HOW DESTRUCTIVE IS CREATIVE DESTRUCTION? EFFECTS OF JOB LOSS ON JOB MOBILITY, WITHDRAWAL AND INCOME

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Abstract
We analyze short and long-term effects of worker displacement. Our sample consists of male workers displaced from Norwegian manufacturing plants. We find that displacement increases the probability of leaving the labor force by 31%. The drop-out rate from the labor force is particularly high in the first years following displacement. The average earnings effects for those who remain in the labor force are moderate, a 3% loss relative to non-displaced workers after seven years. Splitting displaced workers on within- and between-firm movers, we find that the estimated earnings loss is entirely driven by between-firm movers who experience a 3.6% loss. Transfers to other plants within multi-plant firms upon displacement are quite common. Our results support the view that human capital is partly firm specific and partly industry specific. We find no evidence suggesting that human capital is plant specific. (JEL: J63, J65)

1. Introduction

In competitive markets there is a continuous entry and exit of firms. Productive and innovative firms expand and less productive firms downsize. While this process may facilitate an overall market growth, it is important to understand how the process affects workers. Research suggests that the effects of being displaced may be detrimental. The majority of US studies that analyze the costs of involuntary job loss find that earnings and employment losses of displaced workers are large and persistent.[1] For high-tenure workers, earnings losses are estimated to be up to 25% four years after losing the job.

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1. See surveys by Hamermesh 1987, Fallick 1996, and Kletzer 1998.

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There are fewer studies of displaced workers in European countries and the results are less clear. The general picture for Europe is that while earnings losses are smaller, time out of employment is longer than in the United States. The results are not very robust, and depend to a great extent on who are included in the data, how displaced workers are defined, and what type of workers that is used as comparison group. Several studies find firm, job and sector-specific human capital to be very important in explaining earnings outcome for displaced workers.

There are two main shortcomings in the previous literature that we address. First, most studies use only workers who remain in the labor force to measure earnings loss and employment. This may lead to an underestimate of the true costs of displacement, as displacement might influence the probability of leaving the labor force permanently. We contribute to the literature with an explicit analysis of the probability that workers leave the labor force permanently after being displaced. This is possible because we use register-based data which include the whole census of individuals independent of labor market status.

A second shortcoming in the previous literature is that the analyses are based on employment relationships *either* at the plant *or* firm level. Many workers are displaced from plants that belong to multi-plant firms, and some of these workers are re-hired within the firm. Studies based solely on firm level data will therefore underreport displacements, whereas studies based solely on plant level data will mix the costs of displacement for workers that are rehired within the firm with the costs of displacement for workers that are not rehired within the firm. These two groups are likely to face very different costs of displacement. In our study, we overcome these problems as we know both the plant that employs each worker and the firm that owns each plant. This allows us to analyze earnings effects separately for within- and between-firm movers. Being able to identify these two groups, we can also identify how portable plant, firm and sector specific skills are. As far as we know, the potential difference between plant and firm specific human capital has not been explored before. We use an extension of the framework suggested in Neal (1995) and compare workers who move to another plant within the same multi-plant firm with workers who move to another firm in the same industry or to a firm in a different industry or sector.

Worker displacement imply involuntary job loss, but whether a worker leaves an employer involuntary or not cannot be observed in the data. We use the standard procedure in the literature and define displaced workers as workers leaving plants that exit or downsize by 30% or more. We have very rich data on both worker and firm characteristics. These variables are exploited by the construction of narrow comparison groups to the displaced workers. We analyze displacements taking place in the years 1991–1998, which in the following are called *base years*. We follow the workers five years before and seven years after each base year, hence, we utilize a 20-year long panel from 1986 to 2005. Our base year samples consist of male workers in Norway aged 25–65 and who are working at least 20 hours a week at a manufacturing plant with at least five employees. To assure that the treatment and control groups in each base year are as similar as possible, workers that have been displaced or worked less than 20 hours a week during the last five years running up to a base year are excluded.

Being out of the labor force is identified as not having an employer number (plant identifier) nor being registered as unemployed. For a worker with average characteristics, we find that displacement increases the long-run probability of leaving the labor force by 3.4 percentage points relative to non-displaced workers. This represents a 31% increase in the exit probability. The drop-out rate from the labor force is particularly high in the first years following displacement, but there is much heterogeneity. Older workers aged 58–65 leave the labor force to a much higher degree than younger workers. However, for older workers the difference relative to non-displaced workers falls sharply over time. This is due to the fact that this group has such a high probability of retiring early for other reasons, that a displacement incident only has a negligible effect on the probability of being in the labor force when they approach the standard retirement age.

A labor force exit is preceded by about five years of monotonically falling earnings. Workers seem to leave the labor force when the earnings loss is 10%–30% of their pre-displacement earnings. This corresponds to the compensation rate for workers on disability pension and other early retirement schemes, and is consistent with the view that these fairly generous schemes spur workers to leave the labor force early.

The average effect of displacement on earnings for those who remain in the labor force is moderate. The earnings of displaced workers begin to deteriorate four years prior to the displacement incident. The earnings dip is largest in year 2 which is the first full year with post-displacement earnings for all workers. Earnings quickly recover in years 3, 4, and 5, but do not quite reach the pre-displacement level. The year 2 earnings loss is 4.8% relative to the average earnings of non-displaced workers. After seven years the loss is 3%.

When analyzing worker mobility, we find that transfers to other plants within multi-plant firms after displacement are quite common. In the short run, 18% of the displaced workers find a new job within the firm. Furthermore, the relative share of employed workers changing industry is far higher among displaced workers than among non-displaced workers. When assessing the difference in earnings losses following these moves we find no support for plant specific human capital. Displaced workers who are transferred to a different plant within the firm experience no earnings loss. Our results, however, support the view that human capital is partly firm specific and partly industry specific. Given this we would expect short tenure workers to have the highest propensity to change industry. This is exactly the pattern we observe.

A surprising finding is that the large group of workers that leave manufacturing and start working in the private services sector have no earnings loss. It might be expected that this group should have lost its industry specific human capital. One interpretation is that human capital is not industry specific, but rather job or task specific. Workers going to the private sector could, for example, be white collar workers doing the same job in the new firm as in the old. They could also be maintenance workers who serve the same type of firms as before, but who are now employed in a specialized service firm. When assessing the educational composition of each group of moving workers, we see that private services are the most common post-displacement status for all categories of workers with higher education, and the sector recruits a particularly large share of workers with a non-technical master's degree. The same two-digit industry

is the most common post-displacement status for all categories of workers without higher education, and it recruits a particularly large share of workers with secondary technical education. This is consistent with workers with low education and workers with technical education having more industry specific human capital than workers with higher education and workers with non-technically education.

The rest of this paper is organized as follows: Section 2 discusses the previous literature. Section 3 describes the data, gives details on the sample construction and explains the definition of key variables. Section 4 describes relevant labor market institutions in Norway. Section 5 presents descriptive evidence. Section 6 provides the results from the regression analyses, and Section 7 concludes the paper.

2. Literature Review

The costs of displacement have been studied extensively for the last 25 years. Until recently, most of these studies have analyzed displacement in the US labor market. The results indicate substantial negative earnings effects both in the short and in the long run. The earnings loss begins at least three years before displacement and persists for many years. The approach of using comparison groups for measuring the effect of displacement, i.e. measuring the earnings change for displaced workers relative to a control group that was not displaced, was initiated in the early 1990s with papers by Ruhm (1991a, b) and Jacobson, LaLonde, and Sullivan (1993). In their seminal work, Jacobson et al. define workers as displaced if they leave a firm that experiences significant downsizing. They use as a comparison group the workers who do not leave their firms. They find that displaced workers suffer large and long-lasting earnings losses after displacement. Five years after displacement, average quarterly earnings losses were 25%. Several other studies have confirmed the large earning losses of displaced workers in the United States, see for example Kletzer and Fairlie (2003) and Hildreth, von Wachter, and Handwerker (2008).

