CPB Netherlands Bureau for Economic Policy Analysis

CPB Discussion Paper | 285

Labour market effects of job displacement for prime-age and older workers

Anja Deelen
Marloes de Graaf-Zijl
Wiljan van den Berge

Labour market effects of job displacement for prime-age and older workers*

Anja Deelen, Marloes de Graaf-Zijl and Wiljan van den Berge

CPB Netherlands Bureau for Economic Policy Analysis

October 1, 2014

Abstract

This paper studies the effect of firm closures for prime-age and older workers. Administrative data on the Dutch labour force are used to follow a sample of Dutch workers who lost their jobs due to firm closures in the period 2000 – 2009. Applying difference-in-difference techniques and using a control group created by exact matching, we find that involuntary job loss has a severe impact on older workers' labour market prospects. Finding a new job is relatively difficult, and wage cuts are more substantial once they find a new job. The differences between prime-age and older workers are partly mediated by tenure and industry effects. Not only do older workers on average have longer job tenures than prime-age workers, older workers with longer job tenures experience more negative effects of displacement as well. For prime-age workers tenure in the job before displacement makes less of a difference for their outcomes after displacement. Likewise, displaced older workers are more sensitive to the situation in the local labour market in the industry from which they are displaced. Moreover, older workers experience stronger negative effects of changing industries after displacement on their post-displacement wages.

Keywords: Firm closures, Older workers, Unemployment.
JEL Classification: J14, J63, J65.

*We thank Anna Salomons (Utrecht University), Daniel van Vuuren (CPB), Bas ter Weel (CPB, Maastricht University), seminar participants at the European Society for Population Economics 2014 conference (Braga, Portugal), participants at the Utrecht School of Economics seminar March 2014 and seminar participants at the "Labour Market for Older Workers: Mechanisms and Institutions" conference at the Dutch Ministry of Social Affairs in 2014 for their helpful comments. We thank Adri den Ouden for excellent research assistance. Any remaining errors are our own.

Abstract in Dutch

Deze studie onderzoekt de effecten van bedrijfsfaillissementen voor oudere en jongere werknemers. We vergelijken werknemers van 45-54 jaar met die van 35-44 jaar en komen tot de conclusie dat oudere werknemers na gedwongen baanverlies een kleinere kans hebben om een baan te vinden. De ouderen die wel weer aan het werk geraken ondervinden een sterkere loondaling dan de jongere groep. Dit nadeel van ouderen is het sterkst in de eerste twee jaar na ontslag, maar blijft ook in latere jaren substantieel: 2 tot 6 jaar na ontslag blijft de kans op werk van ouderen 3,5%-punt achter bij die van de jongere leeftijdsgroep, terwijl hun loonverlies 1,0%-punt groter is. Het grotere verlies voor ouderen wordt deels verklaard door een langere baanduur voorafgaand aan ontslag en een grotere gevoeligerheid voor de lokale en sectorale arbeidsmarktomstandigheden. Een lange baanduur verkleint de kans om weer werk te vinden en vergroot het loonverlies. Niet alleen hebben ouderen vaker een lange baanduur, ook is het arbeidsmarktperspectief na baanverlies voor ouderen met een lange baanduur ongunstiger dan voor ouderen met een kortere baanduur terwijl voor jongere ontslagenen de baanduur in de baan voorafgaand aan ontslag minder uitmaakt voor hun uitkomsten na ontslag. Ook zijn oudere ontslagenen gevoeliger dan jongeren voor een krimpende arbeidsmarkt in de regio en sector waaruit hun baan afkomstig was, vooral in de eerste jaren na het baanverlies. Een baan vinden in een andere sector dan waar men werkte voorafgaand aan het faillissement draagt ook bij aan het relatief groot loonverlies van oudere werknemers. Het onderzoek is uitgevoerd op basis van microdata van werknemers die in de periode 2000 - 2009 hun baan hebben verloren door bedrijfsfaillissementen.

Steekwoorden: faillissementen, oudere werknemers, werkloosheid.

1 Introduction

> "The problems of displaced workers continue to interest researchers, policymakers, and the public. Displacement is perceived to add to structural unemployment, disrupt lives, foil hard-earned expectations, waste human resources, and pile the burden of economic adjustments on an unfortunate few."

These lines, written by Bruce Fallick in 1996, are still very much true today. Especially since the financial and Euro crises hit the western labour markets hard, concerns about the fate of people who lose their jobs due to firm closures or mass layoffs are widely shared. The labour market position of older displaced workers is of specific interest due to the ageing population and the ensuing policy targets to keep older workers in the work force. One of the main challenges of older workers is to find new employment after displacement.

There are several reasons for the particularly vulnerable position of older workers. They are less attractive to new employers due to a relatively high wage-to-productivity ratio resulting from deferred compensation schemes (Lazear, 1981; Daniel and Heywood, 2007; Heywood et al., 2010), the strong bargaining position of well-protected older workers (De Hek and Van Vuuren, 2011) or costly special provisions for older workers in collective bargaining schemes. Additionally, due to long job tenure, older workers embody substantial firm-specific human capital, which is forgone when they are displaced (Poletaev and Robinson, 2008). Long work experience in a specific industry leads to industry-specific capital which is lost upon displacement if the worker cannot find new employment in the same industry (Carrington, 1993; Neal, 1995). Older workers are especially vulnerable to this effect, since they are more likely to end up in shrinking occupations (Autor and Dorn, 2009; Bosch and ter Weel, 2013). Task specific human capital might suffer the same fate (Gibbons and Waldman, 2004). Furthermore, older workers have longer benefit entitlements, which causes higher reservations wages (Van Ours and Vodopivec, 2006). Finally, older workers have more options to retire from the labour market, sometimes with generous early retirement schemes (Ichino et al., 2013). This paper investigates to what extent the impact of firm closure differs between older and prime-age workers and studies the role of tenure and local labour market conditions in the industry from which workers are displaced as determinants of these differences.

We add to a long tradition of research into the consequences of job displacement. Earlier research has established a substantial and persistent effect of displacement on labour market success. Especially in the U.S., researchers have been interested in this phenomenon for decades.[1] They have shown a severe and permanent drop in earnings after displacement. The European literature on displacement is more recent and focuses more on the incidence of (un)employment instead of just on earnings or wages.[2] In

[1] See e.g. Hamermesh (1989) and Fallick (1996) for overviews. Jacobsen et al. (1993) were the first to use a comparison with non-displaced workers. Most recently several studies by Kenneth Couch add to the US-literature on displaced workers (Couch and Placzek, 2010; Couch et al., 2011).

[2] Important examples of European studies are Burda and Mertens (2001), Kuhn (2002),

general, the U.S. literature has found that losses are primarily caused by lower wages in post-displacement jobs, whereas evidence from many European countries finds almost no wage losses for those who re-enter employment, but rather significantly lower employment probabilities (Hijzen et al., 2010).

Differences between age groups are a well-established phenomenon in the displacement literature, both in the U.S. and in Europe[3], although some European studies have established that age primarily affects the adverse impact in terms of (un)employment, but not so much in terms of earnings or wages (Eliason and Storrie, 2006; Ichino et al., 2013). Our study adds to the literature by analysing the factors that lie behind these differences between age groups.

We use administrative linked employer-employee data to follow a sample of Dutch workers who were displaced due to firm closures in the period 2000 – 2009. We follow Ichino et al. (2013) by constructing a control group of non-displaced workers using exact matching techniques. This control group was taken from the same administrative data source, which includes all Dutch workers. It serves as a comparison to determine the counterfactual wages and employment probabilities of displaced workers. It was constructed in such a way that the displaced and their controls are similar on all observed characteristics and face the same labour market risks in order to reduce the potential bias that might results from the selection of the controls (Hijzen et al., 2010; Huttunen et al., 2011). In order to reduce the possibility of overestimating the effects, for example due to a focus on long-tenured workers in a period of high unemployment (Couch and Placzek, 2010), we have limited our restrictions on the group of displaced workers to a minimum. In total we have nearly 45.000 treated and 158.000 controls between the age 35-54.

Using the difference-in-difference techniques that have been the standard in the literature since the seminal work of Jacobsen et al. (1993), we determine the effect of displacement on employment participation and wages. We improve on this method by estimating difference-in-difference-in-difference designs, which allow us to determine to what extent older displaced workers are more sensitive to the local labour market situation in the industry from which they were displaced, to changing industry or to longer job tenure. As such, we improve the understanding of the well-established finding that older workers are hit harder by job displacement in terms of the job opportunities and earnings.

Our results indicate that the labour market outcomes after displacement are highly contingent on age. Two years after job loss, older displaced workers, aged 45 – 54, face a 17 percentage point lower employment probability than their non-displaced counterparts and there remains a persistent effect of 12 percentage points after six years. In comparison, prime-age workers, aged 35 – 44, encounter a 11 percentage points decline in their employment probability after two years. This declines to 7 percentage points after six

Dustmann and Meghir (2005), Eliason and Storrie (2006), Hijzen et al. (2010), Tatsiramos (2010), Huttunen et al. (2011), OECD (2013), and Ichino et al. (2013).

[3]Differences between age groups were demonstrated by e.g. Topel (1990) , Farber (1993), Farber (1997), Couch (1998), Jacobsen et al. (1993), Eliason and Storrie (2006), Couch and Placzek (2010), OECD (2013).

years. Older workers who do find a job after displacement, experience a 1.8 percentage point stronger wage decline in the first two years after displacement compared to their wage before displacement than displaced prime-age workers. Six years after job loss the difference is still 1.4 percentage points. The differences between prime-age and older workers are much smaller in terms of wages than in terms of employment probabilities. This indicates downward wage rigidity for older workers even after displacement. The Dutch institutions regarding unemployment benefits may be the reason here, since older workers in general have longer benefit entitlements.

