

# Long-term Impact of Job Displacement on Job Quality and Satisfaction: Evidence from Germany\*

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## Abstract

In this research, we investigate the long-term effects of job displacement on several dimensions of job quality and satisfaction, focusing only on individuals who lose their job because of plant closure. Using the German Socio-Economic Panel data from 1984 to 2012, we build a database containing 2,396 individuals who have lost their job because of plant closure. Our control group is created by finding workers who have similar characteristics to the displaced workers before their displacement. The matching method that we use is a coarsened exact matching on pre-treatment covariates and pre-treatment outcomes. We then compare the evolution of job quality in both groups to measure the causal impact of displacement. Our main findings indicate a large and long-lasting impact of displacement on employment probability. The effects of displacement on earnings and hourly wages last until three or four years. As for job security, displaced workers report to be more likely to lose their job again. Indicators of quality of the working environment (working full time, long hours, distance to work), are all affected by displacement in the long run except the probability of working full time. These results are robust when we focus on individuals who do not experience a significant period out of employment.

**Keywords.** Job displacement, plant closure, job quality, coarsened exact matching, panel data.

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# 1 Introduction

Job loss is a major shock on an individual's career and it often has devastating consequences on workers' life trajectories. Research has shown that it entails subsequent unemployment, long-term earnings losses, and declines in psychological and physical well-being. Moreover, as underlined by Brand (2015), "while reemployment mitigates some of the negative effects of job loss, it does not eliminate them". In this paper, we investigate the effects of displacement due to plant closure that carry over to new jobs, when individuals are reemployed. More specifically, we investigate the effects of job loss on the quality of the new jobs, as measured by earnings, labour market security and the quality of the working environment, from one to ten years after displacement. We focus on displacement due to plant closure and we match workers based on their observed characteristics and time-invariant unobservables three years before treatment.

Since the 90's, the costs of displacement have been studied in terms of earnings, hourly wages and hours worked in the United States (Jacobson et al. (1993); Fallick (1996); Couch & Placzek (2010)) and Europe (Eliason & Storrie (2009); Hijzen et al. (2010)). More recently, researchers have focused on the impact on health and well-being. They found that losing one's job increases not only the risk of mortality in the United States (Sullivan & von Wachter 2009), Sweden (Eliason 2014) and Denmark (Browning & Heinesen 2012) but also unhealthy behaviours (Marcus 2014) and mental health problems (Marcus 2013). As for satisfaction, Clark et al. (2008) show that a shock in a career path, such as an unemployment spell, deteriorates subjective well-being - as measured by life satisfaction.

Another strand of the recent literature focuses on labour market outcomes and more precisely earnings, hourly wages, unemployment or self-employment status. These papers try to assess whether the impact of displacement is a long run one or whether recovery occurs shortly after displacement. They found an increase in the probability of being retired (Tatsiramos 2010) or self-employed following job loss (Von Greiff 2009). Among displaced workers, those who find a new job often experience a large and long-lasting drop of earnings until six years after displacement in the United States (Ruhm (1991); Jacobson et al. (1993)). Since the 2000's, similar papers studied the impact of job loss on earnings in Europe but results are more heterogeneous.

Wage losses are much smaller in European countries than in the United-States as demonstrated for the first time by Kuhn (2002)<sup>1</sup>. Eliason & Storrie (2006) find a large and long-run impact of job displacement on earnings in Sweden - until twelve years after displacement. Schwerdt et al. (2010) also show long-run effects in Austria, especially for white-collars. In Germany the impact seems to be smaller: displacement induces a loss of earnings until only two years after displacement (Couch 2001). The duration of income losses depends on how long it takes to find a new job after displacement, on the definition of displaced workers, and on whether downsizing due to plant closure or layoffs are considered (Hijzen et al. 2010). Couch & Placzek (2010) revisit the impact in the United-States using matching estimators, and find lower impacts than previous studies (for instance Fallick (1996), Jacobson et al. (1993)). The impact also varies when using alternative definitions of displaced workers (Hijzen et al. 2010).

All these papers focus on earnings and/or hourly wages as the unique dimension of job quality. However, job quality is a multi-dimensional concept and all dimensions contribute to the well-being of workers. Beyond wages and unemployment, other indicators must be taken into account to properly capture the overall impact of job displacement.

The European Foundation for the Improvement of Living and Working Conditions selects four indicators of job quality which are of greatest importance to workers: earnings, career prospects, working-time quality and the quality of the working environment (Eurofound (2015); Eurofound (2012)). The OECD (2014) develops a framework including three key dimensions of job quality which partly overlap with the previous ones: earnings quality, labour market security and quality of the working environment.

In this paper, we estimate the impact of displacement on monetary outcomes - earnings, hourly wages -, self-reported labour market security and the quality of the working environment as measured by the probability to work full-time and to work long hours, distance to work, the gap between desired and actual hours worked, job satisfaction and life satisfaction. The data we use

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<sup>1</sup>Bender et al. (2002), Borland et al. (2002) and Albæk et al. (2002) provide respectively evidence for France, Germany, United Kingdom, Australia, Belgium and Denmark.

come from the German Socio-Economic Panel (SOEP) which contains a large array of subjective and objective variables measuring job quality. Given the potential endogeneity of displacement, we consider only displacement due to plant closure, which is not directly linked with unobserved individual characteristics. We implement a matching method to identify non-displaced workers who have similar characteristics as displaced workers three years before displacement and then analyse the effects of job loss until ten years after displacement. Our results suggest that job loss induces a deterioration of several aspects of job quality. We find a large and long-lasting impact of displacement on the probability to be employed. For displaced workers who find a new job, we find a deterioration of job quality. Our results on monetary outcomes (earnings and hourly wages) are consistent with those found by Kuhn (2002) and Couch (2001): the impact of displacement lasts for three or four years. As regards job security, displaced workers report to be more likely to lose their job again. Indicators of quality of the working environment (long hours, distance to work), are all affected by displacement except the probability of working full time. In the long run the most affected dimensions are the probability to work more than forty eight hours a week and distance to work, which both increase.

To our knowledge this article is the first measuring the impact of job loss due to plant closure on all dimensions <sup>2</sup> of job quality. The only other articles studying the links between job loss and job quality we are aware of are Lehmann et al. (2013) and Seim et al. (2012). They both estimate the impact of job loss - due to plant closure and lay off - on hourly wages, earnings and hours worked in Russia and Sweden. Not only do they find large and persistent earning losses but also a decrease in hours worked.

Our contribution to the existing literature is twofold. First, we restrict the definition of displaced workers to plant closure - excluding individuals who are laid off in order to make sure that displacement is truly exogenous - and we implement a matching method to identify a relevant control group in order to measure the causal impact of job loss. Additionally, we are able to

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<sup>2</sup>Dimensions defined by OECD (2014), Cazes et al. (2015) and the European Foundation for the Improvement of Living and Working Conditions.

follow individuals over a long time-period, and thus to estimate long-term effects. Second, our article contributes to the literature focusing on job quality. In this literature, indicators are more numerous than ours - see for example Osterman (2013), Green et al. (2013), Rubery & Grimshaw (2001), Crespo et al. (2013). Green et al. (2013) use four indices of non-wage job quality (work quality, working time, work intensity and physical environment) from the Fifth European Working Conditions Survey. With the same database, Cottini & Lucifora (2013) measure job quality with working conditions - such as shifts, job intensity, repetitive work and physical hazards. Contrary to these studies, we do not have a dataset specifically focusing on job quality. Therefore, as suggested by the OECD (2014) and Cazes et al. (2015), we approximate each dimension of the latter by earnings, hourly wages, self-reported labour market security, the probability to work full-time and to work long hours, distance to work, the gap between desired and actual hours worked, job satisfaction and life satisfaction.

The paper is organised as follows. Section 2 presents the empirical strategy. Section 3 provides a detailed description of the data. Section 4 begins with a presentation of the estimated effects of job displacement on the main dimensions measuring job quality. Then, the results of various robustness checks and a presentation of heterogeneous impact follow. Finally, section 5 provides some concluding remarks.

## 2 Empirical strategy

We aim at estimating the long-term impact of job displacement on job quality indicators and individuals' satisfaction. Our strategy is based on Coarsened Exact Matching (CEM) with treated and control individuals being matched not only on their pre-treatment covariates but also on their pre-treatment outcomes. Thus doing, we control for the impact of time-invariant unobservables on outcomes - see Imbens & Wooldridge (2008), Lechner (2011).

Matching is a valid method as long as potential outcomes - i.e. outcomes that each group would have had if they had been respectively treated ( $Y_1$ ) and untreated ( $Y_0$ ) - do not depend on treatment status given covariates and pre-treatment outcomes. This assumption is called ignorability of treatment, or unconfoundedness, or conditional independence assumption (CIA). The richer the

information available for matching, the more credible this assumption (Chabé-Ferret (2015)). The *ignorability of treatment* assumption is violated if individuals choose to be treated based on their return to treatment. In our framework, individuals in the treated group do not choose to lose their job, they lose it due to an exogenous shock: plant closure. In such a case, it is unlikely that the selection into treatment be based on expected gains. The existing literature usually focuses on workers who lose their job because of dismissal - whatever the reason - (Marcus (2014), Clark et al. (2008)), while few papers only use administrative data (Browning et al. (2006), Eliason & Storrie (2009)) and restrict the treatment to job loss due to plant closure. If not restricted to plant closure, dismissals are likely to be correlated with worker’s characteristics since, even when downsizing, employers are likely to choose which employee to dismiss. Here, we focus on workers losing their job because of plant closure, so there is no such selection. We do not control for post-treatment characteristics such as marital status, income or the number of children because job loss could affect post-treatment characteristics, so that the ignorability-of-treatment condition would be violated - i.e. potential outcomes given such variables would be correlated with treatment status.

To estimate the impact of job loss on job quality and satisfaction outcomes over a time span of ten years after job loss, we first define which individuals belong to the treatment and control groups, and then match subjects from the treatment group to subjects from the control group. Figure A1, in Appendix Section A presents how groups are constructed. Treatment -i.e. job loss - can occur at different periods so that we have time varying treatment and control groups. Hereafter, we will call the treated group either “displaced workers” or “treated individuals”. We start with a sample of 2,121 individuals who lose their job at least once, in a panel of 27,267 individuals. We define treatment at a given year  $k$  as losing one’s job due to plant closure at year  $k$ . Similarly, subjects from the control group are individuals with similar characteristics - see below - but who did not lose their job at year  $k$ .

The closing process takes time. German employers are required to inform works councils<sup>3</sup> and to provide at least a 30-day notice before the final shutdown (Couch 2001). For this reason,

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<sup>3</sup>“Works councils were established by the Works Constitution Act of 1952, and additional powers were delegated to them by the Works Constitution Act of 1972. In general, works councils have powers regarding local personnel issues such as the scheduling of work, the hiring of new workers, and conditions for dismissal” (Couch 2001)

matching on workers' characteristics just before treatment is likely to yield biased estimates, as it would violate the ignorability-of-treatment condition. For instance, a worker who is aware that he is about to be displaced could have a lower job satisfaction before displacement, meaning that pre-treatment characteristics (here job satisfaction) would be impacted by treatment status. When we match on five or six years before displacement we have suggestive evidence that the effects of plant closure are anticipated up to two years before displacement. Therefore, in order to match treated individuals with subjects from the control group, we use pre-treatment covariates and outcomes as measured three years before the treatment year ( $k$ ). In our setting, the ignorability-of-treatment is therefore:

$$\mathbb{E}(Y_{i,k+m}|X_{k-3}, Y_{k-3}, D = 0) = \mathbb{E}(Y_{i,k+m}|X_{k-3}, Y_{k-3}, D = 1)$$

for  $i = 0, 1$ ,  $m = 1, \dots, 10$ , and  $k = 1984, \dots, 2012$

where  $(Y_{0,k+m}, Y_{1,k+m})$  are vectors of potential outcomes of treated ( $Y_{1,k+m}$ ) or untreated ( $Y_{0,k+m}$ ) individuals,  $m$  years after a displacement which occurred at year  $k$  for the treated group.

We then estimate differences in job quality and job satisfaction across both groups, by comparing the average outcomes in the treatment and control groups one to ten years after treatment. To do so, we use coarsened exact matching (CEM) rather than exact matching or propensity score matching. While Exact Matching provides perfect balance - a treated unit is matched to control units with the same covariate values - it produces too few matches due to the richness of covariates in our data, and even no match when some variables are continuous. Given this problem, we implement a coarsened exact matching (CEM) method, which performs exact matching on coarsened variables. It is a Monotonic Imbalance Bounding matching method. The maximum imbalance between treated and control groups is chosen ex ante - see Iacus et al. (2009) and Iacus et al. (2011) -, in contrast to propensity score matching.

Then, the number of matched individuals has to be checked. All forms of imbalance - nonlinearities or interactions - are controlled for because we only match individuals if they have exactly the same characteristics for all coarsened variables. The critical point of CEM is the coarsening level for each variable: categories have to be small enough to make sense, and large enough to have

enough matched individuals. Given the discrepancy between the number of individuals that could belong to the control group (26,802) and the treatment group (at most 1,543 persons), we choose which variables to include and how to coarsen them checking which proportion of the treated individuals are matched. Treated and control individuals are eventually matched on gender, age (five classes), diploma (three classes), region (West Germany - East Germany), and industry (nine classes) - See Appendix B. These variables are measured three years before job loss due to plant closure. For each regression, we also match individuals on the value of the outcome three years before displacement. This enables us to take into account the impact of any time-invariant unobservable variable. Among outcomes, continuous variables are coarsened: wage is coarsened in twenty categories, and distance to work in ten categories. Initially, we have 1,543 individuals in the treatment group (1,692 job-loss spells), and 26,802 individuals in the control group. Restricting our sample to individuals having non-missing values three years before treatment for each variable used for the matching, we end up with 959 individuals in the treatment group (corresponding to 1,041 job-loss spells) and 18,534 individuals in the control group. Overall, 474 to 1,026 job loss spells have been matched, depending on the outcome considered, i.e. they are in a stratum where there is at least one control and one treated individual. Then, we measure the difference in mean outcomes between the two groups from four years before treatment to ten years afterwards, with a separate regression for each time-distance to job loss  $m$ . We use the comparison of outcomes four years before treatment to assess the validity of our method. Matched control and treated individuals are similar in term of outcomes three years before displacement, because they are matched based on the outcome at year  $k - 3$ . Comparing outcomes at year  $k - 4$  provides evidence that both groups are similar before being matched.

We use weights ( $\mu$ ) that equalize the number of treated and control individuals in each stratum. The average impact of treatment on outcome  $Y$  is then given by:

$$\beta_m = \frac{1}{n_1 + n_2} \left( \sum_{i=1}^{n_1} \mu_i \mathbb{E}(Y_{i,k+m} | D = 1) - \sum_{j=1}^{n_2} \mu_j \mathbb{E}(Y_{j,k+m} | D = 0) \right)$$

for  $m = -4, \dots, 10$ ,

where  $n_1$  is the number of treated individuals,  $n_2$  the number of control individuals,  $D$  is an indicator of treatment status,  $k$  is the year of job displacement, and  $m$  is the time-distance to job displacement.