Stevens (1997) examines long-term effects of job displacement on earnings. She finds that the effects of displacement are quite persistent, with earnings and wages remaining approximately 9% below their expected levels six years or more after displacement. Much of this persistence may be explained by additional job losses in the years following displacement. Workers who avoid additional displacements have earnings and wage losses around 1%–2% six or more years after their initial displacement.

In contrast to the large supply of US studies, studies using European data on the costs of job displacement have been scarce. As in the US studies, the main focus has been on earnings losses following displacement. The results of these studies are difficult to summarize, as they provide rather mixed results. The average earnings loss appears to be smaller than in the United States, varying between 1% and 11%.[2]

2. See Borland et al. 2002, Bender et al. 2002, Burda and Mertens 2001, von Wachter and Bender 2006, and Carneiro and Portugal 2006.

Most data sets used in displacement studies cover only workers who remain in the labor force. The PSID, for example, one of the commonly used data sets in the United States, has only information on household heads with positive earnings in every year. This will tend to underestimate the displacement costs, since a consequence of job displacement is that workers may permanently withdraw from the labor force. Chan and Stevens (2001) examine the employment patterns of older workers (50 and above) after job loss, using US data. They find that a job loss results in large and lasting effects on future employment probabilities. Four years after a job loss, at age 55, the employment rate of displaced workers is reported to be 20 percentage points below the employment rate of similar non-displaced workers.

There are very few studies examining employment consequences of job displacement in Europe. Most of these studies provide only descriptive information on the duration of non-employment.[3] Eliason and Storrie (2004) examine the employment consequences of job displacement using data for the entire private sector in Sweden from 1987 to 1999. They find that the effects are long lasting, but dependent on business cycle conditions. Displaced workers have on average between 1 and 2 percentage points higher probability of leaving the labor force and are more likely to be unemployed than similar non-displaced workers. Rege, Telle, and Votruba (2009) investigate the impact of plant downsizing on disability pension utilization in Norway. Their findings show that workers affected by plant downsizing are 28% more likely than comparable workers in non-downsizing plants to receive disability pensions in the following years.[4] Bratsberg, Nilsen, and Vaage (2008) analyze the effect of worker displacement in Norway 1986–1987 on the children's economic outcome in 1999–2001. They find that job loss has a negative effect on earnings for those affected, but they find no significant effect on the next generation.

Another strand of the literature relevant for our paper focuses on interpreting the wage loss for workers as a loss of industry-specific skills when switching to another industry. Especially Neal (1995), Kletzer (1996), and Parent (2000) emphasize that workers have both firm- and industry-specific skills. Displaced workers rehired in the same industry forfeit returns to firm-specific skills while industry switchers forfeit returns both to firm- and industry-specific skills. By comparing these two groups of displaced workers, Neal (1995) finds that the wage loss of industry switchers is larger than for industry stayers, and that the loss increases in pre-displacement tenure and experience.

3. Data, Variable Definitions and Sample Construction

The data on workers used in our study are derived from administrative registers and prepared for research by Statistics Norway. They cover *all* Norwegian residents

3. See Abbring et al. 2002, Albæk, Audenrode, and Browning 2002, Bender et al. (2002).

4. There are also a few case studies from the Scandinavian countries that analyze in detail the outcomes over time for workers displaced from one particular plant after bankruptcy. See Edin 1988 and Westin 1990.

16–74 years old in the years 1986–2005. We have information about employment relationships, labor income, educational attainment, labor market status, and a set of demographic variables such as gender, age, experience, and marital status. A person identification number allows us to follow each worker over time. Likewise, firm and plant identification numbers allow us to identify each worker's employer and examine whether the plant in which the worker is employed is downsizing or closing down. Plant and regional labor market characteristics such as industry, size and the rate of unemployment are also available.

The sample used in our main analysis is constructed by first identifying all male workers between age 25 and 65 who were employed at least 20 hours a week at a plant with at least five workers in one of our *base years*, that is 1991–1998. In the beginning of this period Norway experienced a severe recession that had lasted since 1988. The economy begun to recover in 1993. The recovery slowed down in 1998, but lasted until 2001. In 2001–2003 there was a mild recession before a new and strong expansion begun.

Our base years have been chosen to allow us to follow workers five years before displacement and seven years after displacement. To assure that the treatment and control groups in each base year are as similar as possible, workers that have been displaced or worked less than 20 hours a week during the last five years running up to a base year are excluded. This implies that our sample consists of high-attachment workers. Base years are indexed 0, hence, we follow workers from year –5 to year +7, altogether 13 years. The standard retirement age in Norway is 67. When we include workers up to age 65, it implies that the oldest workers are observed for only one full working year after displacement.

Our sample consists of 906,000 base year observations of 194,000 individual workers. Hence, on average, each worker is observed for 4.7 base years. In total 32,000 of the workers experienced at least one displacement incident. In the entire sample including pre- and post-displacement years we have 3,262,000 observations.

Workers are defined as separating from their job in year 0 if their plant identifier changes from year 0 to year 1. The match between workers and plants is in May until 1995 and in November from 1996. This means that for the years when the match is in November, the separation is most likely to have occurred in year 1.

In line with earlier studies, displaced workers are understood to be individuals who involuntary separate from their jobs by exogenous shocks other than disability. Hence, voluntary job movers and workers fired for cause should not be included, see for instance Fallick (1996). We conceptualize this by defining displaced workers as workers separating from plants that close down or reduce employment by 30% or more in the year when the separation occurs. In addition, early-leavers, that is, workers who leave a plant that exits within the next two years, are treated as displaced. In total 18% of our observed displacements are from plants that have closed down, 67% are from downsizing plants and 15% consist of *early-leavers*. The comparison or control group consists of all non-displaced workers, i.e. both stayers in downsizing plants and workers in all other continuing plants in the manufacturing

sector.[5] Note that the use of temporary layoffs with recalls is a possibility in Norway and displacement includes these workers. Our data allow us to identify this group and in Table 3 we present the proportion of laid-off workers with recall.

Employment status is defined at the time of the worker-firm matching (in May/November). An individual is classified as *employed* if he has a plant identification number at that time, and as *unemployed* if he does not have a plant identification number and is registered with some months of unemployment during the year.[6] Furthermore, workers are classified as *outside the labor force* if they do not have a plant identification number and if they are not registered with any months of unemployment during the year. This implies that *employed workers* may have spells of unemployment at other times during the year, and *unemployed workers* may have spells of employment at other times during the year. Workers who are classified as outside the labor force, however, must have been out of the labor force the entire year.

Earnings are measured as annual income that provides pension points in the national security system. The included components are regular labor income, income as self-employed, and benefits received while on sick leave, being unemployed and on parental leave.[7] The age of the worker is given in the data set. Tenure is measured in years, using the initial date of employment in a given plant. Education is measured as the normalized length of the highest attained education. Regional labor markets are defined by Statistics Norway and follow the EU standard NUTS 4; see Statistics Norway (2000). The size of the regional labor market is measured as the working age population, that is the population aged between 16 and 74. The regional unemployment rate is calculated as the ratio of unemployed man-years to the working-age population. Urban is an indicator variable that describes whether a person lives in one of the ten largest economics regions (NUTS4) in Norway.

4. Institutional Details

There are very few comparative studies of the overall degree of employment protection. A much-cited study by Emerson (1987) ranks Italy as having the strongest employment protection rules, while the UK is at the other end of the spectrum. Norway is ranked in the intermediate range as a country with a fairly high degree of protection, together with Sweden, France, and to a lesser extent Germany.

A few points about the institutional setting in the Norwegian labor market are worth noting. First, a particularly important point is that firms can dismiss workers not only if the firms are making a loss, but also if they perform poorly. There is no legal

5. Although we have high quality administrative data, the procedures described here will obviously imply some misclassifications as the true reason for the separations cannot be known in administrative data. This will bias our estimated effects downward, see Hildreth, von Wachter, and Handwerker (2008).

