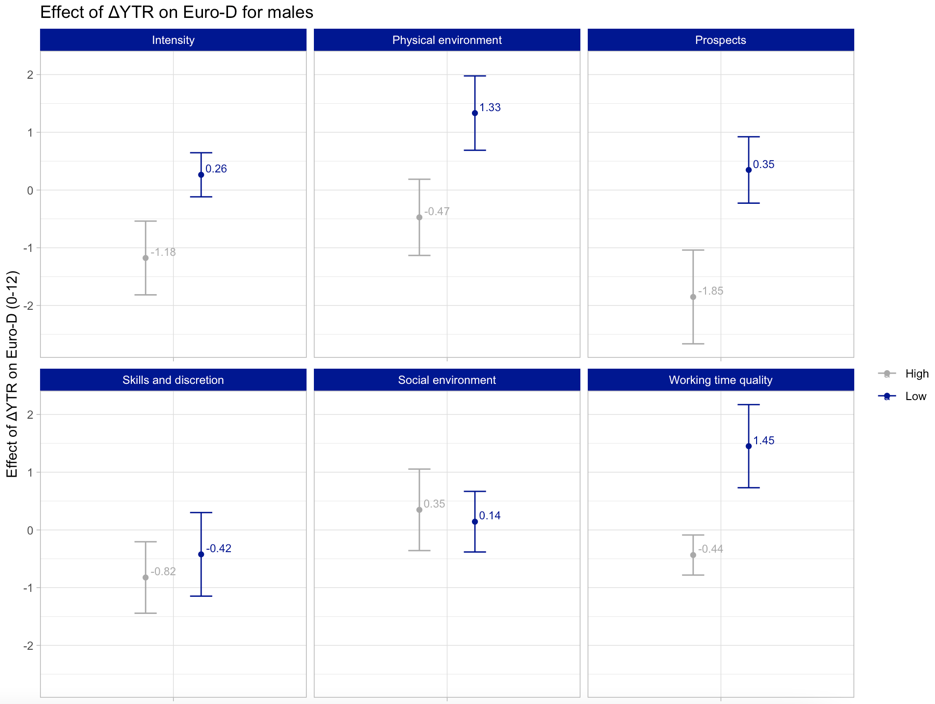
The results are as follows.