## 3 Data and descriptive statistics

### 3.1 Data

#### *The German Socio-Economic Panel*

The data used in this paper are drawn from the German Socio-Economic Panel (SOEP). We use waves from 1984 to 2012 including about 46,600 individuals from German private households. The SOEP questionnaires cover several issues such as health, education and changes in the composition of the household.

Our analysis focuses on the long-term impact of job loss due to plant closure on labour market outcomes, job quality and self-reported satisfaction. Only individuals aged between eighteen and sixty years old are included in our study. Our final sample consists of 37,408 individuals.

#### *Outcomes and control variables*

Because we want to identify the long-term consequences of job loss on labour market outcomes, job quality indicators and individuals' satisfaction, we use plant closure as an exogenous source of job loss.

The job loss variable is constructed using the following question asked yearly from 1990 to 1998 and from 2000 to 2011 to individuals who report a change in their labour market situation : "How was this job terminated?". Respondents may choose one of the following answers: dismissal, mutual agreement, place of work or office has closed, resignation, temporary job or apprenticeship, retirement, sabbatical or, "if you are self-employed, your business closed down". Individuals are considered to have lost their job due to plant closure when they select "place of work or office has closed". These displaced workers do not necessarily experience an unemployment spell.

Taking advantage of the abundance of information in the GSOEP survey, we use job quality

indicators capturing each of the dimensions put forward by the OECD - see above -, i.e. earnings quality, labour market security and quality of the working environment. As recommended by the literature on job quality - see OECD (2014) and Green et al. (2013), for example - we consider as objective indicators of job quality the probability of being employed, distance to work, earnings, hourly wages, the probability of having a full-time job, the probability of working more than forty-eight hours a week, and as subjective indicators the fear of losing one's job (job insecurity) and the gap between hours worked and desired hours.

Even if these job quality indicators capture several dimensions of the well-being of workers, we also use self-reported satisfaction indicators to get a more comprehensive picture of how job displacement affects well-being. We consider two satisfaction variables: job satisfaction and life satisfaction, rated on the same 1 to 10 scale where 0 means completely dissatisfied with one's job (resp. life) and 10 means completely satisfied. This question is asked every year in the SOEP data. Our specifications also include individual characteristics - age and education<sup>4</sup> - and industry dummies. We use the NACE 1-digit standard industrial classification. We also include region and year dummies as control variables.

## 3.2 Descriptive statistics

Descriptive statistics are provided in Appendix Tables C1, C2, C3, C4 and C5.

In our sample, individuals may lose their job between 1990 and 2012. Over that period, 2,396 individuals have lost their job because of plant closure. In 1991, the year with the largest number of job losses, 259 individuals lost their job while only 3 individuals did so in 2012 - see Appendix Table C1. Among those who lose their job at least once (2,151 individuals), the vast majority (1,855 persons) have lost their job only once but 233 have lost their job twice, 21 three times and 2 four times - see Appendix Table C2. Workers who are displaced several times are considered as treated each time. We also restrict our sample to workers who are displaced only once as a robustness check.

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<sup>4</sup>Age and education are coarsened into 3 classes - See Appendix B

Appendix Tables C3, C4 and C5 describe individual characteristics of displaced workers for all years before treatment whereas for the untreated they are computed over the whole period. On average, there are fewer women in the treatment group than in the rest of the population. In our sample, treated individuals are slightly older, live more often in East Germany - see Appendix Table C3 - and they are less likely to hold a higher education diploma than the non-treated individuals. Treated individuals are also slightly more often employed in manufacturing industries, trade and construction sectors and less so in services and banks and insurance - see Appendix Table C4.

When considering job quality indicators and individuals' satisfaction, the treated group appears to report lower job and life satisfaction, lower job security and longer hours worked as well as poorer overall job quality before displacement, compared to the control group - see Table C5. Treated individuals are also more likely to have a full-time job but they work more often more than forty eight hours a week, they live further away from their job, earn less money and are less often in employment.

## 4 Results

### 4.1 Main results

We interpret the coefficients on years  $k - 2$  and  $k - 1$  (two years before to one year before treatment) as the impact of anticipating a displacement. We have matched our treated and control individuals based on their outcomes three years before displacement. We first investigate the impact of job loss due to plant closure on earnings, job security, quality-of-working environment<sup>5</sup> and satisfaction indicators. The main results presented in Figures 1 to 10 (pages 23-27) suggest that job loss induces a deterioration of several aspects of job quality and satisfaction. Each point of those graphs represents an estimate of the effect of displacement ( $\beta_{Y,m}$ ) for a given outcome  $Y$ , and a given time-distance to job loss  $m$ , presented with 95% confidence intervals. The formula for

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<sup>5</sup>We use the nearest categories of job quality developed by OECD (2014)

$\beta_{Y,m}$  is provided in Section 2.

In order to assess the validity of our method, we check whether the coefficients on the outcomes four years before displacement ( $Y_{k-4}$ ) are different from zero. This can be seen as a placebo test: year  $k - 4$  is long before displacement, so there should be no difference between the treatment and control groups at that time. For our ten outcomes, there is no significant effect of being displaced four years before displacement - see Figures 1 to 10. Overall, treated and control individuals are similar four years before job loss, and our matching method is therefore reliable.

Individuals who will lose their job at year  $k$  anticipate their displacement and are more concerned about their job security two to one years before job loss - see Figure 4 (page 24). When considering the results in Figure 9 and Figure 10 (page 27), it is interesting to notice that job and life satisfaction are also affected by anticipations and tend to decrease before displacement. In order to tackle this issue of anticipations, we do not match individuals on years  $k - 2$  and  $k - 1$  but rather on year  $k - 3$ . Furthermore, we cannot interpret the coefficient on the year of displacement, because some treated individuals are already displaced and some are not at the time of the survey.

During the whole period, the impact of displacement on the probability of being employed is negative and significant - see Figure 1. One year after displacement, 30% of displaced workers are not employed (they are either unemployed or inactive) and they are still 5% less likely to have a job ten years after displacement. Displaced individuals who have found a new job after displacement earn less than others, but this effect is only significant three and four years after displacement. It represents at most a 10% decrease in monthly earnings - see Figure 2. Concerning hourly wages, the impact is significant until six years after displacement and represents a 10% decrease as well - see Figure 3. These results are close to those found by Eliason & Storrie (2006) although we find a much larger impact on employment probability (30% to 10% as compared to 7% to 3%), and less long-lasting effects on earnings (until 4 years instead of 12 years).

As regards job security, workers who have been displaced report to be more likely to lose their job again. This effect is significant until four years after displacement - see Figure 4. Our indicators of quality of the working environment are all affected by displacement, except the probability of

working full-time, for which the impact is small and not significant. Displaced workers are more likely to work long hours (more than forty-eight) and to work far away from home, until ten years after job displacement. Overall, displaced workers with a new job are 30% more likely to work long hours, and to commute 8 to 12 kilometres further away - see Figures 6 and 8. They are more dissatisfied with their hours worked than the control group until nine years after displacement. These results are consistent with a negative impact of job loss on job satisfaction - until seven years after displacement, only for those who have a job - and life satisfaction - until eight years after displacement, for all displaced workers (Figures 9 and 10).

To summarize, displacement worsens all aspects of job quality - i.e. the probability of being employed, earnings, hourly wages, job security and the quality of the working environment. Even when they find a new job, displaced workers have lower-quality jobs than non-displaced workers. In the long run, the most affected dimensions are hours worked and distance to work.

#### **4.1.1 Robustness check**

Our main results show that there are long-term impacts of displacement on several aspects of job quality. For some dimensions there is a recovery while for some others - long hours, dissatisfaction with hours worked and distance to work - there is no evidence of a decrease in the effect of displacement over time. Each point estimate is obtained considering individuals who are currently working that year. The further away from the year of displacement the more displaced workers find a new job and thus contribute to the estimates. Therefore, individuals who have been out of employment for a long period could explain the long-term effects.

In this paragraph, we estimate the effects of displacement on the subgroup of workers who were back to employment the year after displacement. Thus doing, we can see how the impact varies over time for a more stable pool of displaced workers and we have a clearer idea of the pattern of recovery in each dimension. On average, displaced workers in this subsample are younger, have lower tenure, are more often white collars and more often men than displaced workers who did not find a job right after displacement - see Appendix E, Table E1. They are as likely as non-displaced workers to be employed both in the short and long run following displacement.

Overall, our main results do not vary at all when we focus on individuals who do not experience a significant period out of employment, except for life satisfaction - see Appendix E, Figures E3.11 to Figures E3.20. Job displacement has no significant impact on life satisfaction for this new sample. This finding suggests that the drop in life satisfaction is driven by individuals who are out of employment for more than one year after displacement. Concerning job quality, several dimensions are impacted by job loss even when individuals find a new job quickly after displacement. Therefore, displacement is not only about being out of employment, it is also a shock on the career path for displaced workers who find a job right after displacement.

## 4.2 Heterogeneous effects

So far, we have presented the average effects of job loss computed on the whole sample. However the impact of displacement is likely to vary, among others, across gender, age, tenure and occupation of the displaced workers. This is what we want to investigate in this section.

We estimate the same model separately for women and men and interpret the impact of job loss on each dimension of job quality and satisfaction indicator - see Appendix D.1. For each category we consider, we use the same selection criteria for both treatment and control groups, i.e., male (resp. female) workers can only be matched with male (resp. female) workers.

When considering the sample of men - see Appendix D.1 - we find that they are affected by a deterioration of some dimensions of job quality over a longer period of time - between six and ten years after displacement - than women even if the difference is not always significant. Displaced men are less likely to have a job, have lower earnings and have a higher probability to work more than forty-eight hours a week than their female counterparts<sup>6</sup> - see Appendix D.1, Figures D1.2, D1.3, D1.4 and D1.7. The impact of job loss due to plant closure on commuting time is particularly long-lasting for men - see Appendix D.1, Figure D1.8. It increases until ten years after displacement and the difference between both genders remains significant from

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<sup>6</sup>The differences are almost never significant for employment probability and earnings. However, the differences are significant from six to eight years after displacement for the probability to work more than forty-eight hours a week.

two to nine years after displacement. For men, we also find a short-run negative effect of job loss on job security, the satisfaction with hours worked and job satisfaction - see Appendix D.1, Figures D1.5, D1.9, D1.10<sup>7</sup>.

The corresponding pattern of results is different for women except for the probability of being in employment. Fewer dimensions are impacted and the effects are less long-lasting. Displaced women do not experience a significant decrease in earnings, hourly wages or the probability to work full-time<sup>8</sup> - see Appendix D.1, Figures D1.3, D1.4 and D1.6. The effects are short-term or mid-term for a couple of outcomes - job security, satisfaction with hours worked, probability to work long hours, job satisfaction and life satisfaction (see Appendix D.1, Figures D1.5, D1.7, D1.9, D1.10 and D1.11)<sup>9</sup>.

Finally, the impact of displacement on our two indicators of the quality of the working environment - full-time and distance to work - is more severe for men. Interestingly, this differentiated impact on job quality is not due to the fact that women exit the labour force after displacement, because the effects on employment probability are similar. However, women also suffer from displacement - their probability to be employed decreases, they perceive lower job security and their satisfaction with hours worked, with their job and with their life decreases.

Displacement is likely to impact differently older and younger workers, as they are impacted at different moments of their career. Figures D2.1 to D2.9, in Appendix D.2, show how our results vary across the age of displaced workers. We define as “young” those workers younger than 45 years old at the time of displacement. The other workers are consider to be “old”.

Most of our job quality indicators are impacted in a similar way for older and younger workers, but the magnitude of the coefficients is generally larger for older workers. First, older workers are more impacted than younger ones in terms of employment probability - see Appendix D.2, Figure D2.1. One year after displacement, the difference between displaced and non-displaced

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<sup>7</sup>The differences of effects are not significant for job security and dissatisfaction with hours worked, except for two year. They are never significant for job satisfaction.

<sup>8</sup>The differences between the coefficients for men and women are almost never significant for hourly wage and earnings, and significant for half of the years for full-time

<sup>9</sup>The differences between the coefficients for men and women are significant only for a few years for most of the outcomes, and significant for distance to work.

workers is twice as high for older workers than for younger ones, and the difference of impact for younger and older workers is significant until six years after displacement. Concerning earnings, hourly wages and job security, the effects are very close and the differences are not significant - see Appendix D.2, Figures D2.1 to D2.9. Older workers are more affected in some dimensions of the quality of the working environment, such as the distance to work and job satisfaction<sup>10</sup>, whereas the impact on life satisfaction is similar across ages. Senior workers also seem to be more impacted in terms of hours worked - the probability to work long hours and the gap between actual and desired hours worked -, but the difference of impact with younger workers is often not significant.

Overall, the difference in the impact of job loss across age mainly concerns the probability of employment. Older workers are less likely to find a new job if displaced. Once they have found a new job, they suffer from a greater deterioration of job quality. However, the overall impact that we find is not entirely driven by older displaced workers, as the results also hold to a lesser extent, for younger workers.

In our sample, older displaced workers have on average fifteen years of tenure as compared to seven years for younger workers. This could explain part of the difference between older and younger workers. Accumulating firm-specific human capital implies higher losses in case of displacement. If, instead of age, we distinguish workers according to their years of tenure before displacement, we find that more tenured workers (more than ten years of tenure) are more impacted in terms of employment probability<sup>11</sup> - see Appendix D.2, Figures D2.11 to D2.19. Once they have found a new job, the impact of job loss on job quality is very similar whatever the length of tenure: the difference across tenure is almost never significant - except for the distance to work in the long run. Similar results are found when we use a threshold of three years of tenure instead of ten years.

In this paragraph, we consider potential heterogeneity across type of occupation. We divide our sample into white and blue collars in order to compare each type of displaced workers with their control counterparts. Displacement deteriorates job quality more for blue-collar workers than

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<sup>10</sup>The effects are significantly different.

<sup>11</sup>The differences in employment probability across tenure are significant.

for white-collar workers, in almost all the dimensions<sup>12</sup> we consider. The overview of the results indicates that a major shock on the career path such as job loss has a negative impact on all outcomes for blue-collar workers, except the probability to work full-time - see Appendix D.3, Figures D3.1 to D3.10. Some dimensions of job quality are impacted only in a short-run - job security and earnings - whereas the effects on commuting distance and satisfaction with hours worked are still significant from four to ten years after displacement. Long-term effects - until nine years after displacement - can be observed for hourly wages and the probability of working long hours. The difference with white collars is significant in the long-run (after six years), when there is full recovery for white collars, while blue collars are still impacted.

Overall, we find that blue collars are more impacted than white collars for employment probability and distance to work over the whole period - see Appendix D.3, Figures D3.1 and D3.7 - with the difference in impact across both groups being significant. The effects of displacement on job quality and satisfaction are generally concentrated among blue collars. White collars are impacted in the same way, but the effects are smaller, and often non significant.