6. Among the workers that have a plant code, some are registered by the employment office as "100% unemployed" at the time of the match, and some are registered as unemployed for 12 months at the end of the calendar year. These workers are classified as unemployed.

7. Since 2002 rehabilitation money also gives pension points and is included in our earnings measure.

rule on the selection of workers to be dismissed, although seniority is a strong norm.[8] Laid-off workers have preference if the firm starts to hire again within one year.

Second, the Norwegian Working Environment Act states that employment is terminable with one month's notice for workers with tenure less than or equal to five years. However, most employment contracts have a three-month notice requirement for both parties. Although there is no generalized legal requirement for severance pay in Norway, agreements in the private sector require lump-sum payments to workers aged 50 and above if they have at least 10 years of tenure. When firms downsize, workers may also be offered pay after termination of employment, if they resign voluntarily. The period with pay may vary from two weeks to two years. Typically, long tenure implies more generous conditions. Other components in voluntary agreements offered to smooth the downsizing process may include job search assistance, social plans for retraining or transfer to another plant within the firm.

Norwegian labor protection rules allow temporary layoffs with recall possibilities. This regulation is part of the *Basic Agreement* between the main employers' and employees' organizations, and it is also observed by most firms outside the employers' organization. A firm may temporarily lay off workers due to temporary changes in demand for its products, etc.

4.1. Unemployment Insurance

The unemployment benefit system in Norway is mandatory. A worker is entitled to a benefit of 62.4% of the previous year's pay, or 62.4% of the average over the last three years. Benefits may be received for up to 156 weeks.[9] The rules are more liberal for older workers. From the age of 60.5 years everyone is basically entitled to unemployment benefit until the retirement age of 67. After the unemployment benefit period, everyone is entitled to means-tested social support. Unemployment benefits are included in our earnings measure, whereas the means-tested social support is not.

4.2. Early Retirement

The mandatory retirement age in Norway is 67, and there is no common early retirement scheme. However, from 1989 there has been an early retirement arrangement for those covered by the main employers' and employees' organizations. The age of early retirement was gradually reduced from 66 to 62 over the years 1989 to 1998 and has remained at 62 thereafter.

A common way of exiting the labor market is through disability pension. In our data period the access to disability pension was fairly liberal, and according to Dahl,

8. Seniority is institutionalized in the *basic agreement* ("Hovedavtalen"), but only in situations where "all else is equal".

9. Until 1997 there was a formal limit of 80 weeks, followed by a period of 13 weeks without benefits, and then 80 new weeks of benefit. In practice there were exemptions from these rules, so effectively there was no interruption in the benefits stream.

Øivind, and Vaage (2000) it is quite clear that labor market conditions were a factor when assessing applicants. In order to receive disability pension, a person has to document that his or her ability to earn an income is reduced by at least 50%. The usual chain of events is first to receive sickness pension for one year and then to register for a period in a work rehabilitation program. Low-income workers receive about 62% of previous pre-tax labor earnings in disability pension. High-income workers will receive less relative to previous income in public pensions, but are more likely to have additional private pensions. See more on this in Section 6.3. Disability pensions are supposed to give workers the same income as they would have received from the national old age pension scheme had they not become disabled. Disability pensions are not included in our earnings measure.

5. Descriptive Evidence

In order to have a clean quasi-experiment, we want the treatment group and the control group to be as similar as possible prior to displacement. This way, post-displacement differences between the groups may be attributed to the displacement incident. Table 1 shows that there is hardly any differences between displaced and non-displaced workers, something which supports our sample selection criteria. The only difference of any significance is that displaced workers have about one year shorter tenure than non-displaced workers. Displaced workers also tend to come from slightly larger plants.[10]

Columns (3)–(10) describe the displaced workers by their status two years after displacement. We want to see whether the displaced workers who end up in different labor market states differ systematically by their observable pre-displacement characteristics. When looking at columns (3) and (4) at the difference between employed and non-employed displaced workers, we see that employed workers are younger, more educated and better paid prior to the displacement incident. Columns (5)–(10) describe the employed workers in greater detail. Among the employed displaced workers, those who are re-employed at the plant from which they were displaced are on average older, have less education and tenure, and have lower pre-displacement earnings. By definition, workers cannot be re-employed in the same plant in the first year after a job loss, and they obviously cannot be re-employed in plants that have closed down. This means that those who are recalled are displaced from downsizing plants and they were either unemployed or worked somewhere else in the

10. Since the table is based on data for individual workers, plant size is naturally weighted by the number of workers. We choose to report this number minus one, and it is then easily interpreted as each individual's number of co-workers. We do this primarily because there is no natural way to report unweighted plant size for the subsamples described in columns (3)–(10). The unweighted plant sizes for plants without and with laid-off workers (in columns (1) and (2)) are 43 and 38, respectively. Comparing these numbers with the table, we see that layoff incidents must be somewhat more rare among large plants, but that those incidents that happen dominate in terms of number of workers affected. Note that the average plant size in our sample is smaller than in most previous displacement studies. This reflects the fact that Norway has an industry structure dominated by small and medium size firms.

TABLE 1. Sample means of selected pre-displacement worker characteristics by displacement status and employment status in year 2

	Non-displaced (1)	*Displaced* (2)	Not Employed (3)	*Employed* (4)	Same Plant (5)	Same firm, diff. plant (6)	Same ind. diff. firm (7)	Other manuf. (8)	Private services (9)	Public services (10)
Age	43.9	43.9	49.4	42.6	43.5	43.8	42.8	41.0	41.5	41.4
Education	10.7	10.8	10.0	11.0	10.8	10.9	10.8	10.6	11.4	11.5
Tenure	9.7	8.6	8.7	8.5	7.4	10.5	8.8	7.7	7.3	6.8
Married	0.67	0.66	0.65	0.66	0.63	0.68	0.66	0.64	0.67	0.67
Earnings	292,100	289,200	242,800	300,600	291,700	310,100	289,600	272,400	321,300	274,700
Earnings in year −5	265,500	268,300	252,200	272,200	258,400	280,100	266,800	249,800	285,500	252,500
Number of co-workers	283	343	225	372	247	510	388	247	331	190
Unemployment rate	3.0	3.0	3.0	2.9	2.8	2.9	3.1	2.9	2.9	2.9
Share urban residents	0.43	0.45	0.46	0.45	0.35	0.39	0.48	0.36	0.48	0.46
No. of observations	872,520	33,101	6,530	26,571	2,292	5,062	10,369	1,340	6,837	671

The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are for whole calendar years. Sample means are measured in year 0 if not otherwise stated.

first post-displacement year. This may explain why they are negatively selected on observable characteristics, see the lemons argument put forward by Gibbons and Katz (1991).[11]

Those who are re-employed at a different plant in the same firm seem to be positively selected on observable characteristics, something which is as expected. They have more education and higher earnings than other employed, displaced workers. By contrast, those who are employed in a different firm within their pre-displacement two digit industry, earn less than other employed, displaced workers. Workers who are employed in other manufacturing industries are even more negatively selected. Most workers who find new employment outside manufacturing go to the private sector. These workers have higher earnings and have much more education than workers who remain in manufacturing. This is consistent with highly educated workers having the most transferable human capital.

5.1. End States for Displaced Workers

In Table 2 we compare displaced and non-displaced workers according to their employment status in the short and long run. From the first two columns we see that 76.2% of workers displaced between year 0 and 1 are re-employed in year 1. If displacements are equally distributed throughout the year, the average displaced worker lost his job six months before we measure employment status, and some workers, obviously, will have been displaced quite recently. For the control group, the employment rate is 95.8%, clearly indicating that the displaced workers in the short run are performing worse than the rest of the workers in the economy. A striking finding is that 5.5% of the displaced workers are not observed in the labor force again within our seven-year post-displacement observation period. Among non-displaced workers the share is 1.8%. Furthermore, 5.3% of the displaced workers are temporarily out of the labor force and 12.2% are registered as unemployed. In addition, 23% of the unemployed are temporarily laid off from their employer with a formal recall possibility. Such layoffs are mostly used in industries with a very cyclical demand.