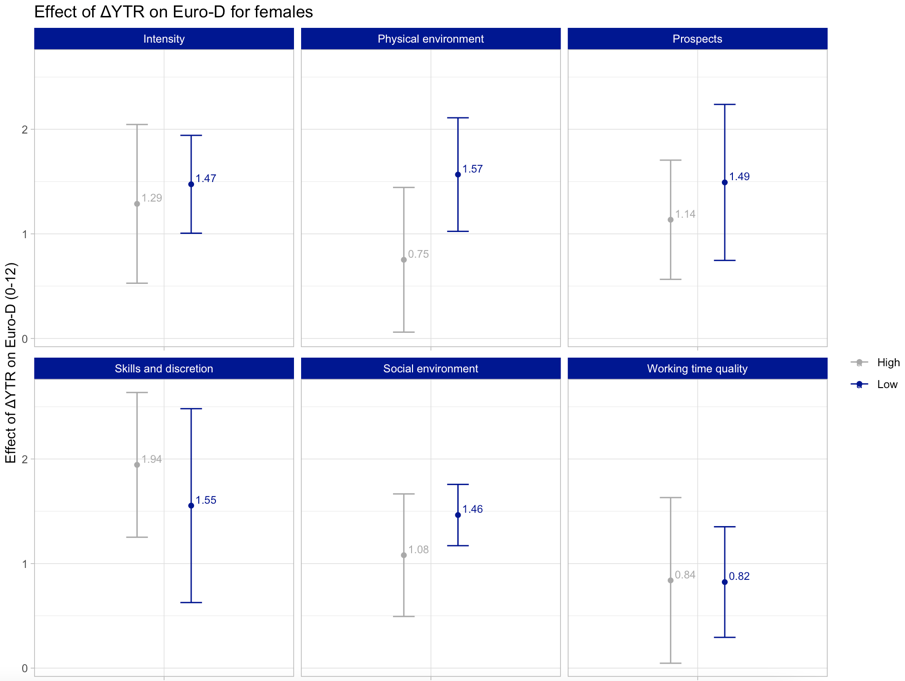
**Heterogeneous effects of work horizon increase (ΔYTR >0) on depression (EuroD (0-12)) depending on working conditions (updated)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | -0.151  (0.488) | -0.588  (0.548) | 0.482  (0.291) |
| **JQI physical environment** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.488  (0.429)  0.111  (0.725)  *0.533* | 1.333\*  (0.644)  -0.473  (0.660)  *0.031* | 1.567\*\*  (0.543)  0.752  (0.692)  *0.040* |
| **JQI social environment** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.184  (0.642)  -0.169  (0.551)  *0.433* | 0.143  (0.525)  0.348  (0.706)  *0.779* | 1.464\*\*\*  (0.293)  1.080\*  (0.586)  *0.522* |
| **JQI skills and discretion** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | -0.356  (0.724)  0.283  (0.961)  *0.214* | -0.423  (0.724)  -0.824  (0.619)  *0.597* | 1.554  (0.927)  1.944\*\*  (0.692)  *0.645* |
| **JQI working time quality** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.677  (0.510)  0.293  (0.527)  *0.513* | 1.451\*  (0.720)  -0.435  (0.347)  *0.027* | 0.823  (0.529)  0.839  (0.792)  *0.980* |
| **JQI intensity** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 1.538\*\*\*  (0.338)  -0.602  (0.452)  *0.001* | 0.264  (0.382)  -1.177\*  (0.639)  *0.013* | 1.474\*\*\*  (0.468)  1.287  (0.759)  *0.456* |
| **JQI prospects** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.179  (0.768)  -0.788  (0.754)  *0.017* | 0.348  (0.575)  -1.852\*\*  (0.812)  *0.000* | 1.492\*  (0.746)  1.135\*  (0.570)  *0.617* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

And some visualizations.





Observations:

* Taking the full sample, males experience a slight improvement in mental health after reforms, while females – a slight deterioration. The results though are not statistically significant.
* When running regressions on reduced samples with low job quality indices, mental health shows deterioration in all cases except for males with a low index of skills and discretion. In most cases, the effect is weaker for women and weaker or even the opposite (amelioration of mental health) for men when analyzing those with high job quality.
* The effect of increased work horizon on mental health is statistically significant for (*in italic* – those with significant differences between samples):
  + *men and women working in poor physical environments (1.333 and 1.567 respectively),*
  + women working in poor social environments (1.464),
  + women in jobs with high skills and discretion (1.944, which could be due to a high cognitive burden),
  + *men suffering from poor working time quality (1.451),*
  + women in high-intensity jobs (1.474) and *men in low-intensity jobs (-1.177),*
  + *men with good job prospects (-1.852).*

I undertook the same strategy with linear probability models by choosing a dummy variable for EuroD > 3 (*eurodcat*) as the dependent variable.

*regress* ***eurodcat*** *i.did i.treated i.post i.gender age agesq nb\_children nb\_grandchildren i.partnerinhh yrseducation thinclog i.life\_insurance sphus chronic jqi\_skills\_discretion jqi\_physical\_environment jqi\_social\_environment jqi\_working\_time\_quality jqi\_intensity jqi\_prospects [aweight=cciw], vce(cluster cell)*

The results are coherent with the previously presented with slight variations.