To conclude, displacement induces a long-lasting deterioration of at least one indicator of job quality for all groups considered. The effects seem more pronounced for men, blue collars, older and more tenured workers.

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<sup>12</sup>The differences across occupation are almost never significant for earnings, hourly wages, perceived job security, full-time work, the probability to work long hours, dissatisfaction with hours worked, job and life, but are significant for employment probability and distance to work.

## 5 Conclusion

In this article, we provide evidence that job loss due to plant closure has a long lasting causal impact on a wide range of indicators of job quality. As for monetary outcomes, our results are close to what we found in the literature on Europe (Eliason & Storrie (2009); Hijzen et al. (2010)): we find long-lasting effects of displacement on the probability to be employed, on hourly wages<sup>13</sup> and only a middle-run impact on earnings contrary to the United-States (Jacobson et al. (1993); Fallick (1996); Couch & Placzek (2010)) where the impact is smaller on employment and larger on earnings. Beyond earnings or hourly wages, job loss due to plant closure also induces a deterioration of several dimensions of job quality and satisfaction. The most affected indicators of quality of the working environment are the probability to work more than forty-eight hours a week and distance to work which both increase after displacement. Even workers who find a new job within one year after displacement experience a worsening of job quality.

We also assess which workers are the most affected by displacement. We find that job loss induces a deterioration of job quality particularly for men, blue-collar workers and older<sup>14</sup> individuals with high tenure. However, the differences across groups are often non significant, which underlines that job quality deterioration following displacement affects all groups considered.

So, when taking job quality into account the cost of displacement turns out to be much higher than when considering only monetary aspects. Most people spend a large part of their time at work and job quality is a main component of individual well-being. This suggests that further investigations of changes in individual's labour market situations should definitely consider the multidimensional aspect of job quality.

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<sup>13</sup>The impact of displacement on hourly wages represents a 10% decrease on the whole period until six years after displacement

<sup>14</sup>An older individual is more than 45 years old.

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# Figures

Figure 1: Impact of job displacement on employment

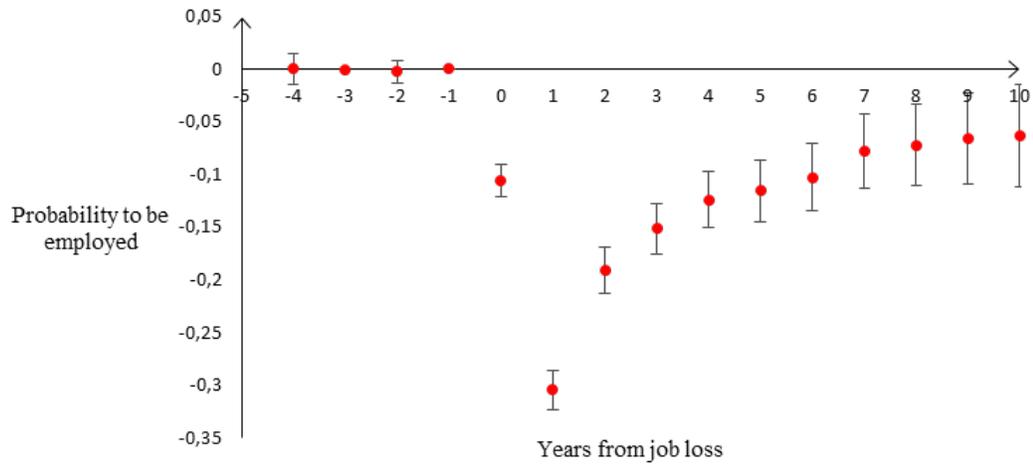


Figure 2: Impact of job displacement on earnings

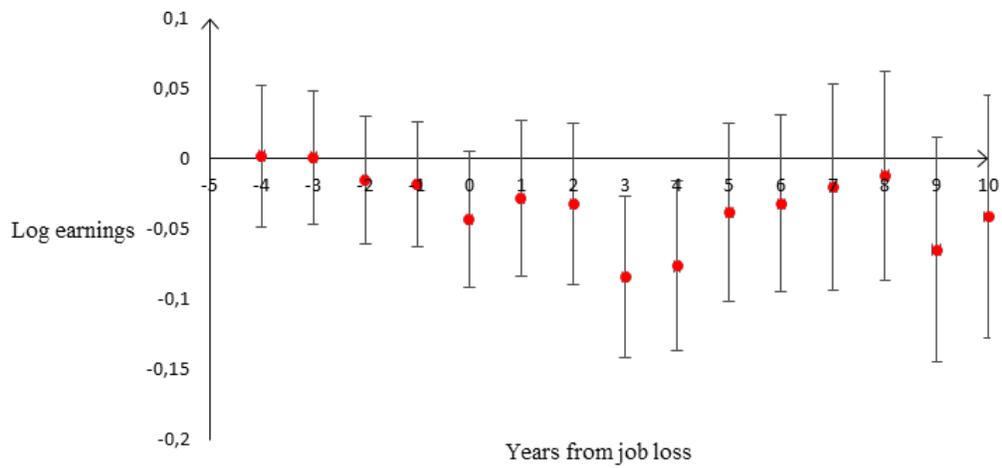


Figure 3: Impact of job displacement on hourly wage

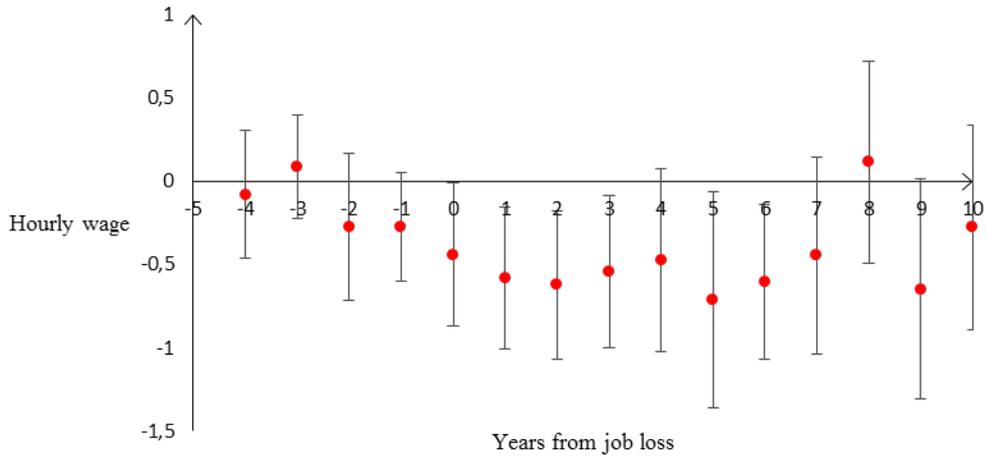


Figure 4: Impact of job displacement on job security

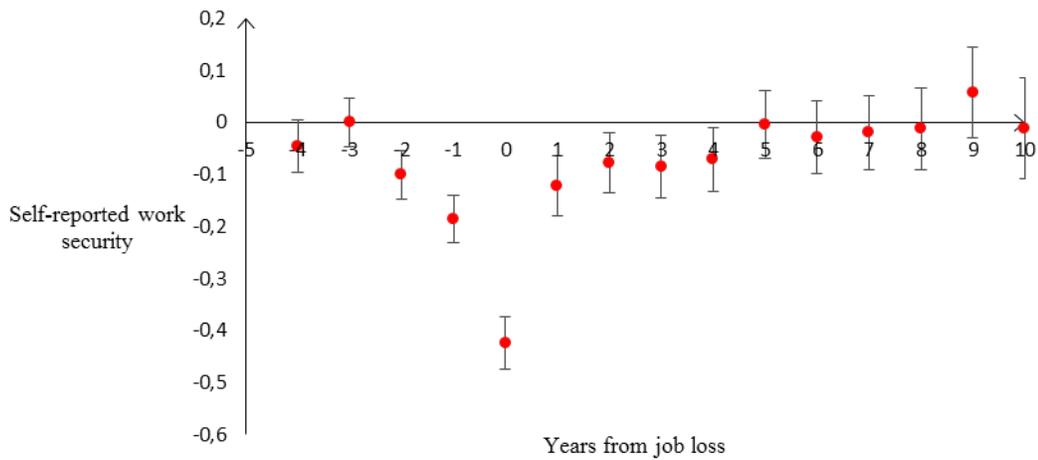


Figure 5: Impact of job displacement on probability to work full-time

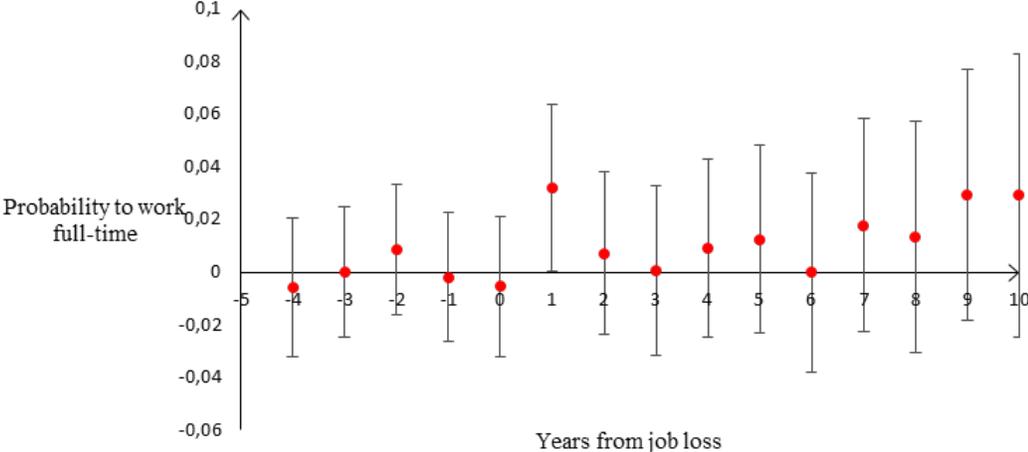


Figure 6: Impact of job displacement on probability to work more than 48 hours a week

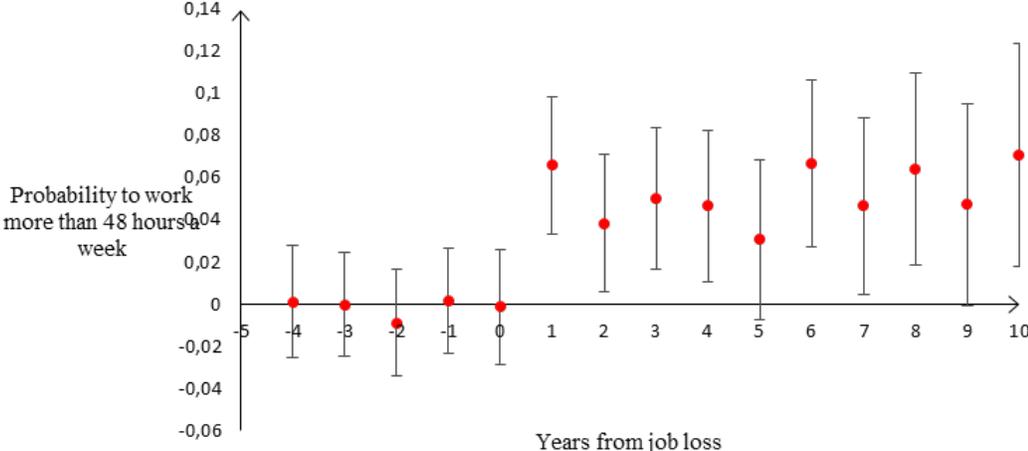


Figure 7: Impact of job displacement on the gap between actual and desired hours worked