The relative performance of displaced workers improves over time, and long-term effects measured in year 7 are given in columns (3) and (4) of Table 2. It should be noticed that many workers leave employment for reasons other than displacement. Employment for non-displaced workers falls from 95.8% in year 1 to 74.8% in year 7.[12] Employment for displaced workers also falls slightly and it is 70.3%

11. Henningsen and Hægeland (2008) study downsizing plants in Norway, and find "evidence consistent with establishments using downsizings as a sorting device to terminate the employment of the least profitable workers". However, they conclude that such opportunistic sorting only affects a minor share of the displacements.

12. Note that among the non-employed in year 7, 3.0% are dead or abroad, 7.4% have reached the ordinary retirement age, 2.3% are unemployed and 12.9% are outside the labor force. Most of the workers outside the labor force are likely to be on an early retirement scheme or on disability pension, see Section 4.2 and our results for old workers in Section 6.1.

TABLE 2. Percentage of workers employed in year 1 and year 7 after displacement

	Year 1		Year 7	
	All displaced (1)	Not displaced (2)	All displaced (3)	Not displaced (4)
Employed	76.2	95.8	70.3	74.8
same plant		90.0	6.6	46.7
different plant within the same firm	18.4	1.4	8.0	3.5
different firm within the same industry	27.3	1.9	27.6	10.1
other two-digit manufacturing industry	3.5	0.5	5.4	2.9
private service	25.5	1.8	19.1	9.4
public service	1.4	0.3	3.1	1.7
Not employed	23.8	4.2	29.7	25.2
Unemployed	12.2	1.1	3.3	2.3
temporarily laid off	2.9	0.3		
not temporarily laid off	9.3	0.8		
Outside labor force	10.8	2.7	15.3	12.9
temporarily outside the labor force	5.3	0.9		
permanently outside the labor force	5.5	1.8		
Reached ordinary retirement age of 67	–	–	8.1	7.4
Dead or moved abroad (not observable in the data)	0.8	0.4	3.5	3.0
Share of workers that are displaced again at least once between years 1 and 7			31.64	14.24
Observations	33,101	872,520	33,101	872,520

The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Permanently outside the labor force means outside the labor force at least until the seventh year after displacement. Temporarily laid off workers have a formal recall possibility and are registered as unemployed.

in year 7. This implies a significant improvement relative to the control group since the percentage point difference between the two groups falls from 19.6 down to 4.5.

The composition of the non-employed workers changes dramatically from the short to the long run. As many as 12.2% of the displaced workers are registered as unemployed and 10.8% are outside the labor force after one year. After seven years, however, 3.3% are registered as unemployed and 15.3% are outside the labor force. In the control group, 12.9% are out of the labor force. This 2.4 percentage point difference in the probability of leaving the labor force after seven years represents an 18% increase in the probability of permanent job loss for displaced workers. If we leave out workers that reach the ordinary retirement age, the percentage increase is 19.25.

Most displacement studies use firm-level data whereas some use plant-level data. According to Kuhn (2002, p. 18) "a common practice, especially in European plant closures, involves the reallocation of large numbers of employees to other branches of the same firm". This makes the distinction between plant and firm important when analyzing displacement. When defining displacement at the plant level, one should find more workers displaced, but on average they are likely to be less severely affected, as some of the workers are not actually displaced from their firms, but have been moved to another plant within the firm. Our data contain identifiers for *both* plant and firm, and hence, we are able to analyze this issue. As far as we know, this has not been done in earlier studies. Our results show that transfers to other plants within multi-plant firms upon displacement are quite common. In the short run, 18% of the displaced workers find a new job within the firm. After seven years, as many as 6% of the workers are back at the plant from which they were displaced. As mentioned previously, this is only possible for workers displaced from downsizing firms. Another 8% are working in the same firm as the one they were displaced from, but at a different plant.

Examining where displaced workers end up in terms of industries, we find that 46% are still working in the same two-digit industry in the short run, and 3.5% move to a different two-digit manufacturing industry.[13] As many as 26% move to the private service sector, while just 1% move to the public sector. These shares do not change much over time. The relative share of employed workers changing industry is far higher among displaced workers than among other workers. This is consistent with the idea that displacement is a vehicle for industry restructuring. Finally, we notice that the originally displaced workers have a higher probability of being displaced again than other workers. The numbers are 32% versus 14% within the seven year horizon we analyze.

5.2. Share of Workers Outside the Labor Force

Figure 1 shows descriptive statistics on how the share of workers outside the labor force develops over time. Our sample selection criteria are such that all workers have

13. The number for workers staying in the same two-digit industry includes workers who remain with the same firm. To the extent that these workers have been transferred to plants in other two-digit industries, this is not accounted for.

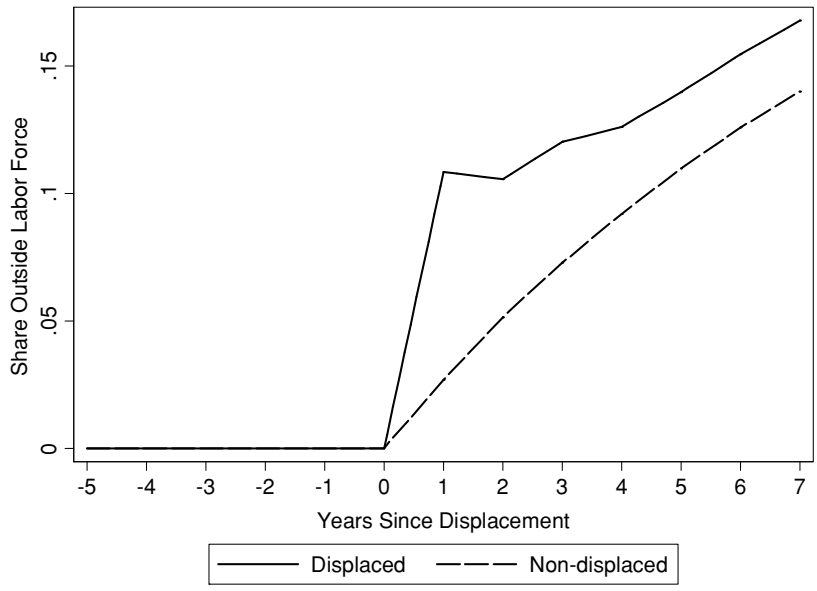


FIGURE 1. Share of workers who are outside the labor force. The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Workers are excluded from the sample the year they turn 67 and thereafter. Shares are first calculated for each pre- and post-displacement year relative to each base year. The graphs display the unweighted averages over these shares for all base years 1991–1998.

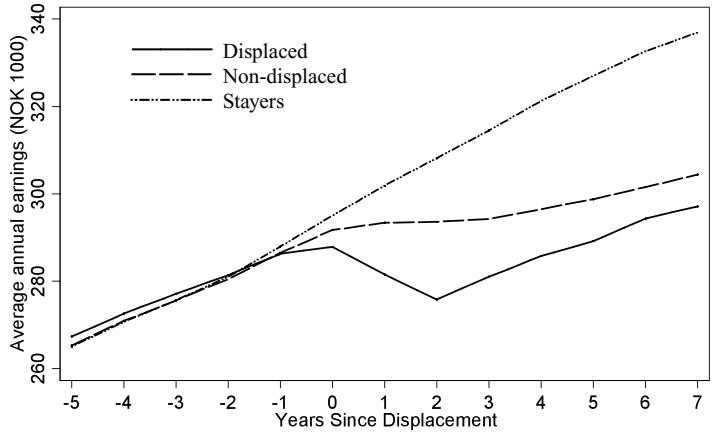
been in the labor force for at least five years prior to the displacement year. Hence, our sample consists of high-attachment workers and there is by construction little difference between the groups prior to displacement. From the displacement year onwards, we see that for non-displaced workers there is an approximately constant hazard of leaving the labor force, with the rate being between 2% and 3% per year. Displaced workers, on the other hand, have a significantly higher probability of leaving the labor force in the first year after displacement and a somewhat higher probability also in years 2 and 3. From year 4 onwards, the hazard for displaced workers is similar to the hazard for non-displaced workers, but the higher probability in years 1, 2 and 3 has translated into a 2.8 percentage point higher share of displaced workers being outside the labor force. Hence, displacement permanently reduces labor force participation.