The new findings (*in italic* – those with significant differences between samples):

* significant effect in case of poor social environment for men (0.197),
* *significant effect in jobs with poor prospects both for men (0.248) and women (0.724).*

**Heterogeneous effects of work horizon increase (ΔYTR >0) on the probability of depression (EuroD > 3) depending on working conditions (updated)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | -0.003  (0.078) | -0.046  (0.081) | 0.081  (0.065) |
| **JQI physical environment** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.158  (0.125)  0.110  (0.176)  *0.735* | 0.162\*  (0.085)  -0.090  (0.141)  *0.040* | 0.572\*\*\*  (0.176)  0.320\*  (0.173)  *0.040* |
| **JQI social environment** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.155  (0.110)  0.034  (0.257)  *0.433* | 0.197\*  (0.099)  -0.057  (0.155)  *0.179* | 0.492\*\*\*  (0.078)  0.396\*\*  (0.157)  *0.647* |
| **JQI skills and discretion** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | -0.041  (0.119)  0.052  (0.184)  *0.407* | 0.023  (0.085)  -0.223  (0.156)  *0.021* | 0.382\*\*\*  (0.115)  0.499\*\*  (0.180)  *0.421* |
| **JQI working time quality** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.217\*  (0.125)  0.213  (0.138)  *0.923* | 0.280\*  (0.131)  -0.011  (0.108)  *0.073* | 0.401\*\*  (0.142)  0.435\*\*  (0.181)  *0.844* |
| **JQI intensity** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.375\*\*\*  (0.101)  -0.029  (0.055)  *0.000* | 0.196  (0.188)  -0.116\*  (0.065)  *0.052* | 0.472\*\*\*  (0.108)  0.523\*\*  (0.184)  *0.926* |
| **JQI prospects** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.208  (0.222)  -0.077  (0.166)  *0.008* | 0.248\*\*  (0.103)  -0.249\*  (0.120)  *0.000* | 0.724\*\*\*  (0.123)  0.394\*\*  (0.133)  *0.056* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

I also ran the same regressions without controls.

*regress* ***eurod*** *i.did i.treated i.post [aweight=cciw], vce(cluster cell)*

*regress* ***eurodcat*** *i.did i.treated i.post [aweight=cciw], vce(cluster cell)*

The results are close to the ones presented before for most regressions although they appear statistically significant more rarely.

Finally, as a validation, I ran these regressions (both with and without controls) with a treatment variable in continuous – *work horizon change (in years)*.

Again, the results are mostly coherent, but rarely significant + usually show smaller effects.

I have not done a beautiful table for all these manipulations, but here is a summary table I did for myself to record the results.



**To discuss:**

* Including fixed effects by 1digit ISCO
* Including fixed effects by industry
* Including fixed effects by cell

I am not sure how to choose as I fear to overwhelm the model with too many dummies. By experimenting I see that including only cell-fixed effects makes results less coherent. However, including 1digit ISCO or industry dummies as well as including cell dummies in combination with one or both of them alternate results in an acceptable and interesting way (some of the effects become a lot stronger in the “desired” direction (with some coefficients > 2), but some, on the contrary, fade away and loose significance).

The following results are, for example, for the case when all three are included. I highlighted some interesting moments compared to the results without these new dummies **in bold**.

*regress* ***eurod*** *i.did i.treated i.post i.gender age agesq nb\_children nb\_grandchildren i.partnerinhh yrseducation thinclog i.life\_insurance sphus chronic jqi\_skills\_discretion jqi\_physical\_environment jqi\_social\_environment jqi\_working\_time\_quality jqi\_intensity jqi\_prospects* ***i.isco1 i.industry\_encoded i.cell\_encoded*** *[aweight=cciw], vce(cluster cell)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | -0.321  (0.488) | -0.718  (0.468) | 0.285  (0.326) |
| **JQI physical environment** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.533  (0.493)  -0.365  (0.769)  *0.236* | 1.172\*\*\*  (0.356)  **-1.382\*\***  (0.597)  *0.001* | 1.231\*  (0.686)  0.552  (0.685)  *0.310* |
| **JQI social environment** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.377  (0.981)  -0.816  (0.914)  *0.175* | 0.442  (0.707)  -1.030  (0.589)  ***0.079*** | 0.700  (0.406)  0.845  (0.658)  *0.775* |
| **JQI skills and discretion** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.224  (0.864)  -0.299  (1.174)  *0.613* | -0.021  (0.696)  **-1.562\*\***  (0.604)  ***0.091*** | **2.283\***  (1.107)  1.913\*\*\*  (0.340)  *0.746* |
| **JQI working time quality** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.452  (0.663)  0.285  (0.741)  *0.840* | 1.194  (0.739)  -0.603  (0.521)  *0.064* | 0.112  (0.817)  1.731  (1.033)  ***0.049*** |
| **JQI intensity** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 1.361\*  (0.679)  -0.890\*\*  (0.390)  *0.002* | 0.284  (0.687)  -1.444\*\*  (0.659)  *0.032* | **2.351\*\***  (0.929)  0.384  (0.531)  ***0.065*** |
| **JQI prospects** | **<= mean - sd**  **>= mean + sd**  *p-value for equality* | 0.159  (0.888)  -1.116  (0.901)  *0.078* | 0.658  (0.583)  -1.963\*\*  (0.727)  *0.003* | 1.754\*\*  (0.665)  1.580\*\*  (0.553)  *0.807* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