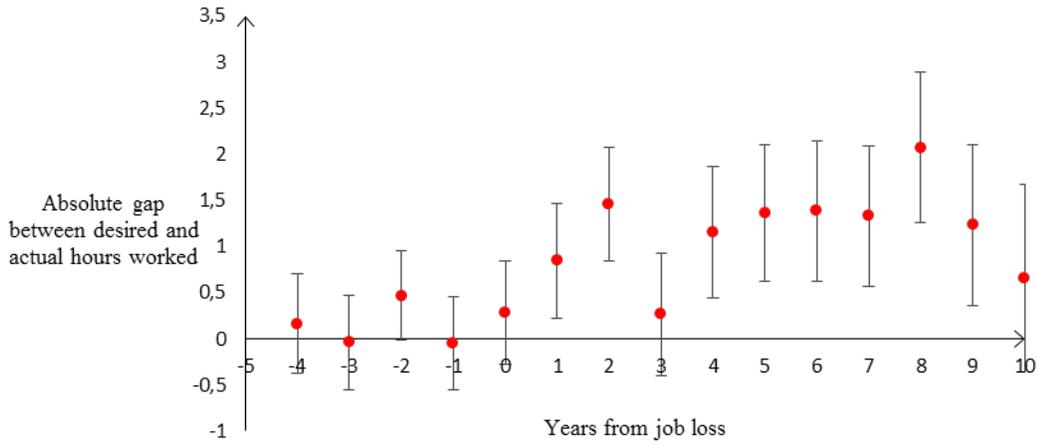


Figure 8: Impact of job displacement on distance to work

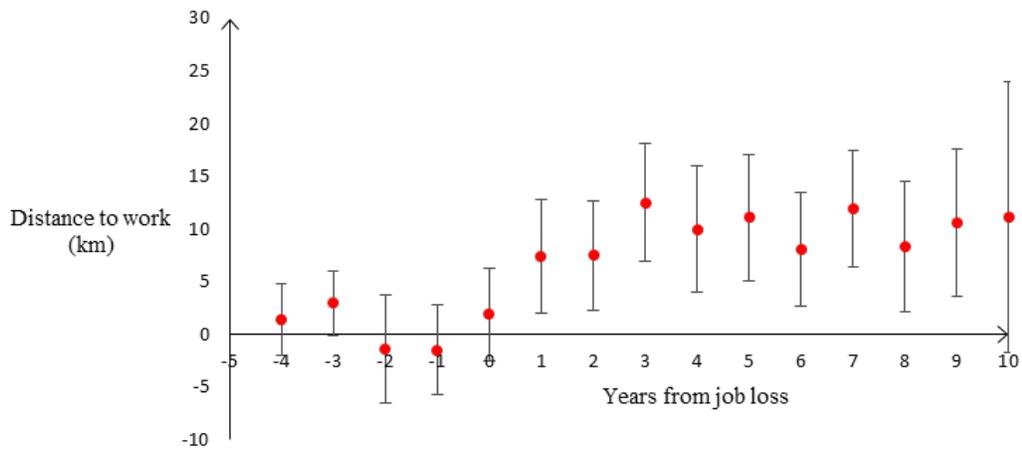


Figure 9: Impact of job displacement on job satisfaction

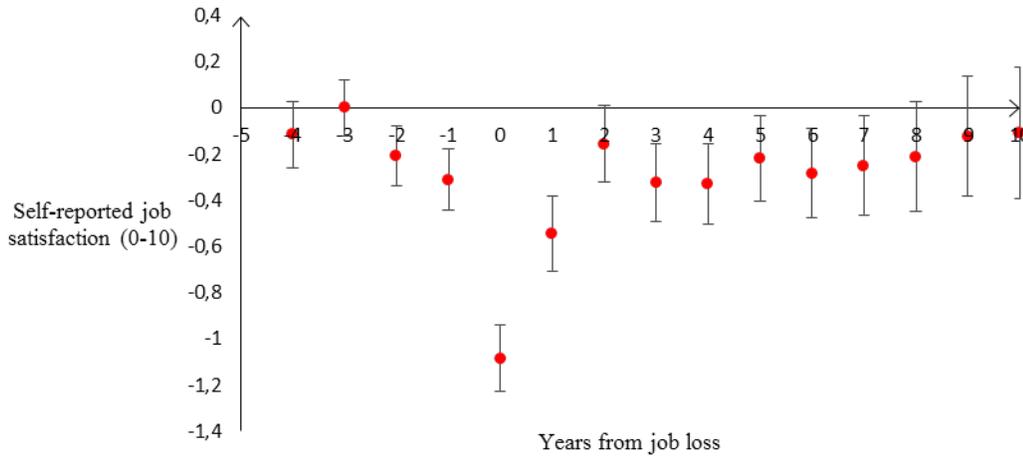
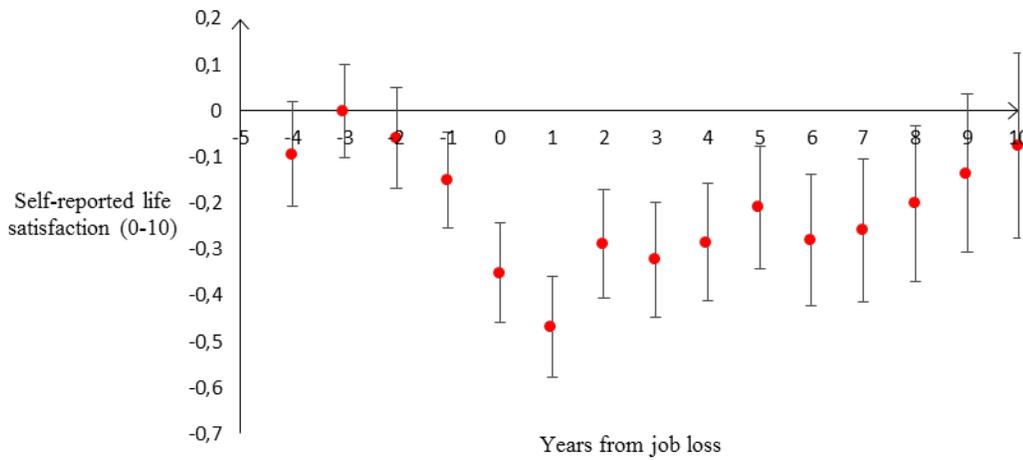


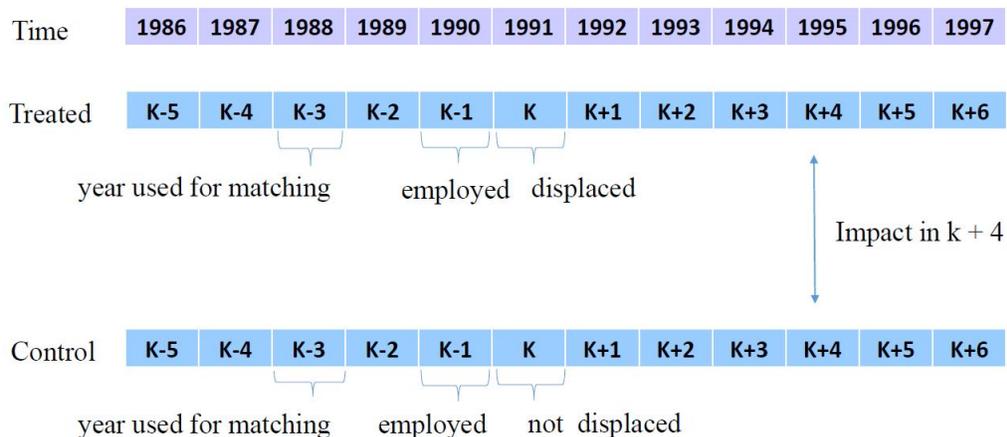
Figure 10: Impact of job displacement on life satisfaction



# Appendix

## A Empirical strategy

Figure A1: Treatment and control groups



## B Coarsened variables

Age is coarsened into five equal categories:

- (1) 18-32 years old
- (2) 33-39 years old
- (3) 40-45 years old
- (4) 46-51 years old
- (5) 51-65 years old.

Education (diploma) is coarsened into three classes:

- (1) less than high school
- (2) high school
- (3) more than high school.

Industry is coarsened into nine categories:

- (1) Agriculture
- (2) Energy
- (3) Mining
- (4) Manufacturing

- (5) Construction
- (6) Trade
- (7) Transport
- (8) Bank, Insurance
- (9) Services.

## C Descriptive statistics

Table C1: Number of individuals losing their job because of plant closure per year

Year	Displacements
1990	167
1991	259
1992	165
1993	130
1994	127
1995	123
1996	121
1997	92
1998	12
2000	112
2001	150
2002	152
2003	147
2004	114
2005	73
2006	92
2007	79
2008	69
2009	87
2010	67
2011	55
2012	3
<b>All years</b>	<b>2,396</b>

Table C2: Number of job loss due to plant closure per individual

Number of job displacements	<b>Freq</b>
At least 1	2,151
1	1,895
2	233
3	21
4	2

Table C3: Descriptive statistics: individual characteristics

	(1)		(2)		(3)
	Treated		Non-Treated		Difference
	Mean	SD	Mean	SD	P-value
Women	0.46	0.50	0.49	0.50	0.02
<i>Location</i>					
East Germany	0.42	0.49	0.22	0.41	0.00
West Germany	0.58	0.49	0.78	0.41	0.00
<i>Age</i>					
16 to 30	0.18	0.30	0.27	0.39	0.00
31 to 38	0.21	0.23	0.19	0.28	0.04
39 to 45	0.23	0.23	0.19	0.29	0.00
46 to 54	0.20	0.22	0.17	0.28	0.00
55 to 69	0.19	0.30	0.17	0.32	0.01
<i>Education</i>					
7 to 11 years	0.39	0.45	0.39	0.46	0.98
11 to 12 years	0.39	0.45	0.34	0.45	0.00
13 to 18 years	0.22	0.40	0.27	0.43	0.00

Note: SD stands for standard deviation and column 3 reports two-sided p-value of a t-test comparing averages of variables for treated individuals before displacement and non-treated individuals.

Table C4: Descriptive statistics: Industries

	(1)		(2)		(3)
	Treated		Non-Treated		Difference
	Mean	SD	Mean	SD	P-value
Agriculture	0.02	0.11	0.02	0.11	0.00
Energy	0.01	0.06	0.01	0.09	0.05
Mining	0.01	0.07	0.01	0.07	0.08
Manufacturing	0.24	0.33	0.22	0.37	0.02
Construction	0.18	0.31	0.15	0.31	0.00
Trade	0.21	0.33	0.16	0.32	0.00
Transport	0.05	0.17	0.05	0.20	0.46
Bank, Insurance	0.02	0.12	0.04	0.18	0.00
Services	0.26	0.35	0.35	0.44	0.00

Note: SD stands for standard deviation and column 3 reports two-sided p-value of a t-test comparing averages of variables for treated individuals before displacement and non-treated individuals.

Table C5: Descriptive statistics: outcomes variables

	(1)		(2)		(3) Difference P-value
	Treated Mean	SD	Non-Treated Mean	SD	
Employed	0.74	0.25	0.81	0.26	0.00
Labor income	6.76	0.60	6.84	0.70	0.00
Full-time	0.77	0.35	0.74	0.39	0.00
Hourly wages	6.57	3.29	7.64	4.69	0.00
Long hours	0.21	0.28	0.16	0.29	0.00
Distance to work	22.13	47.65	19.50	41.76	0.01
Job security	2.03	0.51	2.29	0.55	0.00
Hours gap	7.16	5.24	6.41	5.60	0.00
Job satisfaction	6.57	1.46	7.03	1.56	0.00
Life satisfaction	6.59	1.27	7.09	1.29	0.00

Note: SD stands for standard deviation and column 3 reports two-sided p-value of a t-test comparing averages of variables for treated individuals before displacement and non-treated individuals.

## D Heterogeneous results

### D.1 Job loss and gender differences

Figure D1.1: Impact of job displacement on employment

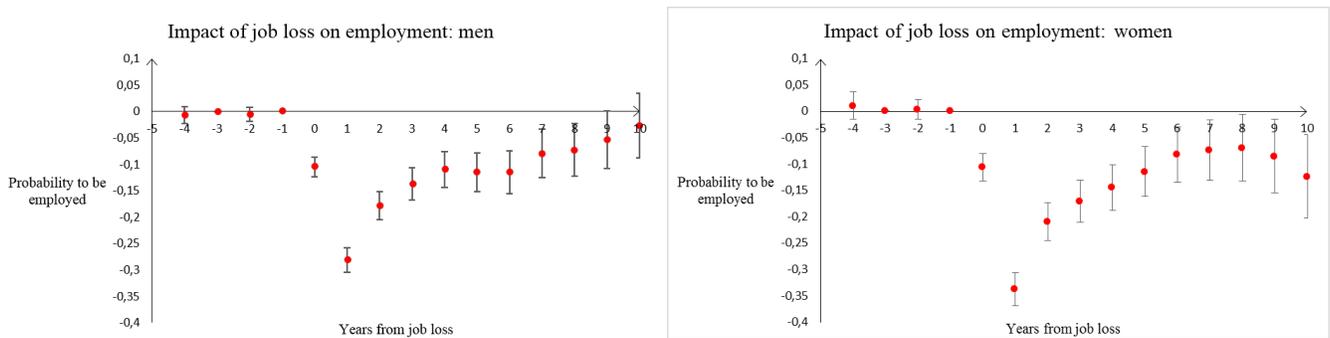


Figure D1.2: Impact of job displacement on earnings

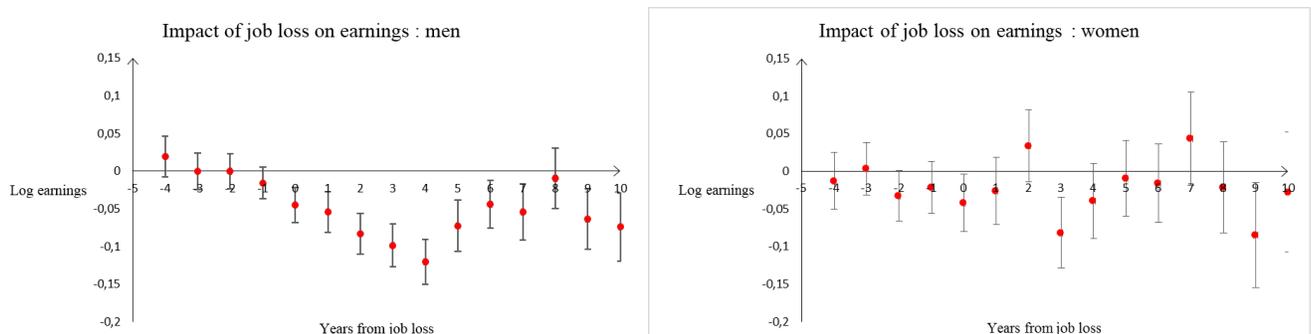


Figure D1.3: Impact of job displacement on hourly wage

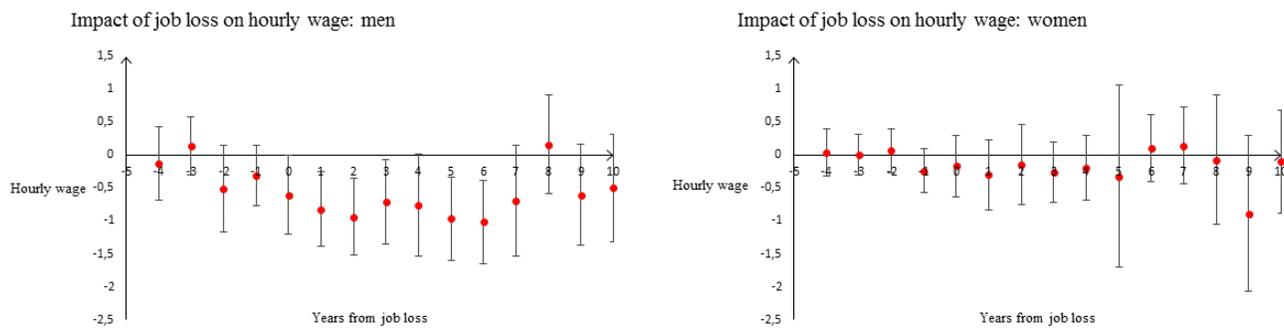


Figure D1.4: Impact of job displacement on job security

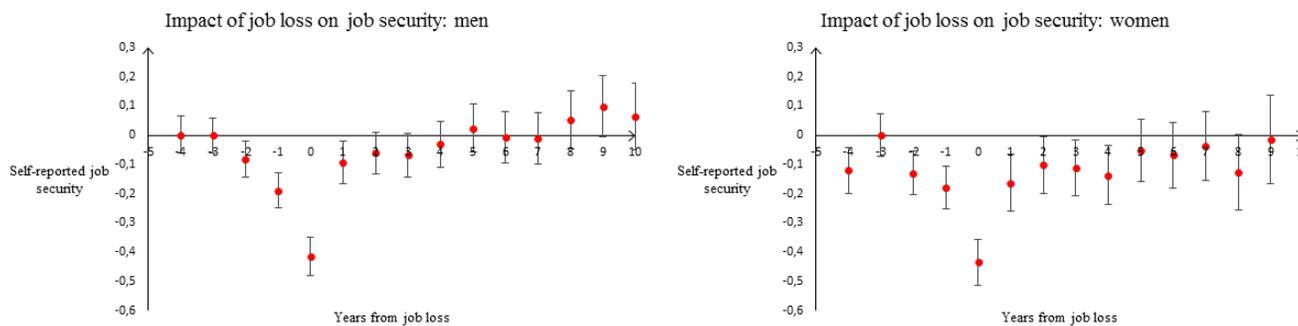


Figure D1.5: Impact of job displacement on probability to work full-time

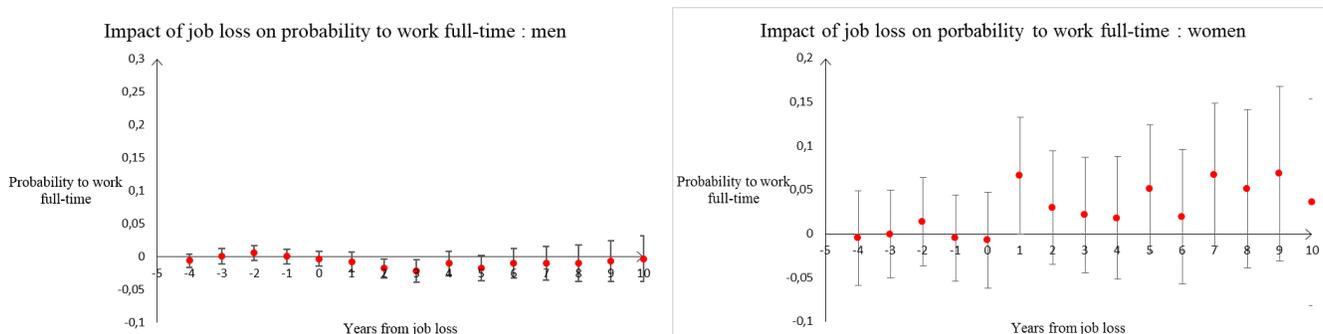


Figure D1.6: Impact of job displacement on probability to work more than 48 hours a week