The 2.8 percentage point estimate above differs slightly from the 2.4 percentage point estimate in Table 2, due to the fact that these two samples are not quite identical. Table 2 includes workers that reach the ordinary retirement age of 67 and classifies this as a separate end state. These workers are excluded in Figure 1.

5.3. Earnings Losses

Figures 2(a) and (b) depict average earnings from year –5 to year 7. Each figure contains three lines, one for displaced workers, one for non-displaced workers, and

(a) Both workers in and out of the labor force.



(b) Only workers in the labor force.

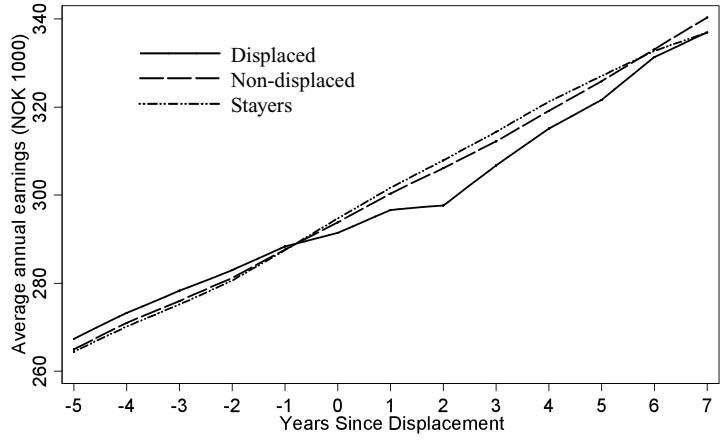


FIGURE 2. Annual earnings before and after displacement. The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, are employed in manufacturing, and have been working at least 20 hours a week and have not been displaced from their jobs in years −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are from whole calendar years; therefore, the first year in which all earnings are entirely from post-displacement jobs is year 2. Workers are excluded from the sample the year they turn 67 and thereafter. Average earnings are first calculated for each pre- and post-displacement year relative to each base year. The graphs display the unweighted averages over these numbers for all base years 1991–1998.

one for *stayers*. The latter is a subgroup of non-displaced workers. Stayers are workers that do not separate from the employer they have in year 0 (whether or not they work in a firm where other workers have been displaced).

Figure 2(a) includes all workers, while Figure 2(b) only includes workers that are in the labor force. First, it should be noted that there is a small decline in earnings before workers are actually displaced in both figures. This is in line with previous studies. Second, in Figure 2(b) displaced workers who remain in the labor force have a fairly

small earnings loss relative to non-displaced workers who remain in the labor force. Hence, the large earnings loss for all displaced workers in Figure 2(a) is driven by those who leave the labor force.[14] Although a dip in earnings for displaced workers is visible also in Figure 2(b), the loss relative to non-displaced workers reaches a maximum of NOK 8,750 in year 2.[15] This loss is less than 3% of the non-displaced workers' earnings in year 2. Displaced workers catch up with the earnings of non-displaced workers over time, however there is still a visible gap between the two groups in year 7.[16] A detailed regression analysis of earnings follows in Section 6.2.

When looking at *stayers*, a comparison of Figures 2(a) and (b) show that the main difference between stayers and all non-displaced workers in Figure 2(a) is driven by the non-displaced workers that leave the labor force exogenously. Hence, accounting for workers that leave the labor force, as we are able to do in our analysis, is extremely important. The seminal study of Jacobson, LaLonde, and Sullivan (1993) uses stayers as the comparison group. Our findings suggest that this creates a severe upward bias in the estimated cost of displacement.

6. Regression Analysis

Table 1 shows that displaced and non-displaced workers have very similar pre-displacement characteristics indicating strongly that the data set is balanced across the treatment and control groups. Hence, the post-displacement outcomes described in the previous section may arguably be interpreted as causal effects of displacement. However, by using a regression framework to condition on worker, industry, firm and labor market variables, we may get more precise estimates and also analyze the effects in greater detail by exploiting the heterogeneity in observable worker characteristics.

6.1. The Effect of Displacement on the Probability of Leaving the Labor Force

We begin our analysis by investigating the effect of displacement on the probability of being out of the labor force in years 1 to 7 after displacement. The following probit specification is applied:

$$P(A_{ikj}) = \Phi(\mathbf{X}_{ik}\beta + \mathbf{Z}_{ik}\gamma + \delta_j D_{ikj} + \tau_k). \quad (1)$$

14. We do not take the analysis of earnings for workers out of the labor force any further as our earnings measure for this group is problematic. Pensions are not included in our earnings measure, hence, the graph in Figure 2(a) does not disclose the private loss for displaced workers out of the labor force. Nor can we estimate the loss to society as unemployment benefits and other social security benefits to employed workers are included for workers that are in the labor force.

15. It may at first seem surprising that the maximum earnings loss is reached in year 2. Note, however, that this is the first year that does not include any pre-displacement earnings, since the displacement incidents may happen between May in year 0 and November in Year 1. In addition, some workers receive severance pay for some time after displacement, and this will postpone the full earnings loss.

16. The last observed annual income for workers leaving the labor market may not represent a full year of work. The figures, however, change very little if we leave out the final earnings observation for each worker.

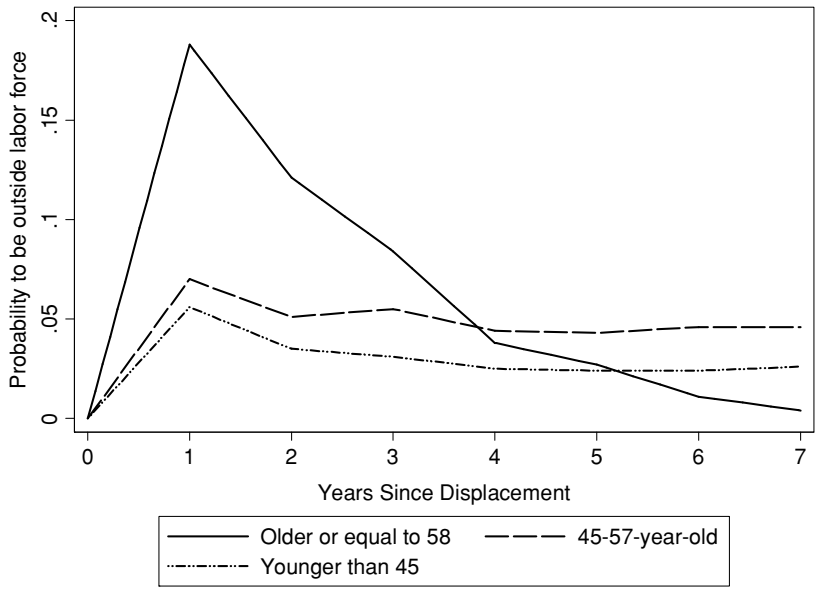


FIGURE 3. Effect of displacement on the probability of being outside the labor force. The dependent variable is a dummy for being out of the labor force. The figure graphs the marginal effects (evaluated at the means) of a dummy "displaced between year 0 and 1" in a probit regression. Control variables included are age, age^2, education, tenure in base year, marital status, plant size, size of region, earnings in year -3, base year industry dummies, region dummies and base year dummies. The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year -5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Workers are excluded from the sample the year they turn 67 and thereafter. The model is estimated separately for each post displacement year by age groups. Age is measured at the time of displacement.