* What other tests can be done to ensure robustness, etc.

**One last remark about ISCO codes and the number of observations**

I also tried to run a test by selecting all individuals without necessarily having ISCO codes available to confirm the effects on the level of reforms without considering job quality. However, what I found is that we actually have ISCO codes available for the vast majority of individuals. Most of the observations that we lose are because of different restrictions on the sample (as the fact of being employed throughout the period of study) and not because of missing ISCO codes.

I also checked with Bertoni’s paper, and I saw that, although they have 18750 observations in total, the number is around 4000-5000 for each pair of waves. Considering that they applied very similar filters while choosing the sample, that makes our current number of observations (4310) quite reasonable.

**Update 19/03/2024**

**Focus on EWCS**

1. Put together two waves of the EWCS and calculated country-wise mean values for each index based on a) 4-digit and b) 3-digit ISCO codes aggregation
2. Filtered data to only include ISCO codes with at least 10 observations, which resulted in the final dataset including:
   * 120 out of 130 (92%) 3-digit ISCO codes (5016 observations)
   * 301 out of 436 (69%) 4-digit ISCO codes (4190 observations)
3. Re-scaled the overall index to 0-100 and included in the models
4. Excluded data from countries that only participated in wave 6 (though we will be able to include it again when we introduce wave 5 as they all participate in it as well)
5. Ran models with cell-fixed effects taking samples below the 25th percentile / above the 75th percentile when splitting by job quality indices

**New means for job quality indices:**

|  |  |  |
| --- | --- | --- |
| **Index** | **Mean (sd) 3-digit ISCO data** | **Mean (sd) 4-digit ISCO data** |
| **JQI skills and discretion** | 59.19 (14.04) | 59.15 (14.83) |
| **JQI physical environment** | 84.98 (8.45) | 85.29 (9.17) |
| **JQI social environment** | 80.32 (5.44) | 80.01 (6.74) |
| **JQI working time quality** | 87.01 (9.21) | 86.98 (11.22) |
| **JQI intensity** | 40.86 (10.23) | 41.18 (12.45) |
| **JQI prospects** | 59.75 (10.95) | 59.74 (12.94) |
| **JQI overall** | 65.61 (8.44) | 65.68 (9.38) |

**New model results (only linear model with EuroD 0-12):**

*regress* ***eurod*** *i.did i.treated i.post i.gender age agesq nb\_children nb\_grandchildren i.partnerinhh yrseducation thinclog i.life\_insurance sphus chronic jqi\_skills\_discretion jqi\_physical\_environment jqi\_social\_environment jqi\_working\_time\_quality jqi\_intensity jqi\_prospects jqi\_overall* ***i.cell*** *[aweight=cciw], vce(cluster cell)*

The results after these manipulations are rather strange, some coefficients are not what we would expect them to be. Maybe aggregating job quality indices by treating the 2010 and 2015 datasets as one was not the best decision?