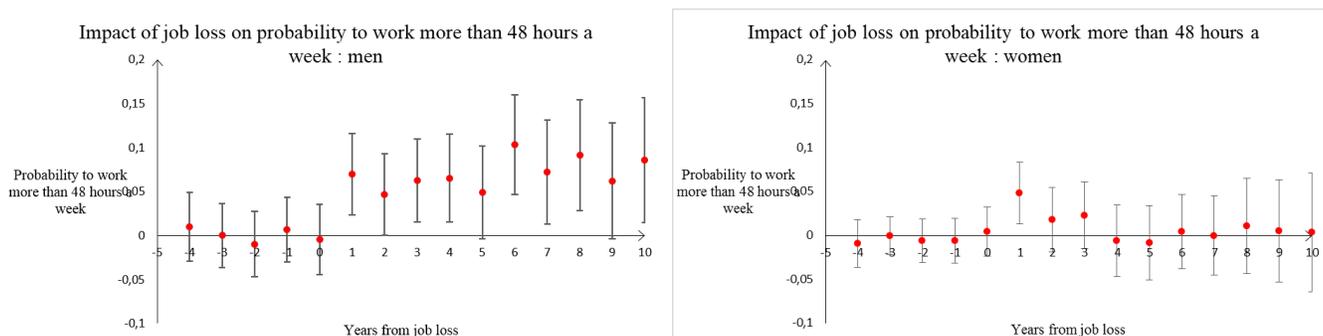


Figure D1.7: Impact of job displacement on distance to work

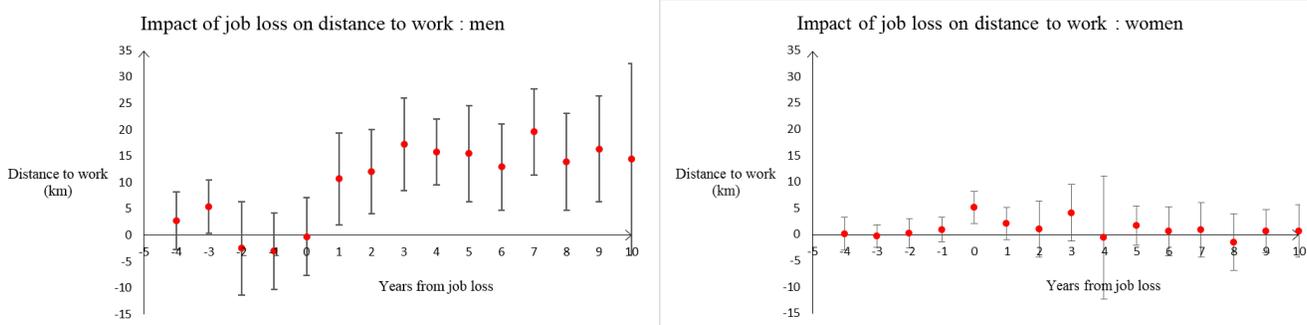


Figure D1.8: Impact of job displacement on the gap between actual and desired hours worked

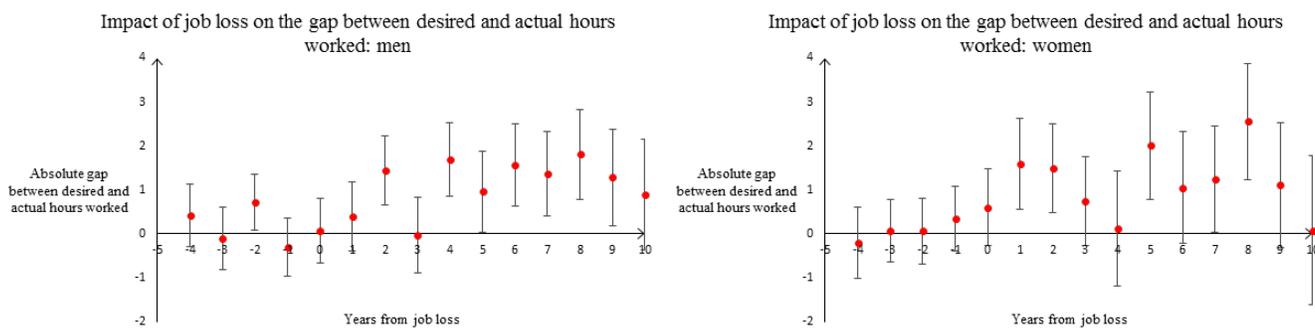


Figure D1.9: Impact of job displacement on job satisfaction

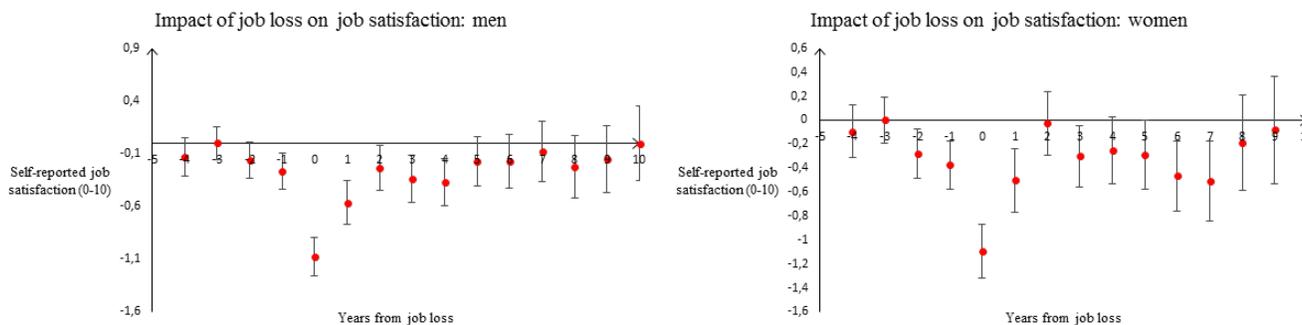
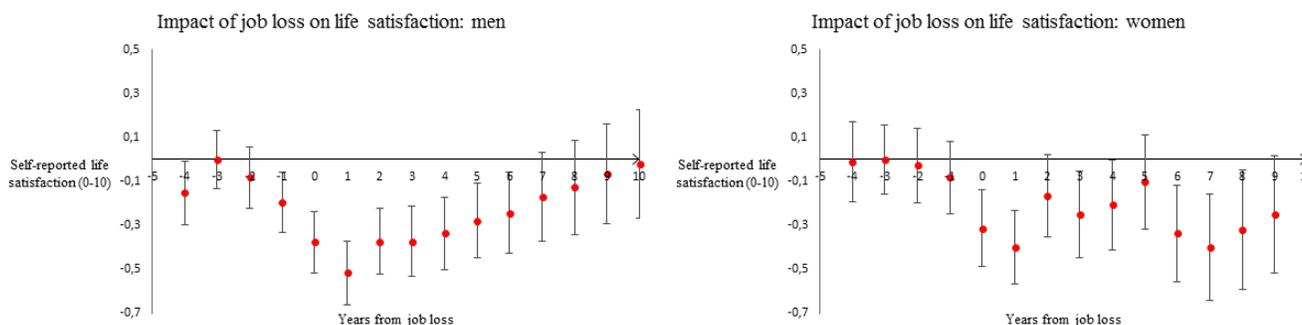


Figure D1.10: Impact of job displacement on life satisfaction



## D.2 Age and tenure

Figure D2.1: Impact of job displacement on employment

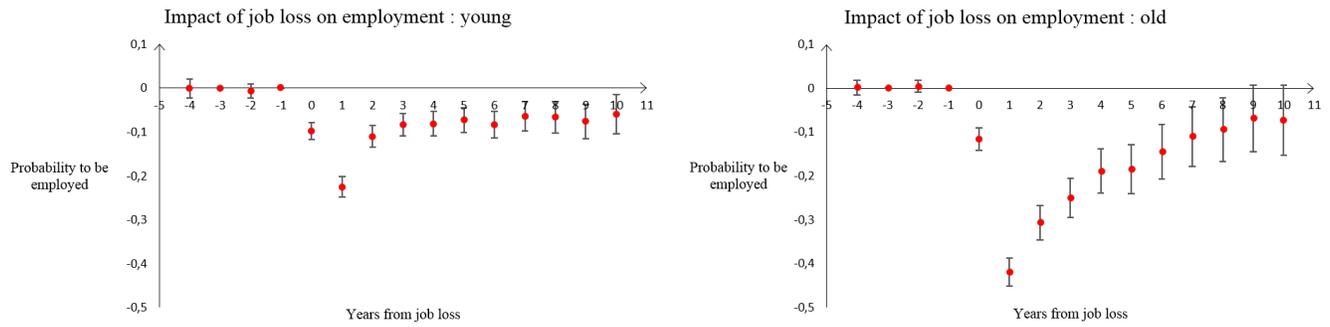


Figure D2.2: Impact of job displacement on earnings

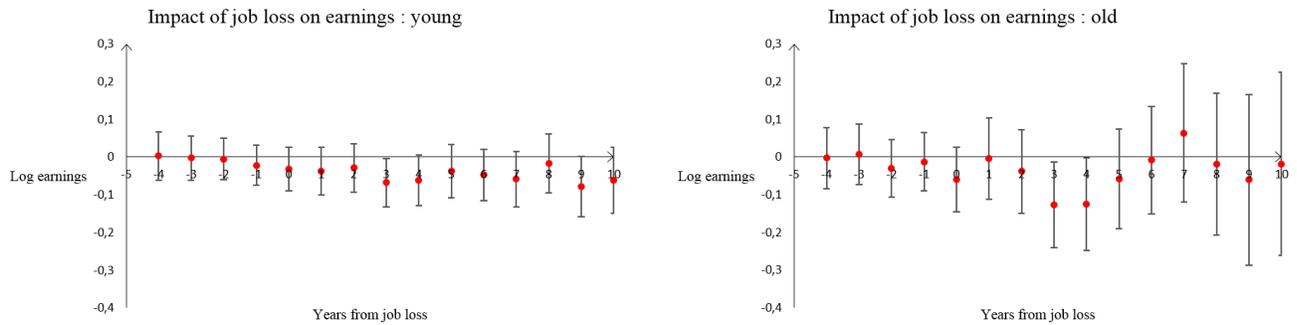


Figure D2.3: Impact of job displacement on hourly wage

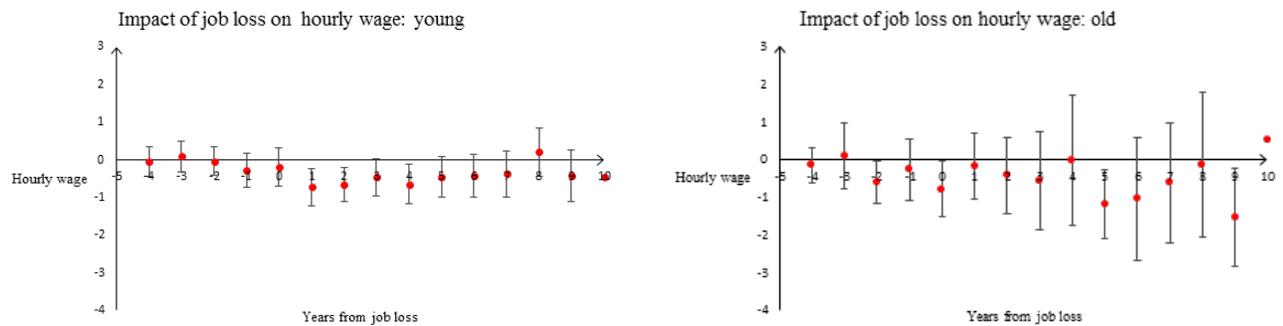


Figure D2.4: Impact of job displacement on job security

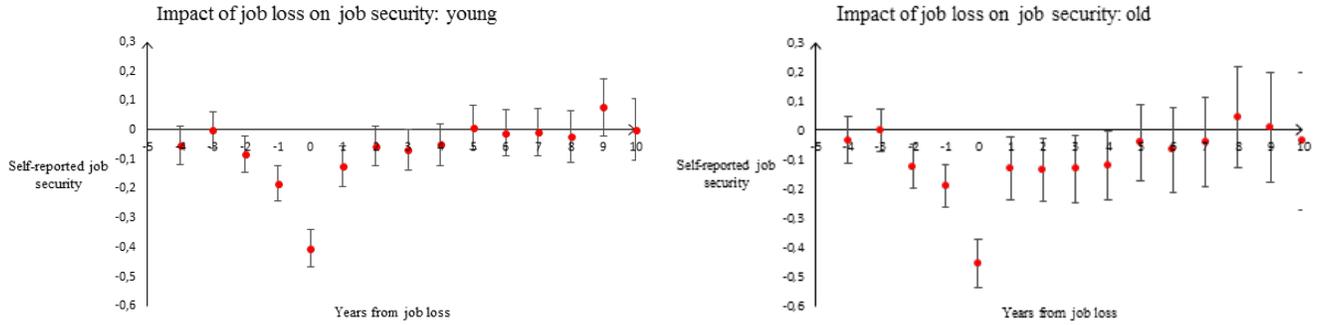


Figure D2.5: Impact of job displacement on probability to work full-time

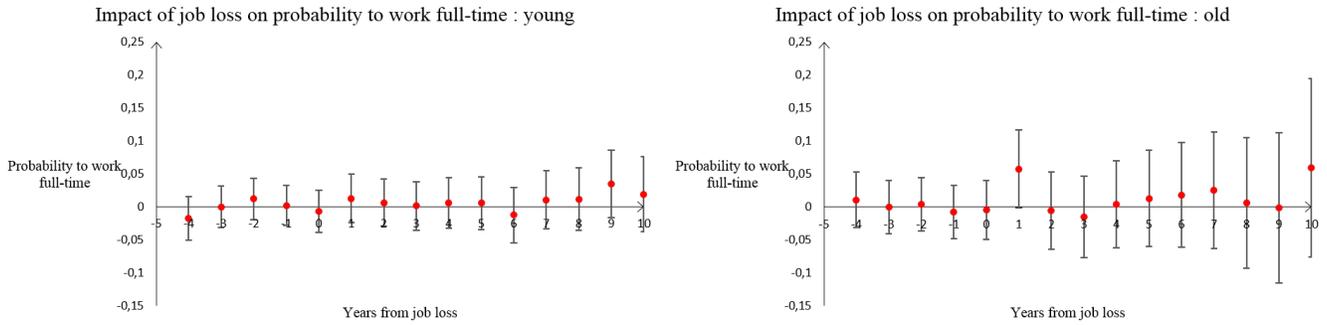


Figure D2.6: Impact of job displacement on probability to work more than 48 hours a week