A_{ikj} (absence) is an indicator variable that has the value one if individual i from base year sample k is outside the labor force in year j after the displacement. $\mathbf{X}$ is a vector of observable pre-displacement worker characteristics comprising years of education, age, age squared, pre-displacement tenure, and pre-displacement marital status. $\mathbf{Z}$ is a vector of plant and regional labor market characteristics including pre-displacement plant size, and size of the pre-displacement labor market, dummies for pre-displacement two-digit ISIC industries and dummies for pre-displacement regions. D_{ikj} is a dummy variable for having been displaced j years ago, and τ_k is a dummy indicating base year k. Hence, by using a rich set of control variables, we compare similar workers who work in base year k in the same sector, and in similar labor markets, where the only difference is displacement.

We pool all base years, but run separate regressions for years $j \in \{1,\ldots,7\}$ after displacement and separate regressions for three age groups; 25 to 44, 45 to 57, and 58 to 65. Age is measured in the base year. The three resulting series with δ-coefficients are graphed in Figure 3. δ is the increase in the probability of being outside the labor force associated with being displaced, evaluated at the mean of the other covariates. We

see that older displaced workers have a higher probability of leaving the labor force immediately after having been displaced than younger displaced workers, but even workers aged 25 to 44 have more than a 5 percentage point increase in the probability of being out of the labor force in the first year after displacement. This effect levels out at about 2.5 percentage points in years 4–7 after the displacement. It seems likely that many of these relatively young workers will be out of the labor market for the rest of their lives, and the economic consequences for society may therefore be large. This contrasts with the effect on workers aged 58–65. Although the probability of being permanently out of the labor market increases by 18 percentage points in the first year after displacement, the difference relative to non-displaced workers falls sharply over time.[17] This is not driven by ordinary retirement, as workers are dropped from the sample after age 66. What happens is that workers aged 58 to 65 have such a high probability of retiring early, that a displacement incident only has a negligible effect on the probability of still being in the labor market when they approach the ordinary retirement age. For middle-aged workers, that is, the age group 45 to 57, displacement has a long-term effect on the probability of leaving the labor market of about 4.5 percentage points. In this respect, this is the group that is most severely affected.

If we pool the three age groups, the estimated first-year effect is a 7.3 percentage point increase in the probability of being out of the labor force, and the estimated effect in year 7 is 3.4 percentage points, evaluated at the mean of the other variables. A non-displaced worker with average characteristics has a 10.8% probability of leaving the labor force, hence, a 3.4 percentage point increase represents a 31.4% increase in probability. This number is quite similar to what Rege, Telle, and Votruba (2009) find when analyzing the effect of displacement on utilization of disability pensions. Our probit results are somewhat higher than the estimates that we obtained from the descriptive Figure 1. To control for observable worker characteristics, therefore, seems to be imåortant. Apparently, displaced workers are positively selected on observables with respect to characteristics that affect the probability of leaving the labor force.

The effects we estimate are larger than the effect reported in the comparable study by Eliason and Storrie (2004).[18] They found that workers 21–50 years old that were displaced due to plant closures in Sweden had a 1 to 2 percentage point higher probability of leaving the labor force after displacement as compared to similar non-displaced workers. Note that their sample comprises workers that are on average younger than the workers in our sample. However, even if we—as far as possible—use the same age groups as they do, we get a somewhat larger effect. For workers 41 to 50 years old they found the long-term effect to be of around 3 percentage points. Their sample comprises all sectors, while we only analyze workers displaced from manufacturing firms.

17. The 18 percentage point first-year effect is in accordance with the negative employment effect for workers aged 55+ estimated by Chan and Stevens (2001).

18. The out-of-the-labor-force results in the working paper Eliason and Storrie (2004), are not included in the 2006 version published in *Journal of Labor Economics*.

6.2. The Effect of Displacement on Earnings

Having examined the effect of displacement on leaving the labor force, we now want to examine the effect on earnings for those who stay in the labor force. Our main specification is

$$Y_{ikj} = \mathbf{X}_{ik}\beta + \mathbf{Z}_{ik}\gamma + \delta_j D_{ikj} + \tau_k + \epsilon_{ikj}. \tag{2}$$

The dependent variable, Y, is the annual income that qualifies for pension from the national security system, including unemployment benefits and benefits while on sick leave.[19] $\mathbf{X}$ and $\mathbf{Z}$ are, as above, vectors of observable *pre-displacement* worker and firm characteristics; experience, experience squared, years of schooling, years of tenure, marital status, plant size, size of the regional labor market, dummies for region, and two-digit ISIC industry. τ_k is a dummy for base year. As above, we pool all base years, k, but we estimate the model separately for each pre-and post-displacement year $j \in \{-5,\ldots,7\}$.

The variables of main interest are the displacement variables, D_{ikj}. These are dummy variables indicating whether worker i in year $k+j$ experienced a displacement j years ago or—if j is negative—whether worker i will experience a displacement $|j|$ years later. Job loss is allowed to affect labor market outcomes five years before and seven years after its occurrence. In each pre- and post-displacement year we estimate the effect by comparing the annual earnings of workers who were employed at least 20 hours per week in base year k and displaced immediately after that year, to similar workers in similar firms in the same labor market in the same industry and at the same time (year $k+j$) who were not displaced.[20]

Figure 4 displays the series of δ-coefficients graphically, that is, the earnings loss in NOK as compared to the non-displaced. The graph for all displaced in the labor force is quite consistent with the difference between the raw earnings of displaced and non-displaced workers shown in Figure 2(b). All δ-coefficients from year –3 onwards are significantly different from zero at conventional levels. We see that the earnings of displaced workers begin to deteriorate four years prior to the displacement incident. As discussed in Section 3, displacement happens in year 0 or year 1. We see that the earnings dip is largest in year 2 which is the first full year with post-displacement earnings for all workers. Earnings quickly recover in years 3, 4, and 5, but do not quite reach the pre-displacement level. The maximum earnings loss is NOK 14,000 in

19. In line with recent studies by, for example, Hildreth, von Wachter, and Handwerker (2008) and von Wachter, Song, and Manchester (2007), we have chosen to use the level of income rather than log income. Our results are robust to using log income on the left hand side.

20. We have chosen not to include an individual fixed effect in the specification for two reasons. First, the δ-coefficients map out the entire earnings history of the displaced workers, and a fixed effect would basically rebase these dummies and remove information about a possible average level difference between the treatment and control group. Second, we follow workers through five years prior to the base year and clean the sample so that the two groups are as similar as possible, see Section 3, and Table 1 showing that indeed the two groups are very similar with respect to raw earnings in pre-displacement year –5.

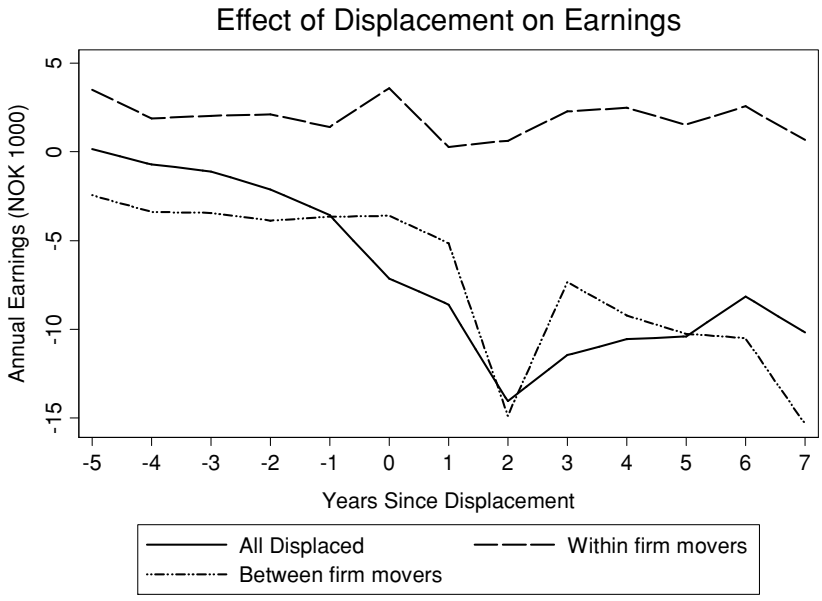


FIGURE 4. Effect of displacement on earnings for workers in the labor force. The dependent variable is annual earnings in NOK 1,000 (1998). The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are from whole calendar years, therefore, the first year where all earnings are entirely from post-displacement jobs is year 2. The sample includes only workers in the labor force. Workers are excluded from the sample the year they turn 67 and thereafter. The model is estimated separately for each pre- and post-displacement year using OLS. Control variables included are experience, experience squared, years of schooling, tenure in base year, marital status in base year, plant size in base year, size of the regional labor market in base year, pre-displacement industry, pre-displacement region dummies and time dummies. Displaced workers are classified as within or between firm movers according to where they work in year 2. Workers that were not employed in year 2 are excluded. Within firm movers are either recalled to the plant they were displaced from or transferred to another plant within the same firm.