**3-digit ISCO codes data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | -0.184  (0.444) | -0.699  (0.448) | 0.472  (0.389) |
| **JQI overall** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.507  (0.334)  0.229  (0.456)  *0.780* | 0.010  (0.392)  -0.560  (0.394)  *0.024* | 0.585\*  (0.318)  0.976\*\*\*  (0.231)  *0.074* |
| **JQI physical environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.237  (0.420)  0.561  (0.529)  *0.193* | -0.625  (0.779)  0.086  (0.761)  *0.092* | 0.849  (0.519)  0.568  (0.385)  *0.638* |
| **JQI social environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | -0.207  (0.578)  0.502  (0.390)  *0.009* | -0.506  (0.325)  -0.475  (0.531)  *0.976* | 0.834  (0.687)  1.236\*\*\*  (0.134)  *0.322* |
| **JQI skills and discretion** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | -0.547  (0.521)  0.452  (0.553)  *0.000* | -0.376  (0.258)  -0.979  (0.592)  *0.890* | 0.508  (0.459)  1.487\*\*  (0.473)  *0.021* |
| **JQI working time quality** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.267  (0.433)  0.007  (0.494)  *0.858* | -0.169  (0.293)  -0.497  (0.617)  *0.499* | 0.279  (0.482)  0.750\*  (0.374)  *0.017* |
| **JQI intensity** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.319  (0.489)  -0.264  (0.392)  *0.607* | -0.480  (0.301)  -0.512  (0.475)  *0.891* | 0.847\*\*  (0.344)  0.688\*\*  (0.235)  *0.376* |
| **JQI prospects** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.583  (0.459)  0.222  (0.475)  *0.420* | -0.697  (0.514)  -0.713  (0.685)  *0.953* | 1.298\*\*  (0.584)  1.042\*\*  (0.350)  *0.645* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

**Add wave 5**

1. Added wave 5 of SHARE.
2. Grouped data into blocks: 1) wave 4 + wave 5, 2) wave 5 + wave 6. The data for wave 5 is therefore repeated 2 times, as a post-treatment period in block 1 and as a pre-treatment period in block 2.
3. Added information on retirement rules for 2013 and calculated retirement ages, work horizons, etc.
4. Merged with EWCS data based on the country and ISCO codes (as now we don’t have the year component for job quality indices, it’s perfectly fine).
5. Replaced cell fixed effects with *cell by block* fixed effects in the regressions, clustered errors by *cell by block* too.

These actions allowed to save data from the Netherlands, Poland, Portugal, and Luxembourg as they participated in wave 5 as well as wave 6.

The resulting dataset has 12 648 observations for 3-digit ISCO data and 10 594 observations for 4-digit ISCO data.

**New model results (only linear model with EuroD 0-12):**

*regress* ***eurod*** *i.did i.treated i.post i.gender age agesq nb\_children nb\_grandchildren i.partnerinhh yrseducation thinclog i.life\_insurance sphus chronic jqi\_skills\_discretion jqi\_physical\_environment jqi\_social\_environment jqi\_working\_time\_quality jqi\_intensity jqi\_prospects jqi\_overall* ***i.cell\_block*** *[aweight=cciw], vce(cluster cell\_block)*

The results after adding wave 5 are also not very reassuring, some coefficients fall out of the expected range. Still related to the change in the EWCS data treatment? Moreover, the effects are significantly lower in amplitude. I guess this can be related to the fact that the amplitude of reforms is also lower when comparing the periods of 2 years in between the waves, instead of a greater period of 4 years as it was for waves 4 and 6.