Tenure, the local labour market situation in the industry from which people are displaced and the transition to another industry partly explain the stronger impact of displacement on older workers. Not only do older workers on average have longer job tenures than prime-age workers, older workers with longer job tenures experience more negative effects of displacement as well. For prime-age workers tenure in the job before displacement makes less of a difference for their outcomes after displacement. Likewise, displaced older workers are more sensitive to the situation in the local labour market in the industry from which they are displaced and experience stronger negative effects of changing industries after displacement on their post-displacement wages, probably due to industry-specific human capital that is lost upon displacement. But these intermediary processes do not explain the entire age difference. A large part of the age difference remains unexplained, which might indicate that, in addition to the human capital explanation, other explanations are important. This could be either institution-based higher labour costs for older workers, such as inflexible collectively agreed wages or special provisions for older workers, higher employment protection for older workers or higher expected costs due to sickness laws. Alternatively, age discrimination by employers on other grounds, such as stereotypes in terms of quality and productivity (Van Dalen et al., 2010), might play a role. But also supply side arguments might be at the core of the difference in the sense that older workers have longer benefit entitlements and higher severance payments, which results in higher reservation wages and better retirement options.

From a policy perspective, our results are of interest for the employment fostering agenda. Like many other countries, the Dutch government has designed an agenda to raise the employment participation of older workers. Early retirement has been made less attractive and workers face incentives to work longer. But we show that displaced older workers experience difficulties to find a new job. A shorter tenure shields older workers to some extent from adverse labour market effects, as does working in a growing industry. This might lead to a discussion about institutions that hinder job mobility of older workers, such as last-in-first out principles in employment protection legislation and industry-based pension rights. In addition, one might discuss the value of wage setting regimes that stimulate delayed compensation schemes and special provisions for older workers, because they lead to a (perceived) labour cost-productivity gap for older workers (Conen et al., 2012).

The paper is organized as follows. Section 2 shows how we constructed the data from various administrative data sources, displays descriptive graphs and presents our

empirical strategy. Section 3 discusses the results of our analyses and section 4 presents sensitivity analyses. Section 5 concludes.

2 Data and empirical strategy

2.1 Data

This paper uses administrative linked employer-employee data in which all Dutch citizens can be followed over time from 1999 until 2011. We merged data from this so-called Social Statistical File (SSB) on employment participation and wages to information on personal characteristics from municipal registrations (GBA) and information on involvement in firm closures for the period 2000 – 2009.

The issue of selectivity bias of control versus treatment group is important for studies of post-displacement labour market experiences and merits some attention. The problem arises when workers possess private information about an impending displacement (Burda and Mertens, 2001). If the firm closure is anticipated, workers with the best outside options might leave the ship before it sinks and one may end up with a selected sample of workers. Therefore, it is common to include all workers who exited the firm up to one year, and in some studies even two years, before closure as displaced. Taking a wider window mitigates the problem of early leavers, but increases the risk that workers are included who moved for reasons other than firm closure. Dustmann and Meghir (2005) and Eliason and Storrie (2006) tested the effect of using a 2 year time window. According to Dustmann and Meghir (2005) the wider window led to weaker results, but the difference is insignificant, while Eliason and Storrie find that the wider window led to stronger results. Our dataset treats all dismissals at firms where the court has issued a bankruptcy in year t or year $t+1$ as displaced.

Other elements of sample selection have also been found important for the estimated effects of displacement. Many have argued that the strong results in the seminal work of Jacobsen et al. (1993) can to a substantial part be attributed to their selection of displaced workers and the comparison group. The focus on long-tenured workers leads to more negative results than one would find for the full sample of workers that were hit by mass layoffs and firm closures (Hijzen et al., 2010). Perhaps more serious, Jacobsen et al. (1993) use stayers as the comparison group, which creates a severe upward bias in the estimated costs of displacement. In practice, many non-displaced workers leave the labour force, especially among the older workers, or are dismissed or displaced later. Leaving those out of the comparison group overestimates the negative effects of displacement (Hijzen et al., 2010; Huttunen et al., 2011).

Other common restrictions on the sample of displaced workers are to exclude workers from small firms, focus on men or on a certain sector, restrict to prime-age workers (e.g. 20 – 49 is a common restriction), and focus on workers for whom all demographic information is available. Our sample includes men and women from all industries and all ages. The only restriction is the fact that someone was employed the entire year before displacement and the availability of all demographic information.

Furthermore, the strong findings in Jacobsen et al. (1993) might be due to their quarterly earnings measure. Quarterly earnings are sensitive to the number of weeks that a person worked during that quarter. If workers find new employment during a quarter, naturally the earnings in that quarter are lower than when he had worked the full quarter. This affects the earnings of the displaced group more than the earnings of the control group of non-displaced workers. According to Topel (1990) virtually all of the short-run recovery of annual earnings is due to an increase in weeks worked, rather than to increases in weekly earnings. Indeed, Jacobsen et al. (1993) observed a sharp drop in quarterly earnings of displaced workers relative to those of non-displaced workers upon separation, in combination with a rapid rise over the next six quarters, and a slow rise thereafter. It remains unclear to what extent this drop in earnings is due to lower wages or to people finding new jobs during the quarter. In this paper we aim to disentangle the employment probability from the wages earned. We use monthly wages, corrected for the number of days that a person actually worked in the specific month. This implies that our wage measure is not sensitive to people finding new employment during the month.

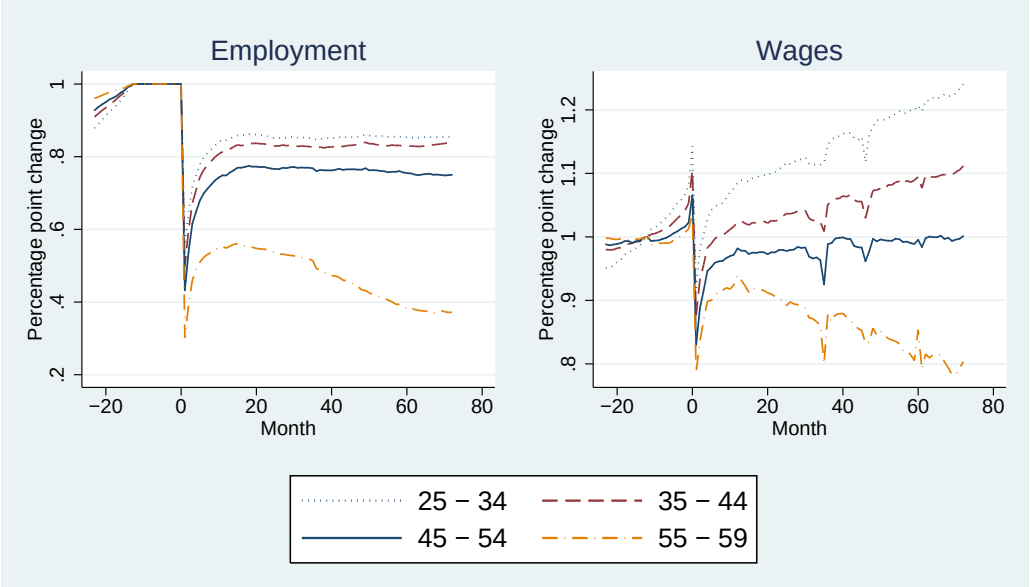
The wage measure that we use is the monthly real gross wage in the months after displacement relative to the wage 13 months before displacement. Reason for the comparison to the 13th month before displacement is not the common dip that was first established by Jacobsen et al. (1993), but a hump in the months leading up to displacement. This hump can be attributed to holiday allowances paid upon displacement. Holiday allowances are a statutory 8 percent top up of the yearly wage, usually paid in May. If the job ends, a worker receives the holiday rights he has built up during the months worked since last May with his final wage. In addition, overdue salary and unused vacation days paid upon bankruptcy might be responsible for the spike. Bankruptcies generally don't involve severance payments. The 13th month before displacement is the first month before displacement in which the wage is not distorted by these additional payments. We did not choose a reference month further from the moment of displacement because that would effectively restrict our sample to those workers that were employed for an even longer period prior to the displacement date.

We treat someone as employed the month she finds a job. This means that we don't distinguish between unemployment and inactivity. Our data includes both private and public sector jobs, as well as self-employment. Unfortunately we are unable to distinguish between the type of employment.

2.2 Descriptive statistics

Employment probabilities after job displacement are much lower for older workers than for younger workers. The left-hand side of Figure 1 shows the percentage of employed workers in different age groups over the period between 24 months before and 72 months after displacement. Employment probabilities from 13 months before displacement up to displacement are 1 by definition. Directly after displacement, employment probabilities for the oldest age group are approximately 30 percent. For the youngest age group this is around 55 percent. For all age groups the employment probability increases

Figure 1: Stylized facts for displaced workers by age (0 = displacement).



Source: Own calculations based on registration data from Statistics Netherlands.

over time, but remains well below 1. The differences between the age groups are stable over time, with the exception of the oldest group. For this group the employment probability gradually decreases as time passes, which must be related to retirement (see also Huttunen et al. (2011)).

Developments in monthly real gross wages (relative to pre-displacement wages) differ substantially between workers below and above the age of 50. The right-hand side of Figure 1 shows the monthly real gross wage relative to the wage 13 months before displacement for different age groups. Immediately after displacement, the oldest workers who do find new employment earn about 22 percent below their pre-displacement wage. The youngest age group earns a wage that is less than 10 percent below the previous wage. All age groups below the age of 55 experience wage growth as time goes on, while the group older than 55 experiences a decrease. This can at least partly be due to selection effects since we only observe wages for people who are in work. In addition, a reduction in working hours might cause lower monthly wages.

Contrary to many other studies, we don't find a wage dip before displacement.[4] In fact, we observe an increase in the wage some months before displacement (see section 2.1).

[4]Most other studies in the large literature regarding the earnings effects of job displacement have established the sharp drop in earnings prior to job loss that was first exhibited by Jacobsen et al. (1993), Studies that do not find a dip in the wages before displacement are Couch (2001), Lengermann and Vilhuber (2002) and Schoeni and Dardia (2003). Couch and Placzek (2010) and Hildreth et al. (2007) find the same upward spikes in earnings in the year prior to separation as we do.