year 2 (the equivalent of approximately $2,000). This is 4.8% of the average earnings of the non-displaced workers. After seven years the loss is NOK 10,000, or 3%.

The earnings loss for displaced workers who are rehired within the firm can be quite different from the earnings loss of displaced workers who are not rehired within the firm. In order to investigate this issue, we have split the sample on within- and between-firm movers according to whether workers were re-employed in the same plant in year 2. From the two resulting graphs in Figure 4 we see that within firm movers is a positively selected group and that the earnings loss for displaced workers is entirely driven by between-firm movers. For the latter group, the maximum earnings loss is NOK 19,000 in year 2 and NOK 13,000 in year 7 (about 3.6%). We return to this issue and split the two groups further in Section 6.4 where we analyze plant-, firm- and industry-specific human capital.

Workers in the labor force consist of workers that are employed and workers that are registered as unemployed. In Table 3 we explore this distinction, and the reference category is employed and not displaced. When we control for whether or not workers are employed at the time when we observe the match between workers and plants, the year 2 loss is reduced from NOK 14,000 to NOK 9,200. Not surprisingly, we see that unemployed workers, whether displaced or not, have significantly lower earnings than non-displaced, employed workers. There are two reasons for this. First, their unemployment benefits do not fully compensate their wage losses, and, second, unemployed workers are in general likely to be negatively selected on unobservable characteristics. We also notice that the loss for this group is increasing over time. The reason is probably that the group becomes more and more negatively selected. In the first year all workers in the sample have just become unemployed since everyone by definition is working in year 0. As time goes by, there are more long-term unemployed in the pool of unemployed. Long-term unemployed workers are more negatively selected on average and have lower unemployment benefits. The coefficient on unemployment, therefore, becomes more negative.

Unemployed workers that have been displaced, have in all years after year 1 lower earnings than unemployed workers that have not been displaced. Since we control for displacement as such, this suggests that unemployed, displaced workers are more negatively selected than unemployed, non-displaced workers.[21] The higher earnings in year 1 may be due to severance payments or a shorter unemployment spell on average. Notice that workers that are employed at the time we observe the match between workers and firms, may have unemployment spells at other times during the year, and, likewise, workers classified as unemployed may have spells of employment during the year. If we expand the regression reported in Table 3 to control for this, we find that the maximum earnings loss for displaced workers that do not experience any spell of unemployment is NOK 7,600 in year 2.

We have also checked the robustness of our results with respect to restricting the sample to plants with at least 50 employees. This is the cut-off used in Jacobson, LaLonde, and Sullivan (1993). The year 2 loss is then reduced from NOK 14,000 to NOK 10,000 and the year 7 loss is reduced from NOK 10,000 to NOK 5,000. There may be several reasons for this. First, workers displaced from large plants have a higher probability of belonging to a multi-plant firm and therefore a higher probability of finding a new job within the firm. Second, large plants are more likely to have

21. This finding may seem to be at odds with Gibbons and Katz (1991). Note, however, that after year 1 the mix of long-term and short-term unemployed may vary between the two groups. Note also that our definition of displacement includes a substantial number of workers from downsizing firms where employers have some discretion with respect to whom to lay off. Moreover, far from all non-displaced unemployed workers are laid off for a cause. Most of the non-displaced unemployed in our sample will either be from a large firm lay-off incident that affected less than 30% of the total workforce or be (more or less) voluntary resignations due to bad matches. Some may also be workers who return to the labor market from education, labor market programs or temporary disability. It seems likely that all of these groups will be more or less negatively selected as compared to employed workers, but it is hard to predict on theoretical grounds how they should compare to unemployed displaced workers who are also likely to be negatively selected.

TABLE 3. Effect of displacement and unemployment on earnings in different post displacement years for those in the labor force

	Year 1 (1)	Year 2 (2)	Year 3 (3)	Year 4 (4)	Year 5 (5)	Year 6 (6)	Year 7 (7)
Displaced ∗ employed	−1.377	−9.191	−8.127	−7.919	−7.708	−5.857	−8.279
	(1.57)	(9.96)**	(8.28)**	(7.48)**	(7.23)**	(4.49)**	(6.66)**
Unemployed	−74.233	−84.546	−95.407	−101.472	−106.357	−113.525	−119.368
	(86.89)**	(101.88)**	(103.39)**	(97.95)**	(99.66)**	(98.59)**	(98.55)**
Displaced ∗ unemployed	14.298	−7.580	−4.122	−4.811	−6.738	−6.487	−12.222
	(10.09)**	(4.45)**	(1.99)*	(1.97)*	(2.52)*	(2.06)*	(3.33)**
Observations	874,941	843,395	812,527	782,019	751,014	721,234	692,851
R-squared	0.07	0.06	0.06	0.05	0.05	0.04	0.04

*significant at 5% **significant at 1%.

The dependent variable is annual earnings in 1,000 NOK (1998). The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are from whole calendar years, therefore, the first year where all earnings are entirely from post-displacement jobs is year 2. The sample includes only workers in the labor force. The model is estimated separately for each pre- and post-displacement year using OLS. Control variables included, but not reported, are experience, experience squared, years of schooling, tenure in base year, marital status in base year, plant size in base year, size of the regional labor market in base year, pre-displacement industry, pre-displacement region dummies and time dummies. Huber-White robust standard errors allowing for clustering of errors by individuals are in parentheses.

programs helping workers to find new jobs after mass layoffs. Third, workers in large plants may be positively selected on unobservables and therefore less vulnerable to displacement. Finally, we have checked the robustness of our results with respect to including a full set of controls for additional displacements after the first displacement incident. Unlike Stevens (1997), we find that this has very little effect on the estimated δ-coefficients. We find, for example, that the year 2 loss is reduced from NOK 14,000 to NOK 13,500 and that the year 7 loss is reduced from NOK 10,000 to NOK 9,000. The δ-coefficients are now to be interpreted as the earnings loss from displacement for workers who stay in the labor force and do not experience any additional displacements within the seven year post-displacement window that we observe. One reason for the small effect of additional displacements may be that the most vulnerable workers leave the labor force altogether.

6.3. Earnings History of Workers Leaving the Labor Force

To sum up the regressions in the two preceding sections, we may conclude that the most severe effect of displacement is not reduced earnings, but an increase in the risk of leaving the labor force. In many cases workers may have a choice of whether or not to withdraw from the labor force. The generosity of the disability pensions and early retirement schemes will naturally be an important element when this decision is made. It is therefore interesting to analyze the earnings history of workers that leave the labor force permanently. Figure 4 presents such an analysis. The specification is the same as in equation (2), graphed in Figure 5, but the series of regressions are run separately on workers leaving the labor force in each of the years 0 through 6, and on the group of workers that do not leave the labor force within the time window we investigate. We see a very characteristic pattern where labor force exit is preceded by about five years of monotonically falling earnings. A labor force exit seems to happen when the earnings loss is between NOK 50,000 and NOK 80,000. This corresponds to a loss of 15%–30% of pre-displacement earnings. Note, however, that the last observed annual income will often not represent a full year of work. If we therefore look at the second to last observed annual income, a loss of about NOK 40,000 may be closer to the true turning point. This represents only a 10% loss.