**3-digit ISCO codes data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | -0.101  (0.135) | -0.288\*  (0.162) | 0.137  (0.204) |
| **JQI overall** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.105  (0.179)  -0.169  (0.251)  *0.335* | 0.142  (0.128)  -0.434\*  (0.221)  *0.053* | -0.122  (0.238)  0.079  (0.473)  *0.619* |
| **JQI physical environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.025  (0.190)  -0.143  (0.266)  *0.606* | 0.070  (0.235)  -0.490\*  (0.285)  *0.142* | 0.077  (0.273)  0.095  (0.453)  *0.968* |
| **JQI social environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.054  (0.145)  -0.118  (0.212)  *0.430* | -0.002  (0.162)  -0.425\*\*\*  (0.151)  *0.003* | 0.085  (0.266)  0.061  (0.396)  *0.934* |
| **JQI skills and discretion** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | -0.242  (0.226)  -0.340  (0.222)  *0.745* | -0.229  (0.285)  -0.693  (0.181)  *0.175* | -0.226  (0.240)  0.142  (0.420)  *0.284* |
| **JQI working time quality** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | -0.079  (0.174)  -0.248  (0.291)  *0.550* | 0.039  (0.139)  -0.403  (0.304)  *0.271* | -0.192  (0.320)  0.222  (0.478)  *0.329* |
| **JQI intensity** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.212  (0.241)  -0.403\*\*  (0.174)  *0.028* | -0.037  (0.301)  -0.395\*  (0.221)  *0.339* | 0.135  (0.344)  -0.049  (0.465)  *0.733* |
| **JQI prospects** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.151  (0.181)  -0.221  (0.206)  *0.063* | -0.040  (0.189)  -0.572\*\*\*  (0.173)  *0.051* | 0.221  (0.274)  0.357  (0.419)  *0.689* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

1. Took a balanced sample by blocks (individuals are present both in wave 4 and 5 in the first block and both in wave 5 and 6 in the second block). Due to this, I can save data from countries that joined SHARE only in wave 5.

The resulting dataset has 8 436 observations for 3-digit ISCO data and 7 002 observations for 4-digit ISCO data.

The results of regressions are a lot more coherent with the balanced samples. The effects are more pronounced when using data based on 4-digit ISCO codes.

*regress* ***eurod*** *i.did i.treated i.post i.gender age agesq nb\_children nb\_grandchildren i.partnerinhh yrseducation thinclog i.life\_insurance sphus chronic jqi\_skills\_discretion jqi\_physical\_environment jqi\_social\_environment jqi\_working\_time\_quality jqi\_intensity jqi\_prospects jqi\_overall* ***i.cell\_block*** *[aweight=cciw], vce(cluster cell\_block)*

*regress* ***eurod*** *i.did i.treated i.post* ***i.cell\_block*** *[aweight=cciw], vce(cluster cell\_block)*

**4-digit ISCO codes data – no controls**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | 0.083  (0.090) | 0.057  (0.135) | 0.101  (0.131) |
| **JQI overall** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.374  (0.236)  0.078  (0.236)  *0.353* | -0.011  (0.222)  0.016  (0.161)  *0.924* | **0.480\***  **(0.274)**  0.222  (0.458)  *0.578* |
| **JQI physical environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.612\*\***  **(0.296)**  -0.076  (0.153)  ***0.068*** | 0.711  (0.469)  **-0.434\*\*\***  **(0.136)**  ***0.018*** | 0.400  (0.330)  0.034  (0.247)  *0.380* |
| **JQI social environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.067  (0.149)  -0.055  (0.140)  *0.595* | -0.0004  (0.145)  -0.090  (0.183)  *0.729* | 0.098  (0.303)  0.006  (0.190)  *0.828* |
| **JQI skills and discretion** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.166  (0.227)  -0.058  (0.231)  *0.498* | 0.422  (0.329)  -0.156  (0.228)  *0.177* | -0.206  (0.414)  0.413  (0.306)  *0.265* |
| **JQI working time quality** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.626\*\***  **(0.257)**  0.026  (0.319)  *0.141* | 0.714  (0.591)  -0.214  (0.246)  ***0.065*** | **0.638\*\*\***  **(0.219)**  0.281  (0.487)  *0.564* |
| **JQI intensity** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.611\*\***  (0.269)  -0.121  (0.254)  ***0.053*** | **0.869\*\***  **(0.389)**  **-0.416\*\*\***  **(0.144)**  ***0.005*** | 0.304  (0.265)  0.131  (0.409)  *0.690* |
| **JQI prospects** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.385  (0.248)  -0.204  (0.405)  ***0.032*** | **0.673\***  **(0.339)**  **-0.830\*\*\***  **(0.288)**  ***0.000*** | 0.075  (0.292)  0.379  (0.258)  *0.398* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