2.3 Control group

Our control group was taken from the same dataset as the treatment group. The Social Statistical Files contain information on all jobs of all Dutch citizens. We selected information about workers who were in work during the entire month during which a displaced worker lost his or her job. Although some employees in the control group may have been displaced (but not observed), the vast majority of the control group – over 95 percent – was not. The ensuing downward bias of the results is therefore probably small.

Our control group was not restricted to stay employed in the months after the treated were displaced. Hijzen et al. (2010) and Huttunen et al. (2011) have shown that such a restriction on the control group leads to an upward bias in the results. The only restriction that we put on our control group is that they were in employment the entire month during which a treated person was displaced, plus the condition that controls are not displaced due to firm closures within the first 12 months after the displacement date of the worker they are matched to.[5] Besides this restriction, both displaced and controls are subject to the same labour market risks, such as dismissals on individuals grounds, mass layoffs and future firm closures, voluntary quits or job mobility.

Following Ichino et al. (2013), we apply a procedure of exact matching to find matches for the displaced workers.[6] Matching variables are age in years, sex, industry, education level, working hours, region and tenure class.[7] For each displaced worker, a maximum of 5 controls was drawn from the data. In principle, a control person can serve as control for more than one displaced person, but given the large number of possible controls relative to the number of treated, the chances are small.

Table 1 presents descriptive statistics of the pre- and post-matching samples of the treated and controls for 2005.[8] Out of nearly 5,000 displaced workers between 35 and 54 years of age we have been able to match almost 2,000. For these 2,000 displaced workers, a control group of more than 7,000 non-displaced workers was drawn from the entire population of nearly 5.5 million.[9] In total we have 44,688 treated and 158,034 controls between 35 and 54 years of age, leaving us with an average of 3.5 controls per

[5] Due to the large number of potential controls relative to the number of treated, this restriction should not affect our estimates.

[6] Eliason and Storrie (2006); Hijzen et al. (2010) and Couch and Placzek (2010) use propensity score matching to determine the effects of job displacement.

[7] Education is measured in three levels: low (up to primary education), middle (up to upper secondary education) and high (up to tertiary education). Working hours are measured in three groups: 0 to 18 hours, 18 to 36 hours and 36 hours or more. For region of residence we take the twelve Dutch provinces. We matched exact on those with 1 - 5 years of tenure, and for those with longer tenures we matched on classes of 5 years until 30 years. Everyone with more than 30 years of tenure was included in one class.

[8] The reason we only present descriptive statistics for one year, is due to memory restrictions. It proved impossible to create a file with observed characteristics for all treated and potential controls for all years. The amount of data was too large.

[9] Since we only observe education for about two thirds of our sample and to test the sensitivity of our matching procedure, we have also applied the same procedure without education and using wages as a proxy for education. Apart from leaving us with a larger sample, the three matching procedures produce similar results.

treated.

Before the matching procedure the potential control group differed markedly from the treatment group in terms of age, sex, sector of industry and other characteristics. After the matching procedure these differences have vanished to a large extent. The sample of post-matching controls (column 4) resembles the sample of post-matching treated in terms of age, job positions and sectors of industry. For example, 17% of the matched treated and controls originate from the financial sector, while only 4% of the pre-matching controls works in the financial sector. Moreover, 25% of the matched treated and 22% of the matched controls are female, while 43% of the pre-matching controls are female. Regarding region of residence there is no selection before or after matching (not in table).

Note that, although we applied exact matching, the shares of the matched treated and the matched controls are close but not always exactly the same. The shares may diverge because not all sub groups (male vs. female; part-time vs. full-time, etc.) have the same number of controls. For example, in the case of sex the divergence is caused by the fact that treated males are on average matched to more controls than treated females are. We did not match on wages, and this shows in a divergence between post-matching treated and controls. The previously mentioned effect may play a role here as well: the relatively high wages have more controls than low wages. Difference in the absolute wage levels between treated and controls should not affect our estimates, since our outcome variable is the wage relative to the wage 13 months before displacement.

2.4 Empirical strategy

We use the difference-in-difference techniques that have been the standard in the literature since the seminal work of Jacobsen et al. (1993). We follow the recent literature and apply diff-in-diff estimates to the matched sample (e.g. Eliason and Storrie (2006); Hijzen et al. (2010); Couch and Placzek (2010); Ichino et al. (2013)). This allows us to mimic a randomized experiment as good as possible given our dataset.[10] While displacement due to firm closures is probably the most exogenous type of dismissal, we cannot exclude selection bias. Firms experiencing bankruptcies may differ from surviving firms, not only in firm characteristics but also in terms of employee characteristics. If confounding factors indeed influence both the probability to receive treatment and the potential outcomes of the treated, the estimated treatment effect is biased. By combining difference-in-difference techniques with matching we reduce the bias in the estimated treatment effect by assuring that treated and controls have the same distributions of observable factors. The size of our dataset allows us to apply exact matching.

[10] Eichler and Lechner (2002); Origo (2009), referring to techniques developed in Heckman et al. (1997), give a good overview of the issues involved. Heckman et al. (1997) show that by extending matching by diff-in-diff techniques the identifying assumption is relaxed to assuming that only the *change* (contrary to the *level*, as in case of the Conditional Independence Assumption) of the non-treatment outcome is independent of treatment assignment. This relaxed assumption is known in the literature as the conditional bias stability assumption (BSA).

Table 1: Summary statistics

	Pre-matching		Post-matching	
	Treated	Controls	Treated	Controls
Monthly wage (euros)	2810.93	2875.00	3022.49	3321.86
(std. dev.)	1765.14	2426.86	1599.87	2316.04
Tenure (years)	6.45	7.77	10.35	10.64
(std. dev.)	6.45	7.2	6.17	5.65
Age	42.84	43.01	43.05	42.96
(std. dev.)	5.74	5.68	5.85	5.85
Education				
Low	.12	.06	.09	.07
Middle	.68	.57	.70	.72
High	.20	.37	.21	.21
Female	.31	.43	.25	.22
Part-time	.30	.43	.20	.18
Permanent contract	.96	.96	.99	.99
Position				
Director and major shareholder	.02	.02	.03	.03
Temp	.03	.03	.00	.00
On-call employee	.01	.02	.00	.00
Other	.94	.92	.97	.97
Sector of industry				
Manufacturing	.25	.13	.31	.31
Wholesale and retail trade	.13	.10	.10	.10
Transport and storage	.07	.05	.05	.04
Accommodation and food serving	.01	.01	.00	.00
Information and communication	.00	.01	.00	.00
Financial institutions	.12	.04	.17	.17
Consultancy, research	.14	.12	.11	.11
Renting and leasing of tangible goods	.05	.06	.01	.01
Public administration	.00	.09	.00	.00
Education	.00	.09	.00	.00
Health and social activities	.04	.17	.04	.04
Culture, sport and recreation	.01	.01	.00	.00
Other services	.02	.01	.02	.01
Other	.16	.11	.19	.21

Notes: The summary statistics refer to 2005. The table only only includes workers between 35 and 54 years of age.
Source: Own calculations using registration data from Statistics Netherlands on displaced workers.

We start with a specification that follows Ichino et al. (2013) and focuses on two age groups of old versus prime-age workers. The basic model specification is:

$$Y_{i,t} = \sum_{t=-24}^{t=72} \alpha_d Z_i T_i M_{i,t}^d + \sum_{t=-24}^{t=72} \beta_d T_i M_{i,t}^d + \sum_{t=-24}^{t=72} \gamma_d Z_i M_{i,t}^d + \sum_{t=-24}^{t=72} \delta_d M_{i,t}^d + \eta_i + \theta_t + \epsilon_{i,t} \quad (1)$$

where $Y_{i,t}$ is the outcome of interest (employment status or wage), i is the individual worker, t is time measured in months, Z_i is an indicator taking value 1 if a worker is aged 45 - 54 and 0 if a workers is aged 35 - 44, T_i is a dummy taking 1 if the worker is displaced due to firm-closure and $M_{i,t}^d$ is a dummy taking 1 for the record in which worker i is observed at d months distance from the (actual or fictional) date of displacement. η_i is the unobserved individual fixed effect[11], θ_t captures calendar time effects (specified as a set of dummy variables for each year) and $\epsilon_{i,t}$ is the individual and time-specific error term.

To aid the interpretation, we present results as expected values of $Y_{i,t}$ for a given worker. For example, if we want to know the effect of displacement for older workers compared to prime-age workers, we calculate the following expected value (ignoring the fixed effects and time trend):

$$\mathbb{E}(Y_{i,t}|Z_i = 1, T_i = 1, M_{i,t}^d = 1) - E(Y_{i,t}|Z_i = 0, T_i = 1, M_{i,t}^d = 1)$$

This is equal to:

$$(\delta_d + \gamma_d + \beta_d + \alpha_d) - (\delta_d + \beta_d) = \gamma_d + \alpha_d$$

Section A.1 in the Appendix presents further details on the calculation of expected values.

The focus on age-group 45-54 (older workers) compared to 35-44 (prime-age workers) is partly based on the observation that the oldest age group of 55-64 shows a distinct employment pattern due to (early) retirement. This group shows a decrease in employment probabilities over time. Both control group and treatment group leave the labour market due to early retirement. If displaced workers retire later, this shows up as a positive effect some years after displacement (see e.g. Eliason and Storrie (2006) and Huttunen et al. (2011)). In the current set-up we are not so much interested in retirement patterns, but rather in the effect of displacement on job finding rates and wages. We therefore focus on the ages just below the oldest group. We exclude the youngest age group because they typically include a large share of people who are still in education and are employed in small part-time jobs on the side.[12]

[11] By including individual fixed effects, we use the monthly available information on wages and employment instead of just the periods we explicitly include in our analysis to control for time-invariant unobservables.

[12] We have estimated the same model with multiple age groups and the results are in line with those presented below.