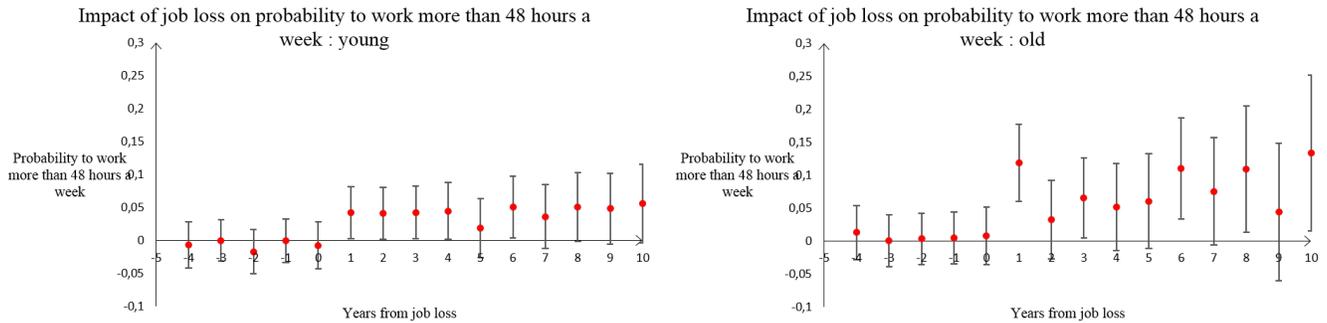


Figure D2.7: Impact of job displacement on distance to work

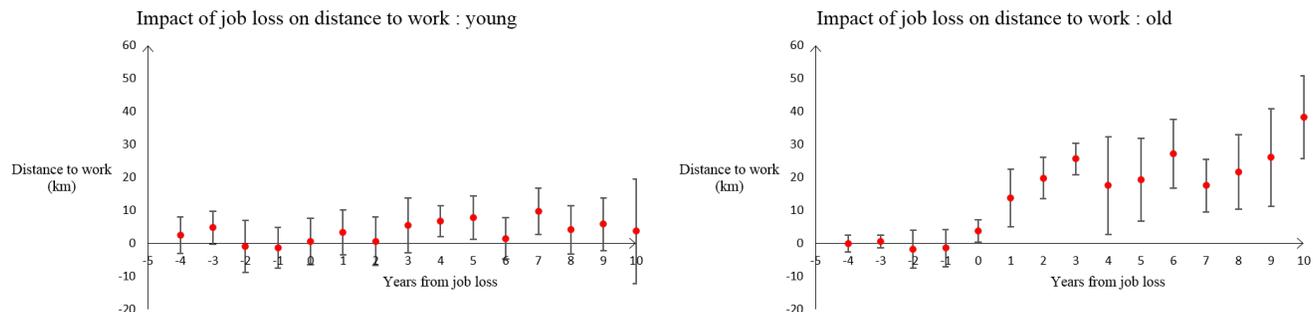


Figure D2.8: Impact of job displacement on the gap between actual and desired hours worked

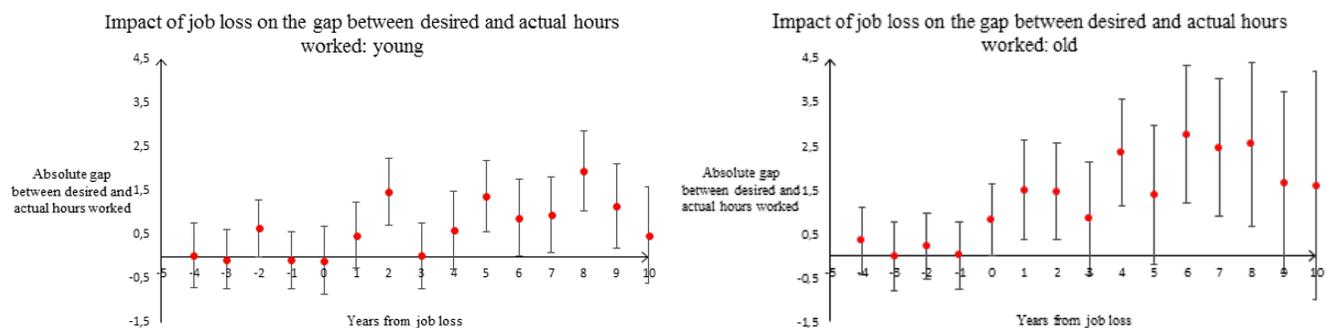


Figure D2.9: Impact of job displacement on job satisfaction

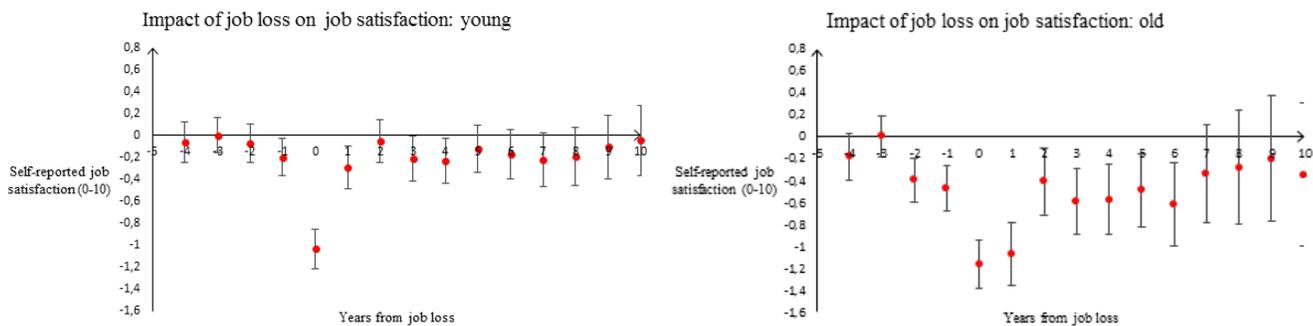


Figure D2.10: Impact of job displacement on life satisfaction

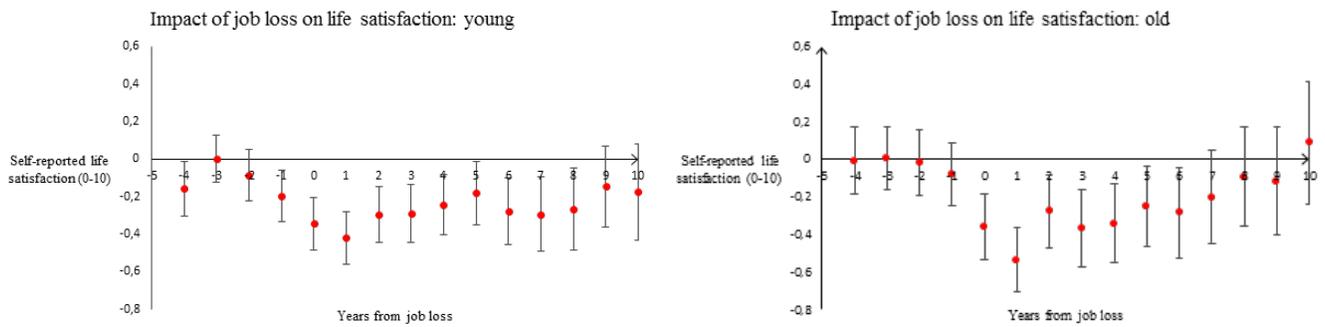


Figure D2.11: Impact of job displacement on employment

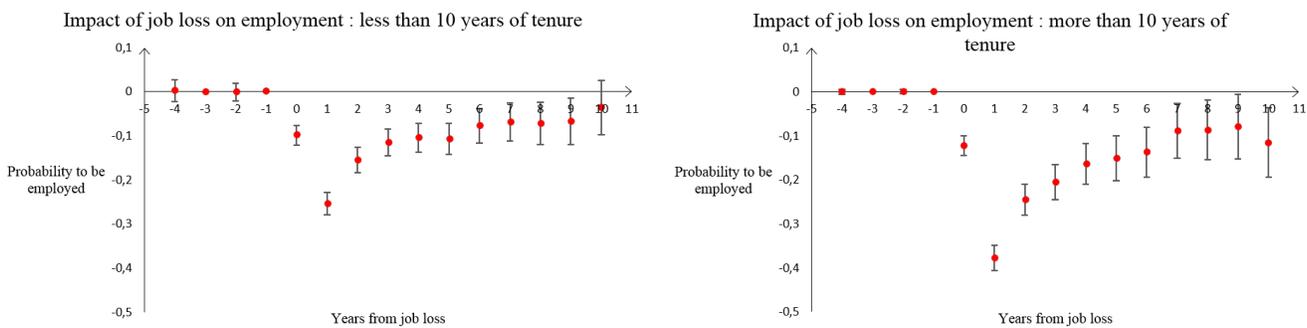


Figure D2.12: Impact of job displacement on earnings

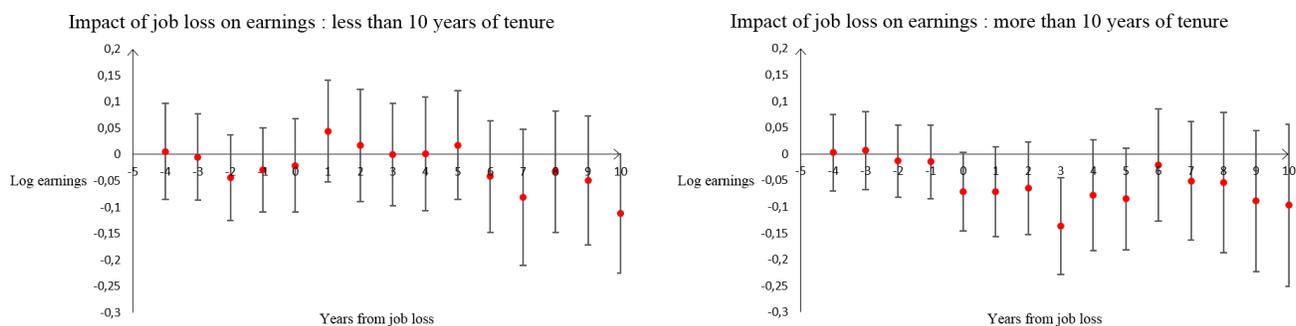


Figure D2.13: Impact of job displacement on hourly wage

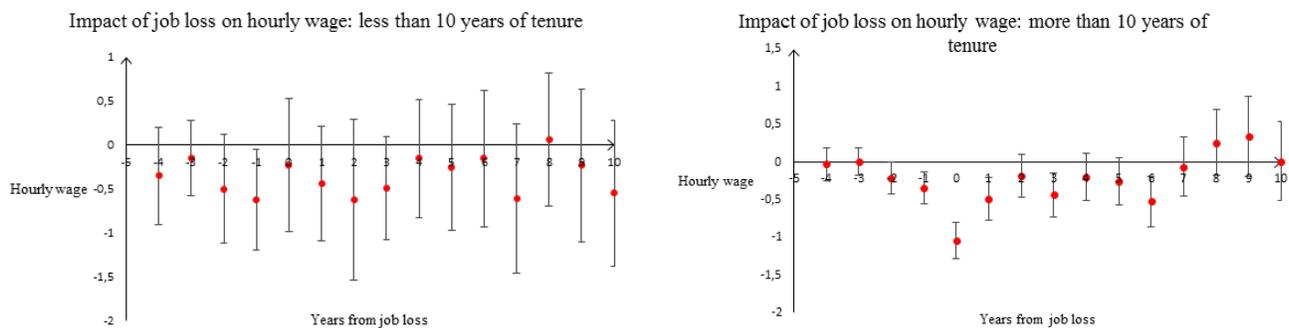


Figure D2.14: Impact of job displacement on job security

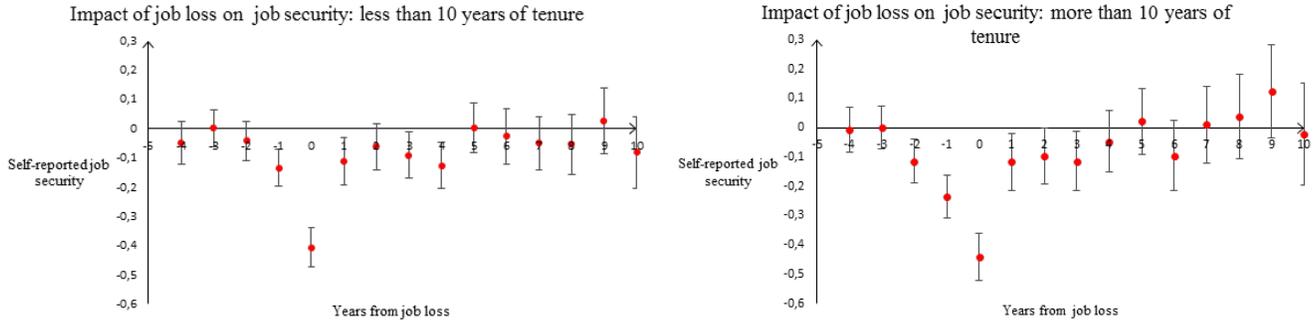


Figure D2.15: Impact of job displacement on probability to work full-time

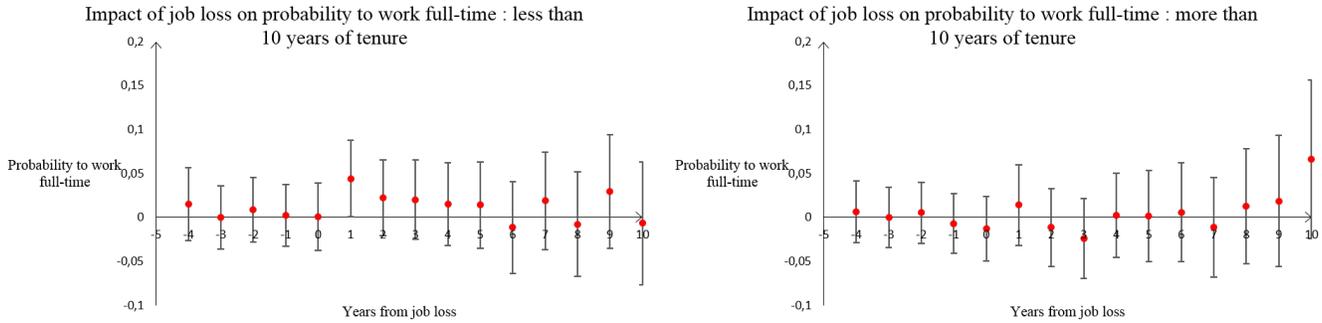


Figure D2.16: Impact of job displacement on probability to work more than 48 hours a week