**4-digit ISCO codes data – with controls**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | 0.047  (0.083) | -0.103  (0.092) | 0.147  (0.128) |
| **JQI overall** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.239  (0.196)  0.083  (0.231)  *0.562* | -0.087  (0.271)  0.002  (0.193)  *0.797* | **0.747\*\***  **(0.292)**  0.092  (0.364)  *0.191* |
| **JQI physical environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.382\***  **(0.218)**  -0.106  (0.209)  *0.165* | 0.464  (0.354)  **-0.628\*\*\***  **(0.160)**  ***0.003*** | 0.439  (0.271)  0.095  (0.453)  *0.501* |
| **JQI social environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.125  (0.173)  -0.181  (0.124)  *0.242* | -0.021  (0.153)  -0.253  (0.184)  *0.393* | 0.282  (0.312)  -0.077  (0.183)  *0.418* |
| **JQI skills and discretion** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.084  (0.179)  -0.074  (0.227)  *0.535* | 0.239  (0.212)  -0.335  (0.246)  ***0.082*** | -0.191  (0.466)  0.142  (0.420)  *0.382* |
| **JQI working time quality** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.457\*\***  **(0.212)**  0.086  (0.332)  *0.369* | 0.311  (0.398)  -0.234  (0.205)  *0.135* | **0.643\*\*\***  **(0.217)**  0.458  (0.480)  *0.755* |
| **JQI intensity** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.438\*\***  **(0.195)**  -0.103  (0.248)  ***0.084*** | **0.474\***  **(0.243)**  **-0.557\*\***  **(0.206)**  ***0.008*** | 0.411  (0.267)  0.225  (0.367)  *0.600* |
| **JQI prospects** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.325  (0.202)  -0.356  (0.232)  ***0.006*** | 0.377  (0.234)  **-0.754\*\***  **(0.330)**  ***0.001*** | 0.257  (0.371)  0.101  (0.238)  *0.683* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

**Update 04/04 – DID with robust approach**

**Borusyak et al. (2021)**

This method is well adapted for multi-period DID designs. It provides robust estimations taking into account the heterogeneity of effects between groups and the dynamic effects of treatment in time. It considers time-varying control variables to ensure the validity of the parallel trend assumption. The treated group is compared only to those never treated and only to the first pre-treatment period. Cell fixed effects are included to ensure better precisions of estimations and lower standard errors as a result.

The following model estimates the effect of increased retirement ages (defined as binary only at the moment an individual is first treated) on mental health (EuroD 0-12) with a repeated cross-section specification, time-varying controls, and cell-by-year fixed effects. The standard errors are clustered by cell. The data used is based on 4-digit ISCO codes.

*did\_imputation eurod mergeid year first\_treated [aw=cciw], fe(cell1 year) controls(age nb\_children nb\_grandchildren partnerinhh thinclog life\_insurance sphus chronic) autosample cluster(cell1) hetby(level)*

This model also allows an advantage when estimating the heterogeneity of effects depending on job quality indices. It provides separate effects by sub-groups based on the whole sample estimation, so there is no need to take only the small parts of the sample corresponding to above 75th percentile/ below 25th percentile, but instead we can preserve the full sample for all estimations. Calculation of differences between high/low job quality sub-groupsis done as follows:

*lincom tau\_high-tau\_low*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | 0.013  (0.208) | -0.035  (0.260) | 0.002  (0.253) |
| **JQI physical environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.390\***  **(0.207)**  **-0.336\*\*\***  **(0.112)**  ***0.000*** | 0.316  (0.339)  **-0.467\*\*\***  **(0.163)**  ***0.013*** | 0.227  (0.258)  **-0.353\*\*\***  **(0.119)**  ***0.046*** |
| **JQI social environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | -0.044  (0.226)  -0.090  (0.228)  *0.819* | -0.212  (0.213)  0.025  (0.299)  *0.331* | 0.111  (0.279)  -0.265  (0.204)  ***0.053*** |
| **JQI skills and discretion** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.285  (0.226)  -0.038  (0.259)  *0.231* | -0.004  (0.239)  0.112  (0.378)  *0.700* | **0.539\*\***  **(0.245)**  -0.452  (0.293)  ***0.007*** |
| **JQI working time quality** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.303\***  **(0.171)**  0.130  (0.179)  *0.311* | 0.352  (0.299)  -0.164  (0.222)  ***0.047*** | 0.192  (0.136)  0.149  (0.165)  *0.779* |
| **JQI intensity** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.161  (0.282)  -0.091  (0.240)  *0.333* | 0.465  (0.344)  -0.329  (0.265)  ***0.006*** | -0.302  (0.219)  0.071  (0.285)  ***0.059*** |
| **JQI prospects** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.081  (0.269)  -0.005  (0.180)  *0.665* | -0.078  (0.225)  0.078  (0.298)  *0.422* | 0.215  (0.331)  0.133  (0.261)  *0.805* |
| **JQI overall** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.313  (0.220)  -0.081  (0.242)  *0.140* | -0.276  (0.276)  0.121  (0.341)  *0.308* | **0.403\*\***  **(0.191)**  -0.282  (0.182)  ***0.008*** |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

The following calculations are without the hetby option, but taking sub-samples as we did before. They are better.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **All individuals** | **Males** | **Females** |
| **Full** | | 0.004  (0.206) | -0.093  (0.264) | 0.041  (0.237) |
| **JQI physical environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.079  (0.310)  **-0.697\*\*\***  **(0.252)**  ***0.052*** | 0.008  (0.468)  **-0.443\*\*\***  **(0.147)**  *0.358* | 0.090  (0.429)  **-1.205\*\*\***  **(0.313)**  ***0.015*** |
| **JQI social environment** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | -0.357  (0.256)  -0.272  (0.221)  *0.802* | -0.337  (0.409)  -0.080  (0.453)  *0.674* | -0.078  (0.293)  **-0.345\*\***  **(0.154)**  *0.420* |
| **JQI skills and discretion** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.066  (0.430)  **0.582\***  **(0.298)**  *0.324* | -0.365  (0.555)  0.211  (0.225)  *0.336* | -0.054  (0.435)  **0.709\***  **(0.382)**  *0.188* |
| **JQI working time quality** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.894\*\*\***  **(0.245)**  -0.134  (0.342)  ***0.015*** | 0.725  (0.472)  **-0.643\*\*\***  **(0.077)**  ***0.004*** | 0.707  (0.438)  0.114  (0.288)  *0.258* |
| **JQI intensity** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | **0.519\***  **(0.293)**  **-0.412\*\***  **(0.199)**  ***0.009*** | -0.030  (0.209)  -0.304  (0.408)  *0.550* | **0.936\*\*\***  **(0.319)**  **-0.519\*\*\***  **(0.189)**  ***0.000*** |
| **JQI prospects** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.357  (0.305)  0.291  (0.303)  *0.878* | 0.559  (0.468)  **-0.505\***  **(0.289)**  ***0.053*** | -0.056  (0.258)  **0.514\***  **(0.266)**  *0.124* |
| **JQI overall** | **<= 25th percentile**  **>= 75th percentile**  *p-value for equality* | 0.070  (0.278)  -0.123  (0.326)  *0.675* | -0.257  (0.337)  0.082  (0.439)  *0.540* | **0.589\*\***  **(0.237)**  -0.074  (0.398)  *0.152* |

\* p<0.1, \*\* p < 0.05, \*\*\*p < 0.01

**De Chaisemartin and D’Haultfœuille (2021)**

De Chaisemartin and D’Haultfœuille (2021a) instead consider time-varying covariates and assume that trends are parallel once the linear effect of those time-varying covariates on the outcome is accounted for. This for instance allows them to include group-specific linear trends in the estimation.

The advantage of their model is that it allows for continuous and categoric treatments as well as non-staggered designs.

In our case, it could be interesting as with Borusyak et al. (2021) we only mark treatment as 1 when it is first assigned, we take into account neither the differences in its intensity nor the differences between individuals that get an additional dose of treatment in 2015 and don’t get anything more.