Identification of the parameter of interest α_d depends on a common trend between displaced and matched non-displaced workers. δ_d controls for any differences between workers before and after treatment, whereas β_d and γ_d control for differences between displaced and non-displaced and older and prime-age workers, respectively. We examine the common-trend assumption by estimating a so-called placebo effect. We impose a placebo "treatment" at 21 months before the actual displacement [13] in a simple diff-in-diff equation:

$$Y_{i,t} = \alpha + \beta_1 * \text{POST}_i + \beta_2 * \text{POST}_i * \text{TREATMENT}_i + \eta_i + \epsilon_{i,t} \quad (2)$$

where $Y_{i,t}$ is our outcome variable, POST indicates the period after the placebo treatment, and η_i controls for fixed differences between treated and controls. Coefficient β_2 is the coefficient of interest and measures the effect of the placebo treatment. We estimate this equation for the first two years before displacement with both older and prime age workers together.

Table 2 reports coefficient β_2 for both employment probabilities and wages. While the estimated diff-in-diff parameters for employment are statistically significant at almost every distance from the placebo treatment, this is mostly due to the large sample size. The effects are economically negligible at an average increase of the employment probability before displacement of 0.4 percentage points. In comparison, the decline immediately after the actual displacement is around 50 percentage points. For wages we find statistically significant negative estimates, except for the period up to 21 months after the placebo treatment, which shows a positive estimate. These effects are also economically significant and point to two important differences between the treatment and control group. First, the treatment group experiences a decline in their wage relative to the control group in the period leading up to displacement. The reason is most likely that firms are typically in financial difficulty before they declare bankruptcy and this could lead to lower wage growth than would otherwise have been the case. So while we don't find an absolute dip in wages for the treated before displacement, as much of the literature does, we do find a relative dip compared to the control group (see section 2.2). Second, we observe a small peak in wages just before displacement and this is most likely to the payment of overdue holiday allowances and possibly overdue wages. Together, these results suggest that the wage of workers in the period leading up to displacement is lower than we would expect on the basis of their characteristics. This means that our we will an underestimate the actual effect of displacement on wages.

We expand upon the standard methodology in the literature by further exploring the treatment effects estimated with equation 1. We examine whether the different experiences of older and prime age workers after displacement are for example related to their tenure or industry using a difference-in-difference-in-difference specification. For instance, older displaced workers may be more sensitive to longer job tenure, the local labour market situation in the industry from which they are displaced[14] or changing

[13] The specification is robust to using other periods for the placebo treatment.

[14] The structural decline in the local labour market is calculated as the moving average of the employ-

Table 2: Diff-in-diff coefficient for placebo treatment (Equation 2) of displaced older and prime age workers.

	Placebo effects
Panel A: Employment	
Up to 6 months	.0009
Up to 12 months	.0051***
Up to 18 months	.0037***
Up to 21 months	.0025***
Panel B: Wages	
Up to 6 months	−.0155***
Up to 12 months	−.0110***
Up to 18 months	−.0168***
Up to 21 months	.0070***

Notes: Calculations on the basis of fixed effects estimates of equation 2. All parameters are the result of separate regressions. Significance levels: $***$: 0.1%.
Source: Own calculations using registration data from Statistics Netherlands on displaced workers.

sectors. Note that these estimates cannot be interpreted as treatment effects, since there is not necessarily a common trend in the employment probabilities and wages of long and short tenured workers. Rather, the estimates should be interpreted as an exploration of the reason behind the observed differences between older and prime age workers in their labour market situation after displacement. The expanded specification is:

$$\begin{aligned} Y_{i,t} = & \sum_{t=-24}^{t=72} \kappa_d W_i Z_i T_i M_{i,t}^d + \sum_{t=-24}^{t=72} \alpha_d Z_i T_i M_{i,t}^d + \sum_{t=-24}^{t=72} \mu_d W_i T_i M_{i,t}^d + \\ & \sum_{t=-24}^{t=72} \phi_d W_i Z_i M_{i,t}^d + \sum_{t=-24}^{t=72} \beta_d T_i M_{i,t}^d + \sum_{t=-24}^{t=72} \gamma_d Z_i M_{i,t}^d + \sum_{t=-24}^{t=72} \lambda_d W_i M_{i,t}^d + \\ & \sum_{t=-24}^{t=72} \delta_d M_{i,t}^d + \eta_i + \theta_t + \epsilon_{i,t} \end{aligned} \tag{3}$$

where W_i is a dummy variable that differs in its interpretation in the various specifications: it either represents long tenure, displacement from a declining local labour market or changes sectors after displacement. All other variables are the same as before. In the same fashion as above, we can compute expected values of $Y_{i,t}$. For example, if we

ment per region and sector given by $\Delta E = \frac{E_{t-1}+E_t+E_{t+1}}{E_{t-2}+E_{t-1}+E_t}$. We distinguish 16 sectors of industry and 12 regions (Dutch provinces).

want to know the average "effect" of longer tenure ($W_i = 1$) for older ($Z_i = 1$) workers, we have to compute the following expected value:

$$\mathbb{E}(Y_{i,t}|W_i = 1, Z_i = 1, T_i = 1, M^d_{i,t} = 1) - \mathbb{E}(Y_{i,t}|W_i = 0, Z_i = 1, T_i = 1, M^d_{i,t} = 1)$$

This is equal to:

$$(\delta_d + \beta_d + \gamma_d + \alpha_d + \lambda_d + \mu_d + \phi_d + \kappa_d) - (\delta_d + \beta_d + \gamma_d + \alpha_d) = \lambda_d + \mu_d + \phi_d + \kappa_d$$

The expected values for prime-age workers are:

$$\mathbb{E}(Y_{i,t}|W_i = 1, Z_i = 0, T_i = 1, M^d_{i,t} = 1) - \mathbb{E}(Y_{i,t}|W_i = 0, Z_i = 0, T_i = 1, M^d_{i,t} = 1)$$

This is equal to:

$$(\delta_d + \beta_d + \lambda_d + \mu_d) - (\delta_d + \beta_d) = \lambda_d + \mu_d$$

If we subtract this from the "effect" of longer tenure for older workers, we get a measure that indicates the difference between older workers and prime-aged workers regarding the extent to which longer tenure affects the employment probabilities or wages:

$$(\lambda_d + \mu_d + \phi_d + \kappa_d) - (\lambda_d + \mu_d) = \phi_d + \kappa_d$$

ϕ_d captures the difference between older workers with longer tenure and older workers with shorter tenure and κ_d captures the difference between treated older workers with longer tenure and treated older workers with shorter tenure. Together they determine the difference between older workers and prime-age workers in how tenure affects the employment probabilities (or wages). Other differences can be computed in similar fashion. See section A.1 for more on the calculation of expected values.

3 Results

In line with the literature on job displacement, our results from the difference-in-difference analysis on the matched sample indicate that both employment probabilities and wages plummet upon displacement, and subsequently recover in the period thereafter (Figure 2). Although labour market outcomes of displaced workers improve over time, they do not reach the level of the counterfactual within our period of observation, neither for older workers nor for prime-age workers. The negative effects of displacement are persistent, at least up to six years after the firm closed down.[15]

[15] An implicit assumption in diff-in-diff analyses is that there are no spillover effects or treatment externalities. This means that it is important to assure that the share of displaced workers is relatively low compared to the overall labour force. Unfortunately, we don't have data on the share of all types of dismissals per region and sector. Statistics on the inflow in unemployment benefits per municipality may however give some indication. In the first quarter of 2010 the average (weighted by the municipal labour forces) inflow in UB as a fraction of the relevant municipal labour forces was 1.5%, whereas the variation was limited: in 95% of the municipalities this fraction remained below 2.2%.

Our results confirm that age group 45-54 (older workers) experiences more severe effects of job displacement on their employment probabilities than age group 35-44 (prime-age workers). The left-hand side of Figure 2 shows the employment probabilities of these two age groups from two years before until 6 years after the firm closure by quarter since displacement. Compared to the control group the oldest age group suffers a deterioration of their employment probabilities of 62 percentage points immediately after displacement. For prime-age workers this is 55 percentage points. Two years after displacement, the oldest age group performs 17 percentage points below their control group in terms of employment probabilities, while the prime-aged group scores 13 percentage points below their controls and these differences decline over the remaining four years to 8.5 and 6 percentage points, respectively. So the difference in employment probabilities between displaced older and prime-age workers is persistent up to at least six years after displacement.

In terms of their wage developments, older displaced workers also suffer more than prime-age displaced workers (right-hand side of Figure 2). We analyse the growth in real gross monthly wages compared to the level 13 months before displacement. Older workers are hit harder in the dip, the drop and the recovery phase (terms introduced by Jacobsen et al. (1993)). Already before displacement – the dip phase – there is a gap between old and prime-age displaced workers of approximately 1 percentage point. Upon displacement – the drop phase – older workers suffer a 22 percentage points wage loss, while prime-age workers lose 19 percentage points.[16] This recovers within a year to approximately 8 percentage point wage loss for older workers and 5 percentage points for prime-age workers. In the longer run the difference between older and prime age workers declines to about 1 percentage point, which indicates small persistent age differences in the effect of displacement on wages.