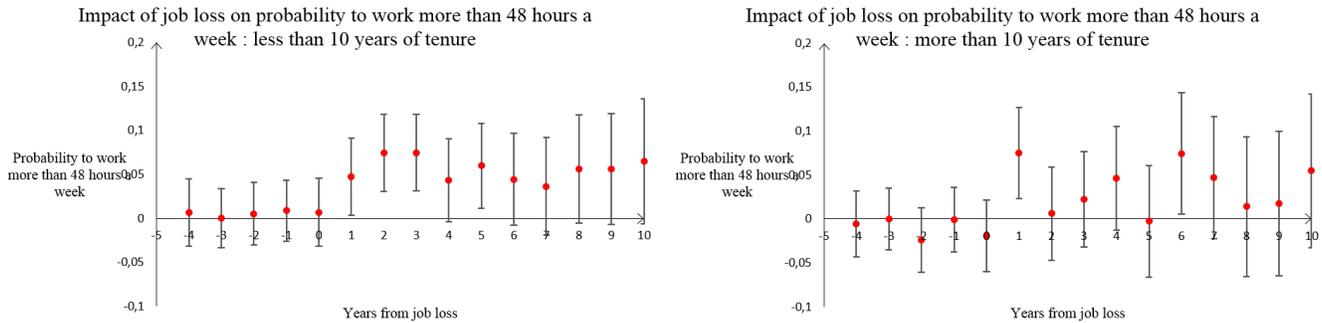


Figure D2.17: Impact of job displacement on distance to work

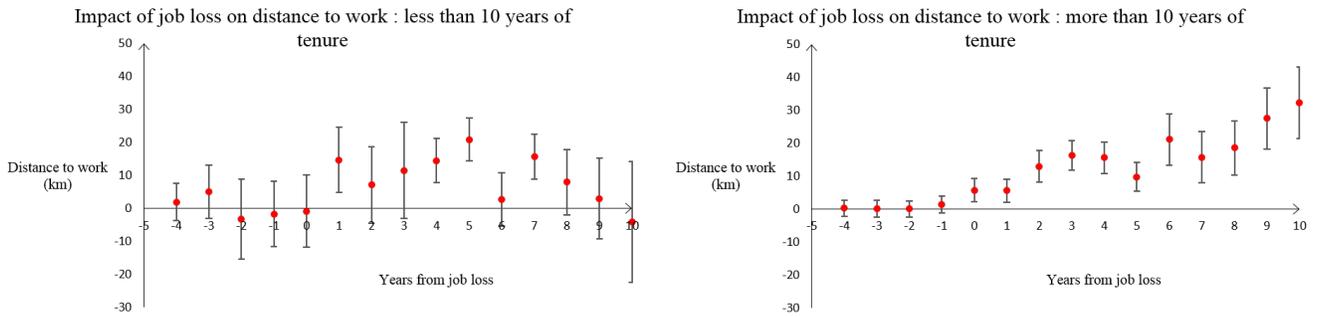


Figure D2.18: Impact of job displacement on the gap between actual and desired hours worked

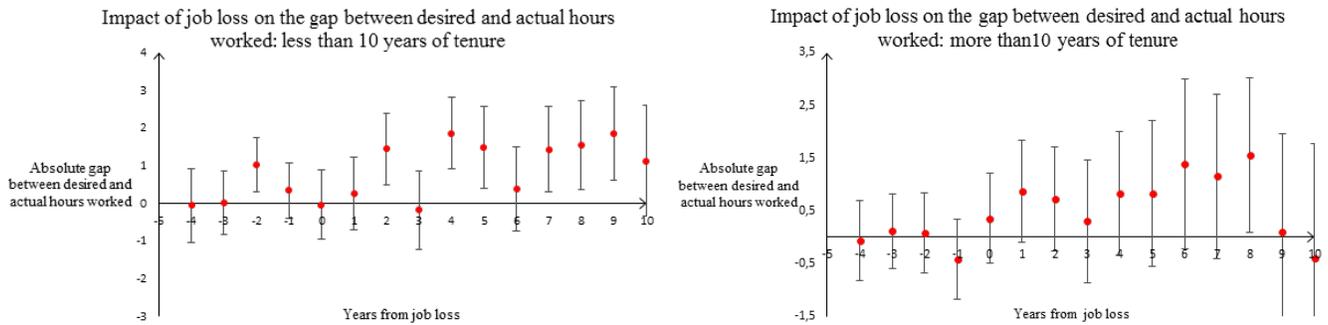


Figure D2.19: Impact of job displacement on job satisfaction

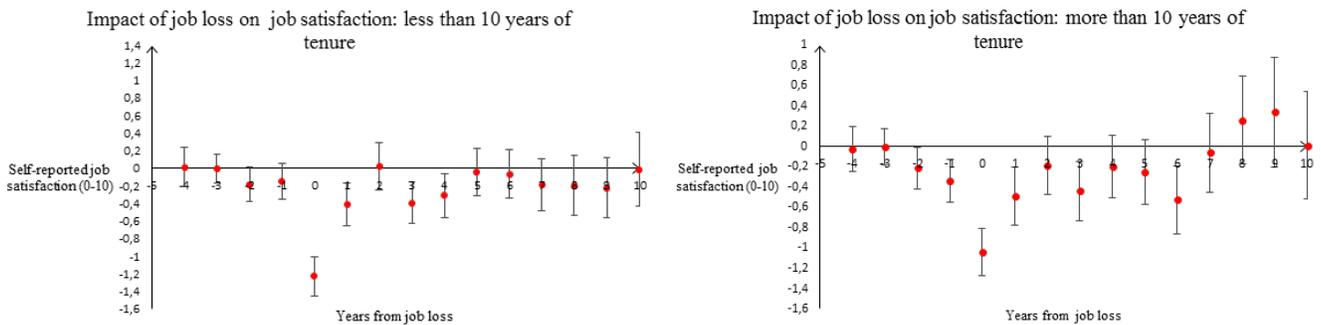
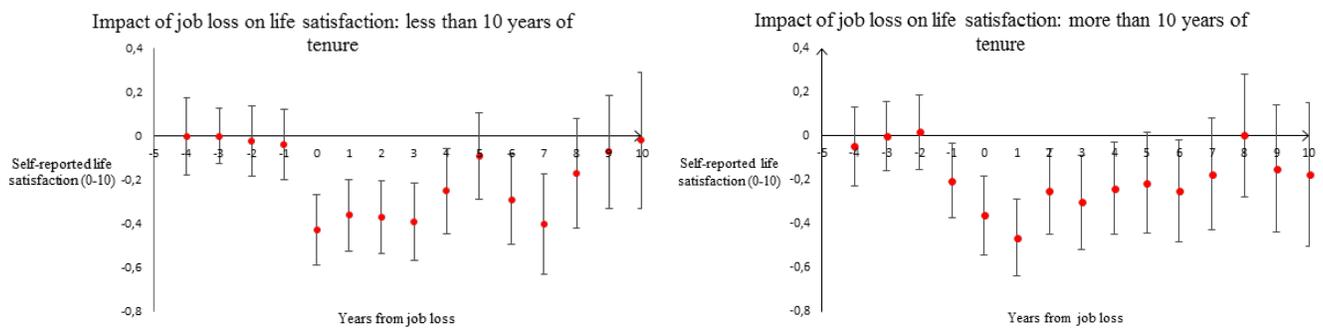


Figure D2.20: Impact of job displacement on life satisfaction



### D.3 White and blue-collar

Figure D3.1: Impact of job displacement on employment

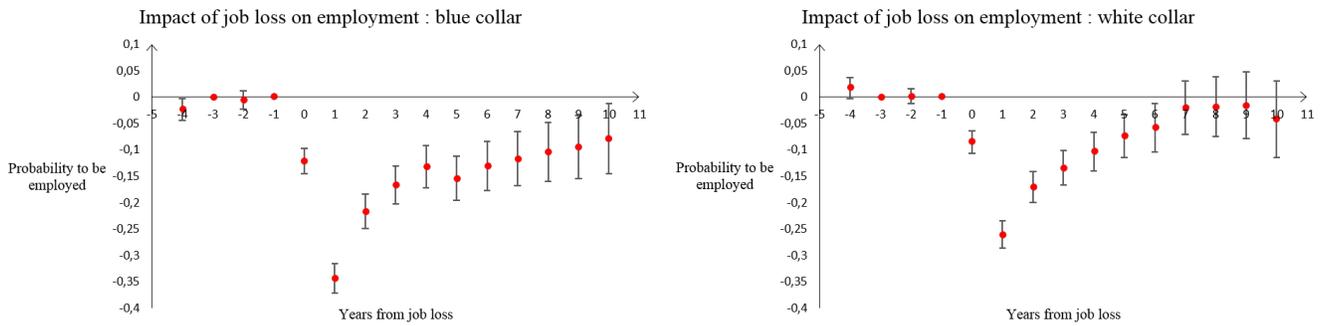


Figure D3.2: Impact of job displacement on earnings

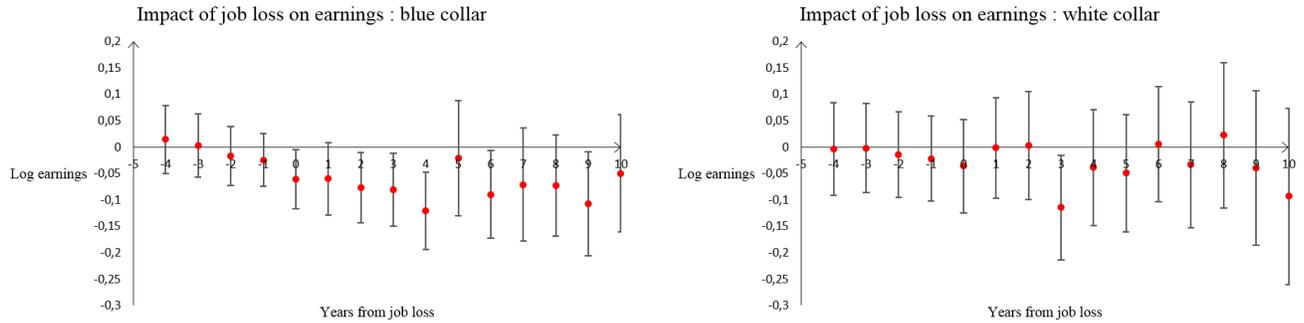


Figure D3.3: Impact of job displacement on hourly wage

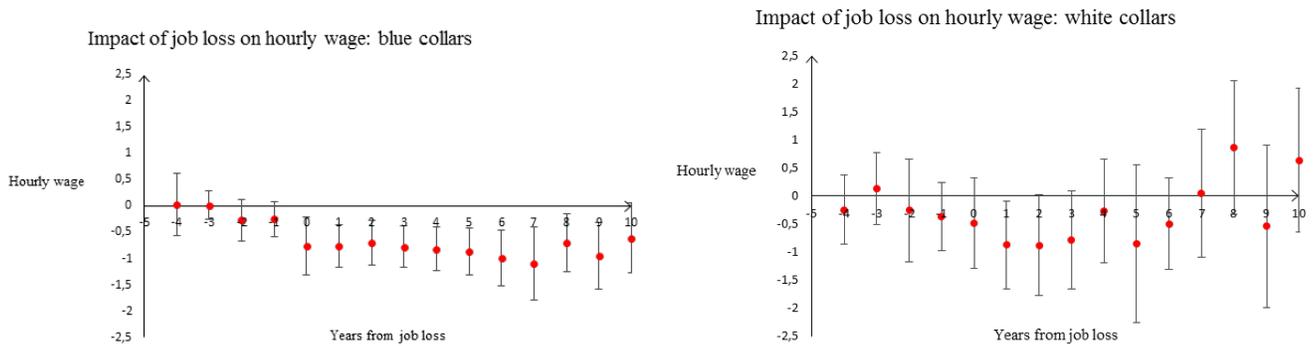


Figure D3.4: Impact of job displacement on job security

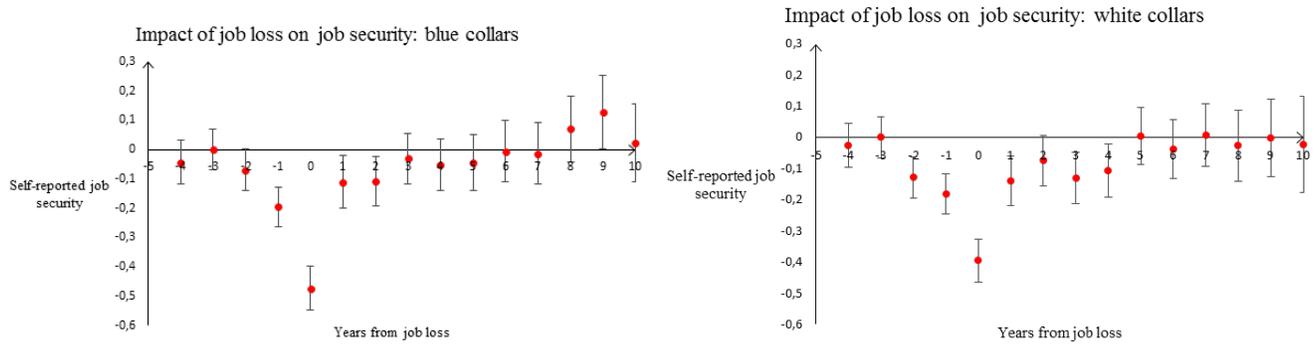


Figure D3.5: Impact of job displacement on probability to work full-time

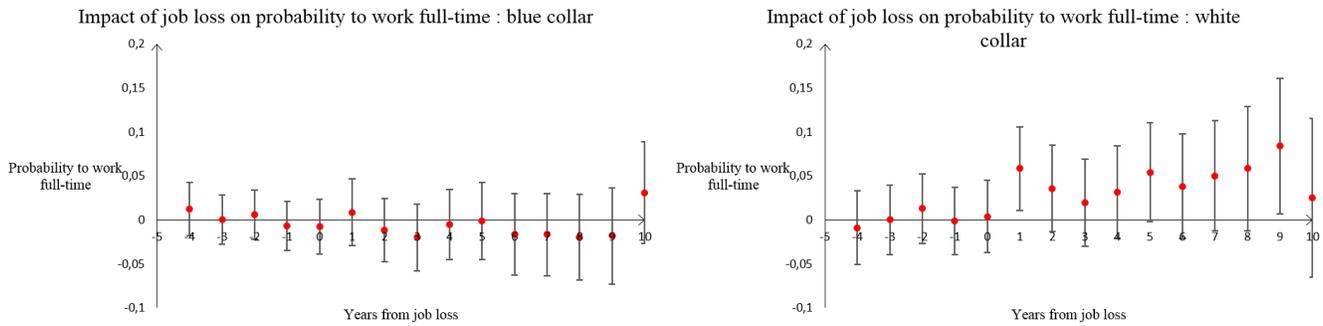


Figure D3.6: Impact of job displacement on probability to work more than 48 hours a week