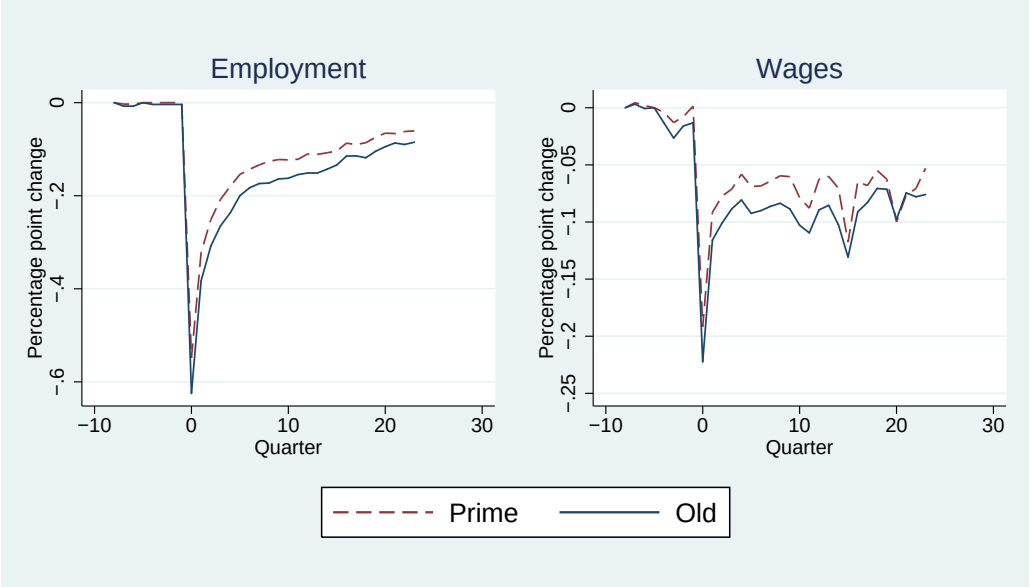
Figure 3 confirms these results for all age groups. Younger workers between 25 and 34 years suffer less than prime age workers, both in terms of employment probabilities and wages. Older workers aged 55 - 59 initially suffer more than other age groups, but as time passes by they actually gain in both employment probabilities and wages relative to their control group. The primary reason seems to be that the control group has (early) retirement options, whereas the displaced older workers don't (see also Huttunen et al. (2011)).

Above, we have established persistent displacement effects in terms of employment probabilities and wages, which are more severe for older workers than for their prime-aged counterparts. Table 3 summarizes the results established above. It shows the effects of displacement on the expected values of $Y_{i,t}$ for two time periods after displacement and compares prime-age and older workers. The long run differences in employment probability and wages are about 3 and 1 percentage points respectively.

The persistent gap between age groups might be related to the characteristics of

[16]Keep in mind that the wages of displaced workers might be biased. They might be biased upwards, because those who do find and accept a job are likely those with the better prospects. On the other hand, those who accept a job quickly after displacement might be the ones with low reservation wages.

Figure 2: Treatment effects for prime-age and old workers on employment probabilities and wages (0 = displacement).



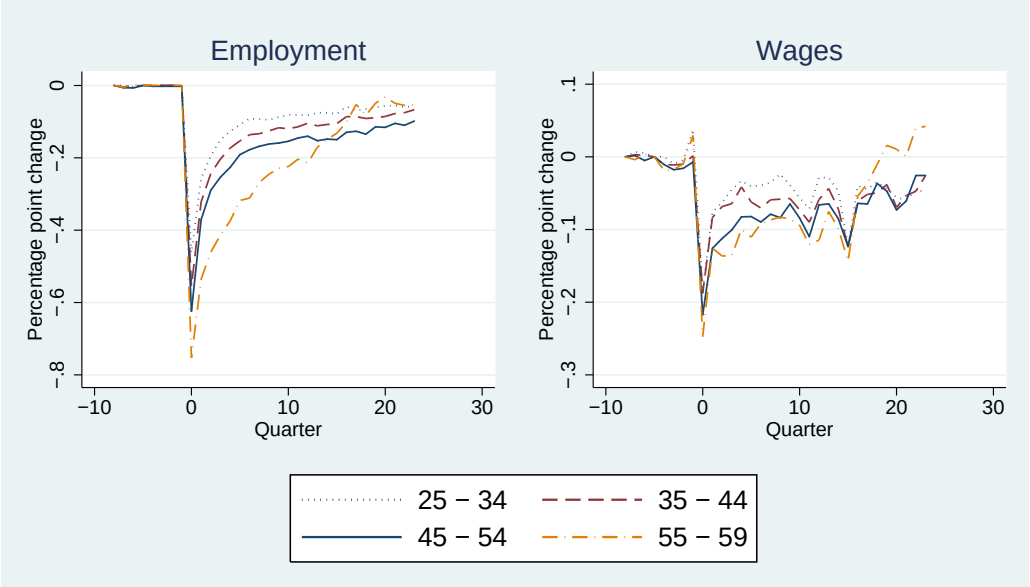
Source: Own calculations based on registration data from Statistics Netherlands. Simulations based on estimates of the diff-in-diff fixed effects model in equation 1.

Table 3: Effects on the expected values of $Y_{i,t}$ for displaced older and prime-age workers and the difference between them.

	Treatment effect old (45 - 54)	Treatment effect prime (35 - 44)	Difference between old and prime
Employment 0 - 2 years after displacement	-.2770	-.2211	-.0559
Employment 2 - 6 years after displacement	-.1370	-.1019	-.0351
Wages 0 - 2 years after displacement	-.0978	-.0804	-.0174
Wages 2 - 6 years after displacement	-.0823	-.0726	-.0097

Notes: Calculations on the basis of fixed effects estimates of equation 1. Calculations for employment and wages are based on separate regressions. Full results and calculation method presented in the Appendix. All effects are significant at the 1% level.
Source: Own calculations using registration data from Statistics Netherlands on displaced workers.

Figure 3: Treatment effects on employment probabilities and wages for four age groups (0 = displacement).



Source: Own calculations based on registration data from Statistics Netherlands. Simulations based on estimates of the diff-in-diff fixed effects model in equation 1.

the age groups. Due to longer job tenure, older workers may embody substantial firm-specific human capital, which is forgone when they are displaced (Poletaev and Robinson, 2008). In addition, older workers may have built up industry-specific capital by a long work experience in a specific industry, and this is lost upon displacement if the worker cannot find new employment in the same industry (Carrington, 1993; Neal, 1995). Older workers may be especially vulnerable to this effect, since they are more likely to end up in shrinking occupations (Autor and Dorn, 2009; Bosch and ter Weel, 2013). Then they will need to look for employment in a different occupation or industry.

Table 4 shows that the oldest age group indeed has longer tenure than the prime-age group. The difference in the share that was displaced from a declining labour market is small. And the share of workers that changes industry does not differ between older and prime-aged workers.

But even if older workers would not have longer tenure, or were not displaced from declining labour markets more often, they might be affected stronger by these factors. This would for instance be the case if employers are more willing to invest in new firm or industry specific capital for prime-age workers than in older workers because they have more time to recoup their investment costs.

To provide deeper insight into the reasons behind the persistent gap between the age groups, our difference-in-difference-in-difference estimation (equation 3) tests to what extent job tenure and sector characteristics affect older worker's employment probabil-

Table 4: Shares of different variables for old and prime-age displaced workers.

	Old (45 – 54)	Prime (35 – 44)
Long tenure ($\geq$ 7 years)	0.45	0.31
Declining sectoral-regional labour market	0.68	0.66
Changing sectors	0.11	0.11

Source: Own calculations using registration data from Statistics Netherlands on displaced workers.

ities and wages after displacement in comparison to prime-age workers. From now on we refer to this as older workers' "sensitivity" to these characteristics. More specifically, we examine whether older workers are more sensitive to long job tenure, to the local labour market situation in the industry from which they are displaced and to making a transition to another industry.

Table 5 presents the effects on the expected values of $Y_{i,t}$ for displaced older and prime age workers with different characteristics. It compares workers with long and shorter tenure (with a cut-off at 7 years)[17], workers in a declining local labour market with those in a growing local labour market and workers who find a job in a different (2-digit) sector after displacement with those who don't.[18]

Older workers suffer more severely from displacement if they have long tenure in their previous job. Column 1 shows that the employment probability of displaced older workers with longer tenure is about 5 percentage points below that of displaced older workers with short tenure in the short run, and is roughly equal in the longer term. For prime age workers (column 2) the differences between long and short tenured workers are much smaller in the short run and in the long run long-tenured displaced workers have even higher employment probabilities than short-tenured displaced workers. The difference in the wage drop after displacement between long and short tenured workers is stable at around 4 percentage points for older workers and around 3 percentage points for prime age workers.

The conditions in the labour market from which older workers are displaced partly explains their labour market outcomes too. In accordance with the observation by Carrington (1993) we find that older workers are more sensitive to the local sectoral labour market from which they are displaced. If they are displaced from a declining local labour market, older workers experience a 4 percentage point stronger loss in their employment probability in the short run than if they are displaced from a stable or growing industry. This difference declines to about 1 percentage point in the longer run. For prime age workers the negative effect is smaller, with 1 percentage points in the short run and no effect in the long run. The estimated effects of being displaced from a declining labour market on wages are similar to the effect on the employment

[17] We have estimated the same specification with different cut-offs for tenure and the results are in line with those presented here.

[18] Since switching sectors requires having found a new job, it is impossible to estimate the "effect" for employment probabilities.

rates in the short run, with about a 2 percentage point stronger negative effect on older workers. But the effect on wages does not vanish in the longer run. Especially prime-age workers experience stronger negative wage effects of being displaced form a declining labour market in the long run.

Our results also support the hypothesis that older workers are more sensitive to switching industries. Older displaced workers who find new employment in a different industry than the one from which they were displaced suffer a wage loss of about 9 percentage points compared to those who found a job in the same industry. For prime-age workers these effects are about 5 percentage points, which indicates a stable long run difference between older and prime age workers of about 4 percentage points.

Table 5: Effects on the expected values of $Y_{i,t}$ for older and prime-age displaced workers displaced with different characteristics (W) and the difference between them.

	W=1 - W=0 for older workers (45 - 54)	W=1 - W=0 for prime age workers (35 - 44)	Difference between old and prime
Panel A: Employment, 0 - 2 years after displacement			
Longer tenure	-.0498	-.0168	-.0330
Declining local labour market	-.0389	-.0138	-.0251
Panel B: Employment, 2 - 6 years after displacement			
Longer tenure	.0035	.0279	-.0244
Declining local labour market	-.0082	-.0009	-.0073
Panel C: Wages, 0 - 2 years after displacement			
Longer tenure	-.0437	-.0279	-.0158
Declining local labour market	-.0314	-.0136	-.0178
Move to another sector	-.0974	-.0577	-.0397
Panel D: Wages, 2 - 6 years after displacement			
Longer tenure	-.0474	-.0393	-.0081
Declining local labour market	-.0248	-.0245	-.0003
Move to another sector	-.0878	-.0496	-.0382

Notes: Calculations on the basis of fixed effects estimates of equation 3. Calculations for employment, wages and additional variables are based on separate regressions. Full results and calculation method presented in the Appendix. All effects are significant at the 1% level.

Source: Own calculations using registration data from Statistics Netherlands on displaced workers.

4 Sensitivity analyses

We test the sensitivity of our results first by comparing the differences between men and women. Panels A and B in Table 6 show the results for the overall displacement effects for older and prime-aged men and women. It is clear that especially older men lose more in terms of employment probabilities than older women. For wages, on the other hand, both older and prime-age women lose more than men. So the adaptation process to a job loss runs more via wages for women, while for men it runs more via their employment rates. A potential explanation can be found in the shorter benefit rights for prime-age and older women, who usually have disrupted careers. In addition, women may be more risk averse and therefore have lower reservation wages. A lower reservation wage for women may also be the result of the fact that their income usually makes up a smaller share of the household income. Alternatively, women in the control group might retire earlier than men in the control group, which would lead to higher employment rates for women in the treatment group.

In October 2006, the Dutch government introduced a comprehensive reform of the system of unemployment benefits. For most unemployed workers this reform reduced the period of benefit entitlement, sometimes the reduction was as strong as 22 months, although it did increase the entitlement period for some other groups by at most 2 months. Previous empirical evidence shows that this reform increased job finding rates, but led to a decrease in the quality of the job found (De Groot and van der Klaauw, 2014). We have run the same specifications as above, but now separated those displaced before the reform from those displaced after the reform. Panels C and D in Table 6 show the results for the overall displacement effects. Our results confirm that employment probabilities are higher for displaced after the reform, at least in the short run. We also observe that in the short run wages are lower for displaced after the reform. The interpretation of the long run effects is less clear, since the Dutch labour market was hit by the Great Recession in 2009. This means that our results likely overestimate the actual impact of the reform on wages and underestimate the impact on employment.[19] In addition, we only have data available until 2011, so we cannot estimate effects up to 6 years after displacement.

For both sensitivity checks we also estimated the full diff-in-diff-in-diff specification and the results are in line with those presented. In addition, we have tested the robustness of our main results by running similar specifications as above with different cut-off points for age, tenure and other variables.[20] The overall picture arising from these tests confirms our main results: older workers suffer more from displacement than younger workers and within age groups, those with longer tenure tend to suffer more, especially the older ones.

[19] Note that this also partly applies to the short run estimates for those laid off in 2008.

[20] The results are not reported here, but are available on request.

Table 6: Effects on the expected values of $Y_{i,t}$ for displaced older and prime age workers for men and women (Panel A and B) and in the period before and after the October 2006 reform of unemployment benefits (Panel C and D).

	Treatment effect old (45 - 54)	Treatment effect prime (35 - 44)	Difference between old and prime
Panel A: Men			
Employment 0 - 2 years after displacement	-.2855	-.2216	-.0639
Employment 2 - 6 years after displacement	-.1380	-.1032	-.0348
Wages 0 - 2 years after displacement	-.0934	-.0766	-.0168
Wages 2 - 6 years after displacement	-.0754	-.0682	-.0072
Panel B: Women			
Employment 0 - 2 years after displacement	-.2505	-.2193	-.0312
Employment 2 - 6 years after displacement	-.1335	-.1014	-.0321
Wages 0 - 2 years after displacement	-.1095	-.0892	-.0203
Wages 2 - 6 years after displacement	-.1014	-.0867	-.0147
Panel C: Before October 2006			
Employment 0 - 2 years after displacement	-.3131	-.2434	-.0697
Employment 2 - 6 years after displacement	-.1422	-.0981	-.0441
Wages 0 - 2 years after displacement	-.0897	-.0781	-.0116
Wages 2 - 6 years after displacement	-.0601	-.0588	-.0013
Panel D: After October 2006			
Employment 0 - 2 years after displacement	-.2476	-.2023	-.0453
Employment 2 - 5 years after displacement	-.1468	-.1208	-.0260
Wages 0 - 2 years after displacement	-.1055	-.0834	-.0221
Wages 2 - 5 years after displacement	-.1200	-.0974	-.0226

Notes: Calculations on the basis of fixed effects estimates of equation 1. Calculations for employment and wages are based on separate regressions. Full results and calculation method presented in the Appendix. All effects are significant at the 1% level.
Source: Own calculations using registration data from Statistics Netherlands on displaced workers.

5 Conclusions

This paper analysed the effect of displacement due to firm closures on the employment probabilities and wages of the workers involved. Our results support findings in the literature that displaced workers experience substantial and persistent effects on employment probabilities and wages. The size of these employment and wage effects are contingent on age. Displaced older workers face worse employment prospects than displaced prime-age workers and displaced older workers who do find a job typically experience larger wage losses than displaced prime-age workers. This picture is clear from descriptive statistics, and remains after comparing the outcomes of displaced workers to their counterfactual outcome in case they had not been displaced. This counterfactual is determined by constructing a control group and applying a difference-in-difference design on the matched sample.

Our result are probably a lower boundary of the actual treatment effect, since a placebo test shows that wages start to decline more than a year before the actual job loss, while we used the 13th month before displacement as the reference point for the wage loss. Comparing to a point further in the past would likely lead to a smaller underestimation, but this would imply a restriction on the treatment and control groups regarding the employment duration before displacement. This restriction would lead to an overestimation of the actual result, since long-tenured workers suffer stronger effects.

We have clearly shown that the differences between age groups are mediated by the longer tenure of older workers, their higher vulnerability to the local labour market situation in the industry from which they were displaced and a change of industry. Not only do older workers on average have longer job tenures than prime-age workers, older workers with longer job tenures experience more negative effects of displacement as well. Displaced older workers with job tenure shorter than seven years have much better prospects in the short run than those with longer tenure. High-tenured displaced older workers experience a 5 percentage-points larger drop in employment probabilities and 4 percentage-point larger decline in their relative wage in the first two years after displacement than short-tenured displaced older workers. This difference remains persistent for wages. For prime-age workers tenure in the job before displacement makes less of a difference for their outcomes after displacement.

The local labour market in the industry from which older workers are displaced partly explains their labour market outcomes too. Workers displaced from industries in which the local labour market was structurally declining have worse employment probabilities and wage prospects. In the first two years after displacement employment probabilities and relative wages for older workers displaced from declining industries are respectively around 4 and 3 percentage points below those of older workers displaced from better performing industries, whereas the wage effect persists in the long run. In general, older workers are not more often displaced from declining industries than prime-age workers, but within the group of older workers the ones displaced from declining industries perform worse. Prime-age workers are less sensitive to the situation in the local labour market in the industry from which they were displaced.

Related, switching industries also mediates the difference between age groups. Older displaced workers who find new employment in a different industry than the one from which they were displaced suffer wage losses that are almost 10 percentage points stronger than those who find work in the same industry. This holds for prime-age workers as well, but to a lesser extent. Again both composition effects and elasticities play together. Older workers switch almost as often to other industries as prime-age workers, but they are more sensitive to making this transition. These differences in the sensitivity to making a switch to another industry make older workers more vulnerable.

Our results suggest that job mobility in earlier stages of the career have beneficial effects after displacement. However, from the individual's point of view it is not always optimal to change jobs, since people lose employment protection (due to the last-in-first-out principle) and pension rights upon transition to another job. Since the effects of job tenure on the incidence and the impact of displacement are opposite, the net effects of job mobility are unclear at the individual level. From the social welfare point of view, the optimal job mobility rate might be higher than from the individual point of view. Moreover, while demotion rarely takes place within firms due to its negative effects on motivation (Henkens and Schippers, 2008), our results suggest that the labour market as a whole essentially does demote older workers once they have lost their job involuntarily.

Theoretically, we can explain the more severe outcomes of older workers after displacement from relatively high labour costs, which result from delayed compensation schemes, higher wages due to the strong bargaining position of well-protected older workers or costly special provisions for older workers in collective bargaining schemes. Alternatively, the wage-to-productivity ratio may be higher for displaced older workers due to firm-specific, industry specific or task specific human capital, which is lost upon displacement, especially in case of long job tenure and when switching industries. Also, the wage-to-productivity ratio might be higher due to declining productivity with age. On the other hand supply side arguments may play a role as well. Older workers have longer benefit entitlements, which causes higher reservations wages and they have more options to retire from the labour market. Our results confirm that job tenure and switching industries are important, which supports the firm and industry specific capital argument. But a substantial part of the difference between age groups remains after controlling for these factors. This implies that other factors play also play an important role, but it is hard to disentangle between these arguments on the basis of our results.

References

Autor, D. and D. Dorn (2009). This job is "getting old": Measuring changes in job opportunities using occupational age structure. *The American Economic Review 99*(2), pp. 45–51.

Bosch, N. and B. ter Weel (2013). Labour-market outcomes of older workers in the Netherlands: Measuring job prospects using the occupational age structure. *De Economist 161*(2), 199–218.

Burda, M. C. and A. Mertens (2001). Estimating wage losses of displaced workers in Germany. *Labour Economics 8*(1), 15 – 41.

Carrington, W. J. (1993). Wage losses for displaced workers: Is it really the firm that matters? *The Journal of Human Resources 28*(3), pp. 435–462.

Conen, W., H. P. van Dalen, and K. Henkens (2012). Ageing and employers' perceptions of labour costs and productivity: A survey among European employers. *International Journal of Manpower 33*(6), 629–647.

Couch, K. A. (1998). Late life job displacement. *The Gerontologist 38*(1), 7–17.

Couch, K. A. (2001). Earnings losses and unemployment of displaced workers in Germany. *Industrial and Labor Relations Review 54*(3), 559–.

Couch, K. A., N. A. Jolly, and D. W. Placzek (2011). Earnings losses of displaced workers and the business cycle: An analysis with administrative data. *Economics Letters 111*(1), 16 – 19.

Couch, K. A. and D. W. Placzek (2010). Earnings losses of displaced workers revisited. *The American Economic Review 100*(1), pp. 572–589.