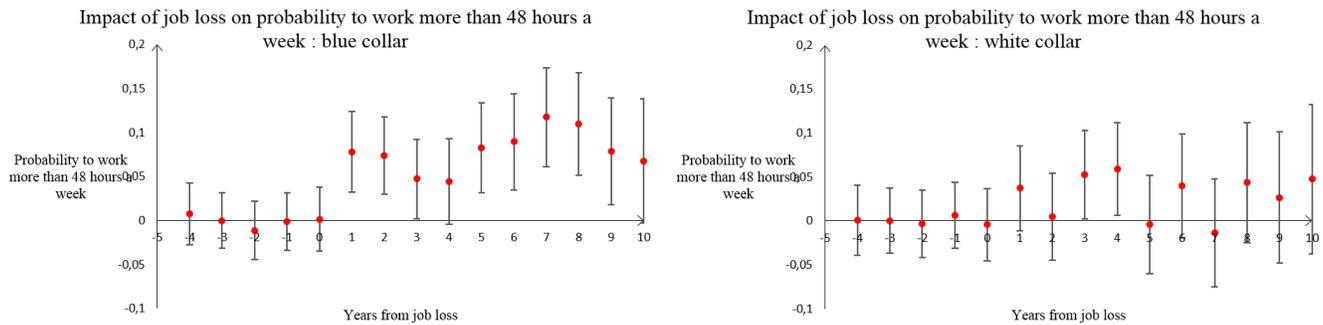


Figure D3.7: Impact of job displacement on distance to work

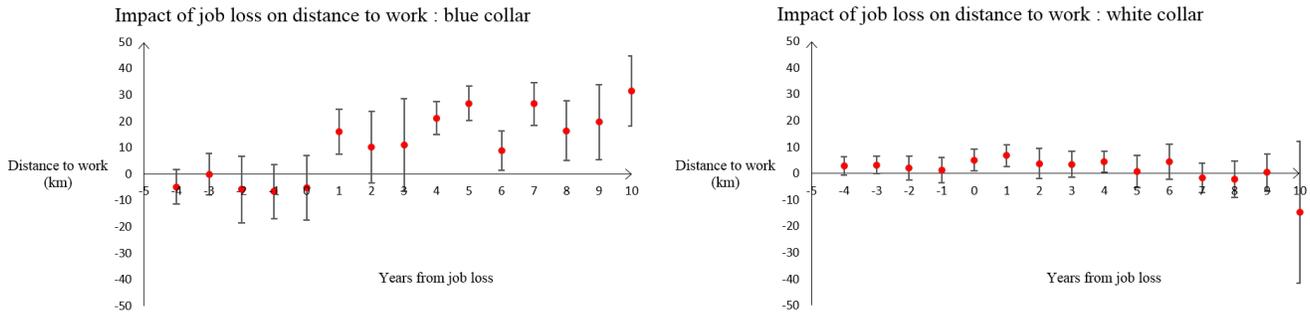


Figure D3.8: Impact of job displacement on the gap between actual and desired hours worked

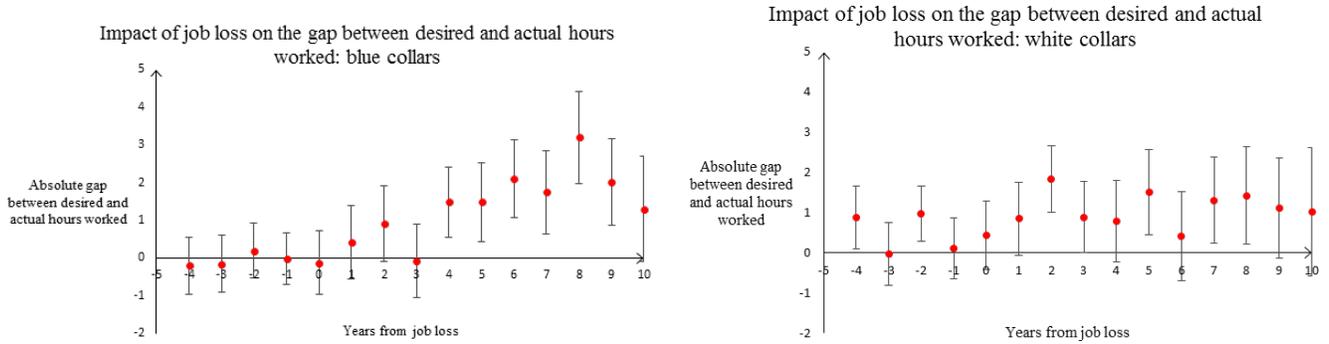


Figure D3.9: Impact of job displacement on job satisfaction

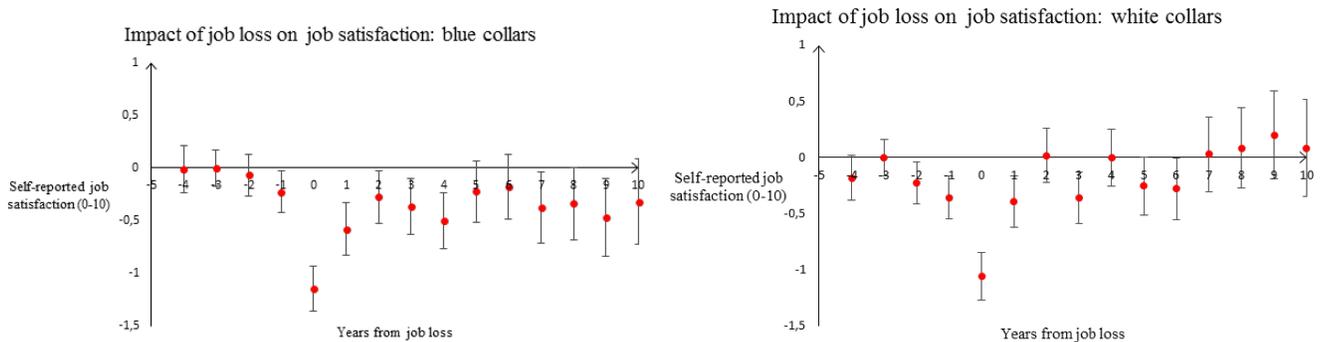
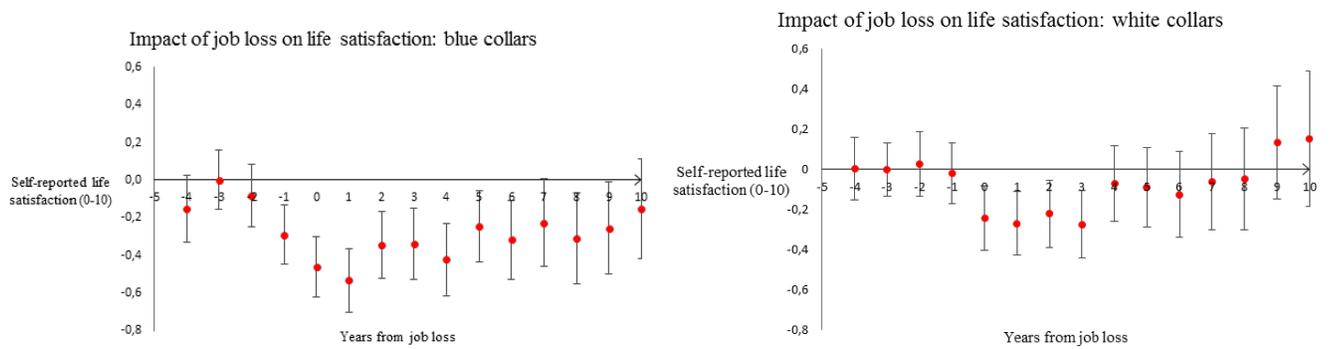


Figure D3.10: Impact of job displacement on life satisfaction



# E Robustness check

Table E1: Short and long-term unemployed: individual characteristics

Time not employed	Number	Female	Age	East	Tenure	Blue-Collars
Less than one year	621	0.38	40.96	0.30	9.32	0.45
More than one year	420	0.46	45.56	0.32	12.04	0.55

Figure E3.1: Impact of job displacement on employment

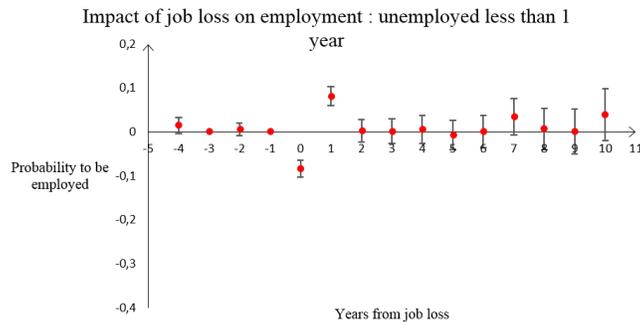


Figure E3.2: Impact of job displacement on earnings

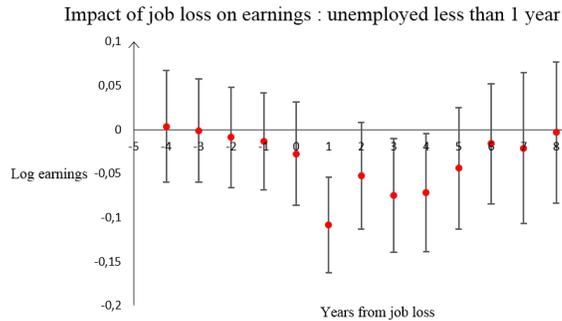


Figure E3.3: Impact of job displacement on hourly wage

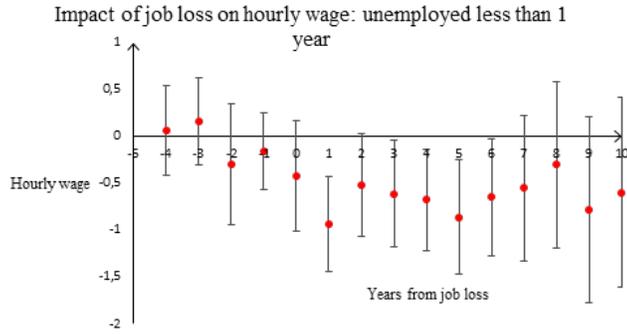


Figure E3.4: Impact of job displacement on job security

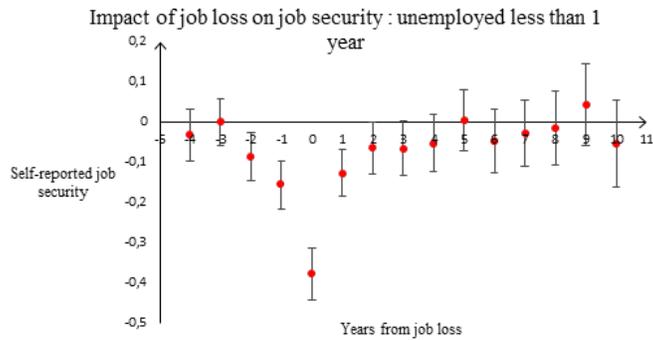


Figure E3.5: Impact of job displacement on probability to work full-time

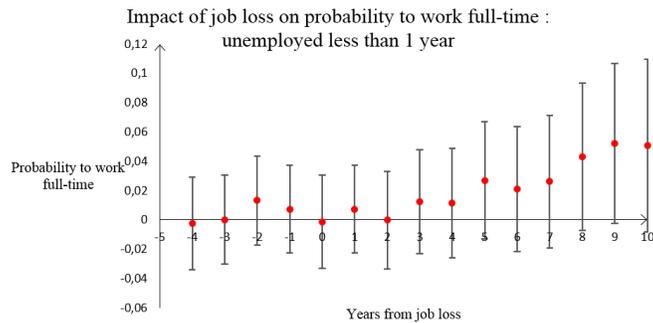


Figure E3.6: Impact of job displacement on probability to work more than 48 hours a week

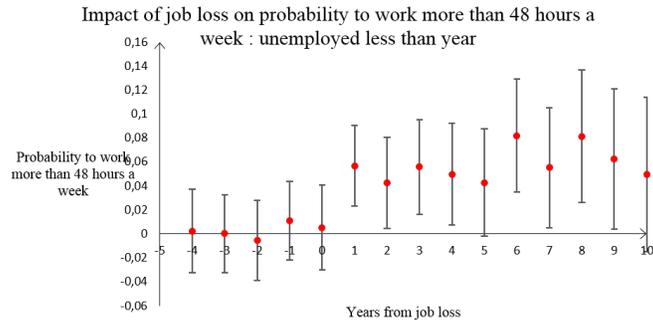


Figure E3.7: Impact of job displacement on distance to work

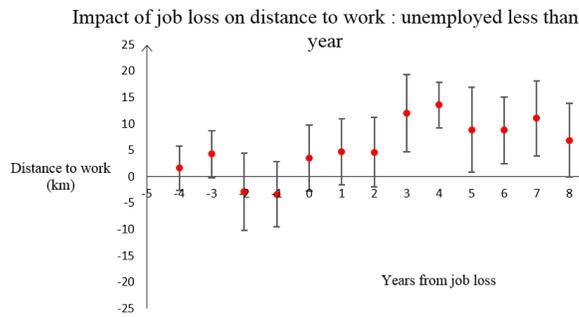


Figure E3.8: Impact of job displacement on the gap between actual and desired hours worked

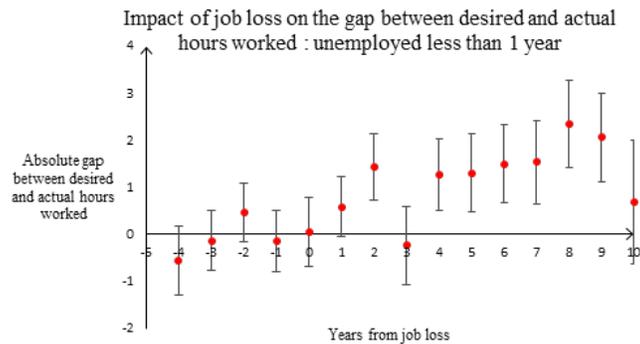


Figure E3.9: Impact of job displacement on job satisfaction

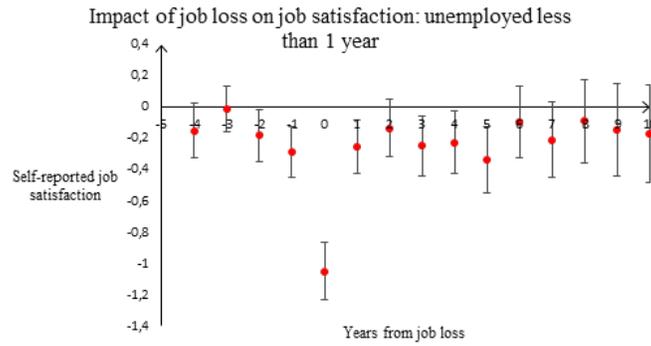


Figure E3.10: Impact of job displacement on life satisfaction