Daniel, K. and J. S. Heywood (2007). The determinants of hiring older workers: UK evidence. *Labour Economics 14*(1), 35 – 51.

De Groot, N. and B. van der Klaauw (2014). The effects of reducing the entitlement period to unemployment insurance benefits. *IZA Discussion Paper No. 8336*.

De Hek, P. and D. Van Vuuren (2011). Are older workers overpaid? A literature review. *International Tax and Public Finance 18*(4), 436–460.

Dustmann, C. and C. Meghir (2005). Wages, experience and seniority. *The Review of Economic Studies 72*(1), 77–108.

Eichler, M. and M. Lechner (2002). An evaluation of public employment programmes in the East German state of Sachsen-Anhalt. *Labour Economics 9*(2), 143 – 186.

Eliason, M. and D. Storrie (2006). Lasting or latent scars? Swedish evidence on the long-term effects of job displacement. *Journal of Labor Economics 24*(4), pp. 831–856.

Fallick, B. C. (1996). A review of the recent empirical literature on displaced workers. *Industrial and Labor Relations Review 50*(1), pp. 5–16.

Farber, H. S. (1993). The incidence and costs of job loss, 1982-91. *Brookings Papers on Economic Activity: Microeconomics*, 73–132.

Farber, H. S. (1997). The changing face of job loss in the United States, 1981-1995. *Brookings Papers on Economic Activity: Microeconomics*, 55–128.

Gibbons, R. and M. Waldman (2004). Task-specific human capital. *The American Economic Review 94*(2), pp. 203–207.

Hamermesh, D. S. (1989). What do we know about worker displacement in the US? *Industrial Relations: A Journal of Economy and Society 28*(1), 51–59.

Heckman, J. J., H. Ichimura, and P. E. Todd (1997). Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. *The Review of Economic Studies 64*(4), 605–654.

Henkens, K. and J. Schippers (2008). *Ageing labour forces: promises and prospects*, Chapter Labour market policies regarding older workers in the Netherlands, pp. 141–158. Edward Elgar Cheltenham, UK.

Heywood, J. S., U. Jirjahn, and G. Tsertsvardze (2010). Hiring older workers and employing older workers: German evidence. *Journal of Population Economics 23*(2), 595–615.

Hijzen, A., R. Upward, and P. W. Wright (2010). The income losses of displaced workers. *Journal of Human Resources 45*(1), 243–269.

Hildreth, A. K. G., T. M. von Wachter, and E. W. Handwerker (2007). Earnings losses of displaced workers in Connecticut. Technical report, Connecticut Department of Labor.

Huttunen, K., J. Møen, and K. G. Salvanes (2011). How destructive is creative destruction? Effects of job loss on job mobility, withdrawal and income. *Journal of the European Economic Association 9*(5), 840–870.

Ichino, A., G. Schwerdt, R. Winter-Ebmer, and J. Zweimüller (2013). Too old to work, too young to retire? *The Austrian Center for Labor Economics and the Analysis of the Welfare State Working Paper No. 1309*.

Jacobsen, L. S., R. J. LaLonde, and D. G. Sullivan (1993). Earnings losses of displaced workers. *The American Economic Review 83*(4), pp. 685–709.

Kuhn, P. J. (Ed.) (2002). *Losing Work, Moving On: International Perspectives on Worker Displacement*. W.E. Upjohn Institute for Employment Research.

Lazear, E. P. (1981). Agency, earnings profiles, productivity, and hours restrictions. *The American Economic Review 71*(4), pp. 606–620.

Lengermann, P. A. and L. Vilhuber (2002). Abandoning the sinking ship: The composition of worker flows prior to displacement. Longitudinal employer-household dynamics technical papers, Center for Economic Studies, U.S. Census Bureau.

Neal, D. (1995). Industry-specific human capital: Evidence from displaced workers. *Journal of Labor Economics 13*(4), pp. 653–677.

OECD (2013). Employment outlook 2013. Technical report, OECD Publishing, Paris.

Origo, F. (2009). Flexible pay, firm performance and the role of unions. new evidence from Italy. *Labour Economics 16*(1), 64 – 78.

Poletaev, M. and C. Robinson (2008). Human capital specificity: Evidence from the Dictionary of Occupational Titles and displaced worker surveys, 1984-2000. *Journal of Labor Economics 26*(3), pp. 387–420.

Schoeni, R. F. and M. Dardia (2003). Estimates of earnings losses of displaced workers using California administrative data. Technical report, PSC Population Studies Center.

Tatsiramos, K. (2010). Job displacement and the transitions to re-employment and early retirement for non-employed older workers. *European Economic Review 54*(4), 517 – 535.

Topel, R. (1990). Specific capital and unemployment: Measuring the costs and consequences of job loss. *Carnegie-Rochester Conference Series on Public Policy 33*(0), 181 – 214.

Van Dalen, H. P., K. Henkens, and J. Schippers (2010). Productivity of older workers: Perceptions of employers and employees. *Population and Development Review 36*(2), 309–330.

Van Ours, J. C. and M. Vodopivec (2006). How shortening the potential duration of unemployment benefits affects the duration of unemployment: Evidence from a natural experiment. *Journal of Labor Economics 24*(2), pp. 351–378.

Appendix

A.1 Calculation of expected values

To aid in the interpretation of our results, we calculate expected values of our outcome variables at different points of interest. The baseline specification is:

$$Y_{i,t} = \sum_{t=-24}^{t=72} \alpha_d Z_i T_i M_{i,t}^d + \sum_{t=-24}^{t=72} \beta_d T_i M_{i,t}^d + \sum_{t=-24}^{t=72} \gamma_d Z_i M_{i,t}^d + \sum_{t=-24}^{t=72} \delta_d M_{i,t}^d + \eta_i + \theta_t + \epsilon_{i,t} \quad (1)$$

where $Y_{i,t}$ is the outcome of interest (employment status or wage), i is the individual worker, t is time measured in months, Z_i is an indicator taking value 1 if a worker is aged 45 - 54 and 0 if a workers is aged 35 - 44, T_i is a dummy taking 1 if the worker is displaced due to firm-closure and $M_{i,t}^d$ is a dummy taking 1 for the record in which worker i is observed at d months distance from the (actual or fictional) date of displacement. η_i is the unobserved individual fixed effect, θ_t captures calendar time effects (specified as a

set of dummie variables for each year) and $\epsilon_{i,t}$ is the individual and time-specific error term. This is associated with the following expected values:

$$\begin{aligned}
\mathbb{E}(Y_{i,t}|Z_i = 0, T_i = 0, M^d_{i,t} = 1) =& \delta_d \\
\mathbb{E}(Y_{i,t}|Z_i = 0, T_i = 1, M^d_{i,t} = 1) =& \delta_d + \beta_d \\
\mathbb{E}(Y_{i,t}|Z_i = 1, T_i = 0, M^d_{i,t} = 1) =& \delta_d + \gamma_d \\
\mathbb{E}(Y_{i,t}|Z_i = 1, T_i = 1, M^d_{i,t} = 1) =& \delta_d + \beta_d + \gamma_d + \alpha_d
\end{aligned}$$

For example, if we want to know the effect of displacement for older workers compared to prime-age workers, we calculate the following expected value (ignoring the fixed effects and time trend):

$$\mathbb{E}(Y_{i,t}|Z_i = 1, T_i = 1, M^d_{i,t} = 1) - E(Y_{i,t}|Z_i = 0, T_i = 1, M^d_{i,t} = 1)$$

This is equal to:

$$(\delta_d + \beta_d + \gamma_d + \alpha_d) - (\delta_d + \beta_d) = \gamma_d + \alpha_d$$

We do the same for the expanded diff-in-diff-in-diff specification, which is:

$$\begin{aligned}
Y_{i,t} = & \sum_{t=-24}^{t=72} \kappa_d W_i Z_i T_i M^d_{i,t} + \sum_{t=-24}^{t=72} \alpha_d Z_i T_i M^d_{i,t} + \sum_{t=-24}^{t=72} \mu_d W_i T_i M^d_{i,t} + \\
& \sum_{t=-24}^{t=72} \phi_d W_i Z_i M^d_{i,t} + \sum_{t=-24}^{t=72} \beta_d T_i M^d_{i,t} + \sum_{t=-24}^{t=72} \gamma_d Z_i M^d_{i,t} + \sum_{t=-24}^{t=72} \lambda_d W_i M^d_{i,t} + \\
& \sum_{t=-24}^{t=72} \delta_d M^d_{i,t} + \eta_i + \theta_t + \epsilon_{i,t}
\end{aligned} \tag{3}$$

where W_i indicates whether a worker has either long tenure, a declining local labour market or changes sectors. All other variables are defined as before. The expected values associated with this equation are the following:

$$\begin{aligned}
\mathbb{E}(Y_{i,t}|W_i = 0, Z_i = 0, T_i = 0, M^d_{i,t} = 1) =& \delta_d \\
\mathbb{E}(Y_{i,t}|W_i = 0, Z_i = 0, T_i = 1, M^d_{i,t} = 1) =& \delta_d + \beta_d \\
\mathbb{E}(Y_{i,t}|W_i = 0, Z_i = 1, T_i = 0, M^d_{i,t} = 1) =& \delta_d + \gamma_d \\
\mathbb{E}(Y_{i,t}|W_i = 0, Z_i = 1, T_i = 1, M^d_{i,t} = 1) =& \delta_d + \beta_d + \gamma_d + \alpha_d \\
\mathbb{E}(Y_{i,t}|W_i = 1, Z_i = 0, T_i = 0, M^d_{i,t} = 1) =& \delta_d + \lambda_d \\
\mathbb{E}(Y_{i,t}|W_i = 1, Z_i = 0, T_i = 1, M^d_{i,t} = 1) =& \delta_d + \beta_d + \lambda_d + \mu_d \\
\mathbb{E}(Y_{i,t}|W_i = 1, Z_i = 1, T_i = 0, M^d_{i,t} = 1) =& \delta_d + \gamma_d + \lambda_d + \phi_d \\
\mathbb{E}(Y_{i,t}|W_i = 1, Z_i = 1, T_i = 1, M^d_{i,t} = 1) =& \delta_d + \beta_d + \gamma_d + \alpha_d + \lambda_d + \mu_d + \phi_d + \kappa_d
\end{aligned}$$

A.2 Full estimation results of the main specifications.

Table A.1: Full set of estimates for the results presented in Table 3 and Table 5.

	(1) Baseline: employment	(2) Baseline: wages	(3) Tenure: employment	(4) Tenure: wages	(5) Structural decline: employment	(6) Structural decline: wages	(7) Sector change: wages
T * OLD * $M^{0,24}$	-.0559***	-.0174***	-.0390***	-.0103***	-.0426***	-.0063***	-.0048***
	(.0007)	(.0009)	(.0009)	(.0012)	(.0013)	(.0016)	(.0011)
T * OLD * $M^{25,72}$	-.0351***	-.0097***	-.0289***	-.0035**	-.0299***	-.0030*	.0005
	(.0007)	(.0009)	(.0009)	(.0011)	(.0012)	(.0014)	(.0012)
OLD * $M^{0,24}$	-.0070***	-.0257***	-.0072***	-.0222***	-.0042***	-.0255***	-.0237***
	(.0003)	(.0004)	(.0005)	(.0005)	(.0006)	(.0007)	(.0004)
OLD * $M^{25,72}$	-.0276***	-.0639***	-.0271***	-.0613***	-.0291***	-.0691***	-.0570***
	(.0003)	(.0004)	(.0004)	(.0005)	(.0006)	(.0006)	(.0004)
T * OLD * TENURE * $M^{0,24}$			-.0303***	-.0154***			
			(.0015)	(.0019)			
T * OLD * TENURE * $M^{25,72}$			-.0142***	-.0158***			
			(.0015)	(.0018)			
TENURE * OLD * $M^{0,24}$			-.0027***	-.0004			
			(.0007)	(.0008)			
TENURE * OLD * $M^{25,72}$			-.0102***	.0077***			
			(.0007)	(.0008)			
TENURE * TREAT * $M^{0,24}$			-.0263***	-.0054***			
			(.0010)	(.0012)			
TENURE * TREAT * $M^{25,72}$			.0005	.0020			
			(.0010)	(.0012)			
TENURE * $M^{0,24}$			.0095***	-.0225***			
			(.0004)	(.0005)			
TENURE * $M^{25,72}$			.0274***	-.0413***			
			(.0004)	(.0005)			
T * OLD * DECLINE * $M^{0,24}$					-.0206***	-.0176***	
					(.0016)	(.0020)	
T * OLD * DECLINE * $M^{25,72}$					-.0097***	-.0099***	
					(.0015)	(.0018)	
OLD * DECLINE * $M^{0,24}$					-.0045***	-.0002	
					(.0007)	(.0008)	

Table A.1: Full set of estimates for the results presented in Table 3 and Table 5.

	(1) Baseline: employment	(2) Baseline: wages	(3) Tenure: employment	(4) Tenure: wages	(5) Structural decline: employment	(6) Structural decline: wages	(7) Sector change: wages
OLD * DECLINE * $M^{25,72}$					.0024***	.0096***	
					(.0007)	(.0008)	
T * DECLINE * $M^{0,24}$					-.0176***	-.0039***	
					(.0010)	(.0012)	
T * DECLINE * $M^{25,72}$					-.0043***	-.0081***	
					(.0009)	(.0011)	
DECLINE * $M^{0,24}$					.0038***	-.0097***	
					(.0005)	(.0005)	
DECLINE * $M^{25,72}$					.0034***	-.0164***	
					(.0004)	(.0005)	
T * OLD * SECTORCHANGE * $M^{0,24}$							.0008
							(.0019)
T * OLD * SECTORCHANGE * $M^{25,72}$							.0068***
							(.0016)
OLD * SECTORCHANGE * $M^{0,24}$							-.0405***
							(.0012)
OLD * SECTORCHANGE * $M^{25,72}$							-.0450***
							(.0008)
T * SECTORCHANGE * $M^{0,24}$							-.0132***
							(.0011)
T * SECTORCHANGE * $M^{25,72}$							.0010
							(.0010)
SECTORCHANGE * $M^{0,24}$							-.0445***
							(.0006)
SECTORCHANGE * $M^{25,72}$							-.0506***
							(.0004)
TREAT * $M^{0,24}$	-.2211***	-.0804***	-.2132***	-.0793***	-.2101***	-.0786***	-.0513***

Table A.1: Full set of estimates for the results presented in Table 3 and Table 5.

	(1) Baseline: employment	(2) Baseline: wages	(3) Tenure: employment	(4) Tenure: wages	(5) Structural decline: employment	(6) Structural decline: wages	(7) Sector change: wages
	(.0004)	(.0005)	(.0005)	(.0007)	(.0008)	(.0009)	(.0007)
TREAT * $M^{25,72}$	-.1019***	-.0726***	-.1014***	-.0740***	-.0982***	-.0687***	-.0548***
	(.0004)	(.0005)	(.0005)	(.0006)	(.0007)	(.0008)	(.0007)
$M^{0,24}$	-.0131***	.0260***	-.0162***	.0334***	-.0167***	.0321***	.0268***
	(.0003)	(.0003)	(.0003)	(.0003)	(.0004)	(.0004)	(.0003)
$M^{25,72}$	-.0455***	.0416***	-.0542***	.0549***	-.0493***	.0509***	.0458***
	(.0004)	(.0005)	(.0004)	(.0005)	(.0005)	(.0006)	(.0005)
Year (ref. category: 2003)							
1998	-.1329***	-.1586***	-.1343***	-.1564***	-.1347***	-.1575***	-.1707***
	(.0008)	(.0009)	(.0008)	(.0009)	(.0008)	(.0009)	(.0009)
1999	.0744***	-.0489***	.0729***	-.0458***	.0728***	-.0479***	-.0594***
	(.0006)	(.0007)	(.0006)	(.0007)	(.0006)	(.0007)	(.0007)
2000	.0654***	-.0050***	.0641***	-.0028***	.0642***	-.0042***	-.0123***
	(.0005)	(.0005)	(.0005)	(.0005)	(.0005)	(.0005)	(.0005)
2001	.0532***	.0048***	.0522***	.0059***	.0524***	.0044***	.0008
	(.0004)	(.0005)	(.0004)	(.0005)	(.0004)	(.0005)	(.0005)
2002	.0287***	.0009*	.0282***	.0012**	.0285***	.0001	.0002
	(.0004)	(.0004)	(.0004)	(.0004)	(.0004)	(.0004)	(.0004)
2004	-.0112***	-.0015***	-.0108***	-.0019***	-.0108***	.0001	.0011**
	(.0003)	(.0004)	(.0003)	(.0004)	(.0003)	(.0004)	(.0004)
2005	-.0063***	.0242***	-.0059***	.0239***	-.0062***	.0257***	.0295***
	(.0003)	(.0004)	(.0003)	(.0004)	(.0003)	(.0004)	(.0004)
2006	-.0059***	.0492***	-.0058***	.0497***	-.0059***	.0488***	.0552***
	(.0004)	(.0004)	(.0004)	(.0004)	(.0004)	(.0004)	(.0004)
2007	-.0005	.0809***	-.0005	.0815***	-.0001	.0801***	.0898***
	(.0004)	(.0005)	(.0004)	(.0005)	(.0004)	(.0005)	(.0005)
2008	-.0057***	.0982***	-.0060***	.0986***	-.0044***	.0983***	.1108***
	(.0004)	(.0005)	(.0004)	(.0005)	(.0005)	(.0005)	(.0005)
2009	-.0432***	.0943***	-.0434***	.0953***	-.0404***	.0956***	.1098***
	(.0005)	(.0006)	(.0005)	(.0006)	(.0005)	(.0006)	(.0006)

Table A.1: Full set of estimates for the results presented in Table 3 and Table 5.

	(1) Baseline: employment	(2) Baseline: wages	(3) Tenure: employment	(4) Tenure: wages	(5) Structural decline: employment	(6) Structural decline: wages	(7) Sector change: wages
2010	-.0531***	.0976***	-.0530***	.0985***	-.0504***	.0996***	.1152***
	(.0006)	(.0007)	(.0006)	(.0007)	(.0006)	(.0007)	(.0007)
2011	-.0579***	.0747***	-.0582***	.0758***	-.0556***	.0775***	.0933***
	(.0007)	(.0008)	(.0007)	(.0008)	(.0007)	(.0008)	(.0008)
Intercept	.9669***	.9838***	.9673***	.9829***	.9668***	.9835***	.9793***
	(.0003)	(.0003)	(.0003)	(.0003)	(.0003)	(.0003)	(.0003)
N	202,722	202,722	202,722	202,722	200,198	200,198	202,722

Notes: Fixed effects estimates of equation 1 (Columns 1 - 2) and equation 3 (Columns 3 - 7). Standard errors in parentheses. Variable OLD is 1 if workers are aged [45,54] and 0 if workers are aged [35,44] at the moment of displacement. $TENURE$ is 1 if tenure is larger than 7 years at the moment of displacement and 0 if smaller than 7 years. $DECLINE$ is 1 if employment in the regional-sectoral labour market declined during the years before/after displacement, where employment change is calculated as $\Delta E = \frac{E_{t-1}+E_t+E_{t+1}}{E_{t-2}+E_{t-1}+E_t}$. $SECTORCHANGE$ is 1 if a worker found a new job in a different sector than the one she previously worked in and 0 if not (see the main text for more information on the construction of these variables). Significance levels: $*$: 5% $**$: 1% $***$: 0.1%.
Source: Own calculations using registration data from Statistics Netherlands on displaced workers.

Publisher:

CPB Netherlands Bureau for Economic Policy Analysis
P.O. Box 80510 | 2508 GM The Hague
T (070) 3383 380

September 2014 | ISBN 978-90-5833-655-2