As we noted in Section 4.2, low-income workers receive about 62% of previous labor earnings in disability pension. Since Norway has a progressive income tax system, this amounts to about 83% of the previous earnings after tax. Private early retirement schemes for workers in some firms have also been introduced. This may increase the earnings to cover up to 90% of last year's pay after tax. Hence, the generous early retirement schemes including disability pensions may be preferable to having a low-paid job.

6.4. The Importance of Plant, Firm and Industry Specific Human Capital

The level of earnings losses for displaced workers is expected to depend on the specificity of the workers human capital. Although post-displacement employment is

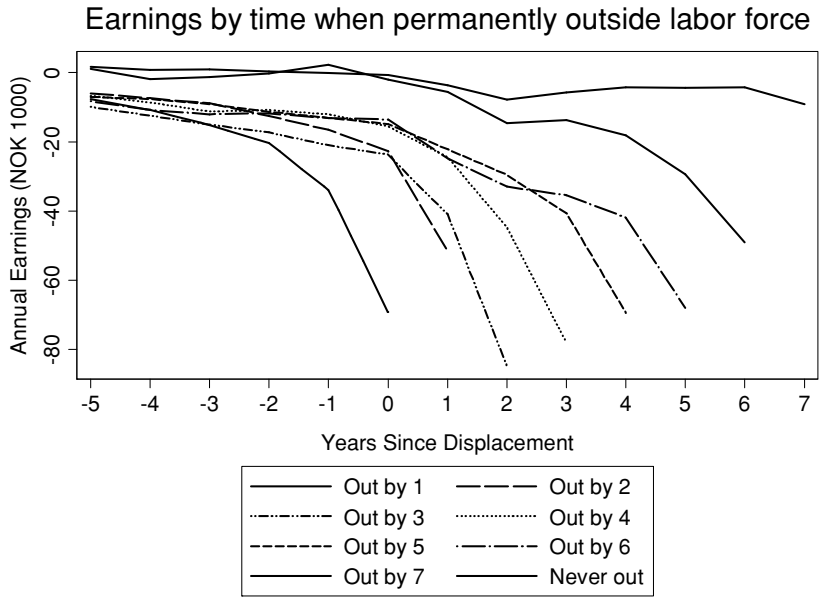


FIGURE 5. Effect of displacement on earnings by the time of exit from the labor force. The dependent variable is annual earnings in 1,000 NOK (1998). The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are from whole calendar years, so the first year where all earnings are entirely from post-displacement jobs is year 2. The sample includes only workers in the labor force. Workers who are temporarily out between year 0 and year 7 are excluded. Workers are excluded from the sample the year they turn 67 and thereafter. The model is estimated separately for each pre- and post-displacement year using OLS. Control variables included are experience, experience squared, years of schooling, tenure in base year, marital status in base year, plant size in base year, size of the regional labor market in base year, pre-displacement industry, pre-displacement region dummies and time dummies.

endogenous, workers with more specific human capital will have fewer options and may on average experience a greater wage loss. Earlier studies have analyzed firm- and industry-specific capital. Given the structure of our data, we may in addition study within-firm dynamics and distinguish between plant- and firm-specific human capital.

Figure 6 displays the displacement coefficients from a series of regressions similar to equation (2). The displacement dummy is interacted with the status in year 2 after displacement, and earnings are in each year measured relative to non-displaced workers. The most striking result in Figure 6 is the earnings of workers that get their year 2 post-displacement job in the public sector. They represent a negatively selected group of workers at the outset, since their earnings on average are about NOK 20,000 less than what non-displaced workers receive. Their earnings begin to deteriorate from this level three years before displacement, and their post-displacement earnings are NOK 70,000–80,000 less than those of non-displaced workers. Some of this loss could be a compensating differential associated with generous pension plans, high job

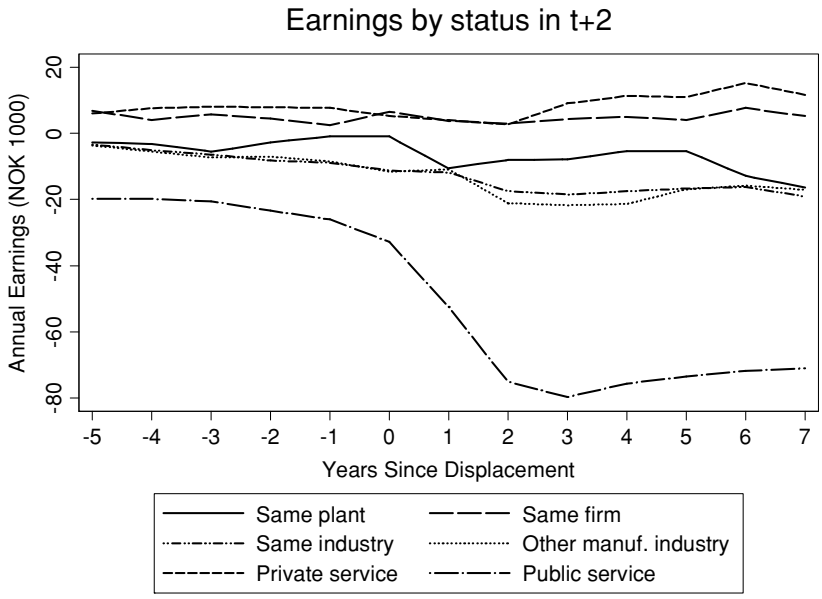


FIGURE 6. Effect of displacement on earnings by employment status in year 2. The dependent variable is annual earnings in NOK 1,000 (1998). The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are from whole calendar years, therefore, the first year where all earnings are entirely from post-displacement jobs is year 2. The sample includes only workers in the labor force. Workers that were not employed in year 2 are excluded. Workers are excluded from the sample the year they turn 67 and thereafter. The model is estimated separately for each pre- and post-displacement year using OLS. Control variables included are experience, experience squared, years of schooling, tenure in base year, marital status in base year, plant size in base year, size of the regional labor market in base year, pre-displacement industry, pre-displacement region dummies and time dummies.

stability and other amenities in the public sector. From Table 1 we see that the share of workers going to the public sector is tiny. In this respect it is not a particularly interesting group.

For workers staying somewhere in the private sector, the change in earnings is very small. Workers recalled to their pre-displacement plant have a post-displacement earnings loss of about NOK 10,000, that is, about 2.7%. Recall is only possible when workers are displaced from a downsizing plant, and a small loss seems reasonable given that they return to distressed firms. Workers transferred to a different plant within the same firm do not face any change in their earnings at all. This is not very surprising either, but it does suggest that there is no strong plant-specific component in human capital. There does not seem to be any difference between workers going to a different firm within the same two-digit industry or to a different manufacturing industry. In both cases the earnings loss is approximately NOK 15,000.

The most surprising finding in Figure 6 is that the large group of workers that leave manufacturing and start working in the private services sector have no earnings

loss. One might expect that this group should have lost their industry-specific human capital. One interpretation is that human capital is not really industry specific, but rather job specific. Workers going to the private sector could, for example, be white collar workers doing the same job in the new firm as in the old. They could also be maintenance workers who serve the same type of firms as before, but who have been outsourced to a specialized service firm. In order to shed further light on this issue, we have looked at the educational composition of each group of workers graphed in Figure 6, and the results are reported in Table 4. We see that the private service sector is the most common post-displacement status for all categories of workers with higher education, and recruits a particularly large share of workers with a non-technical master's degree. The same industry is the most common post-displacement status for all categories of workers without higher education, and recruits a particularly large share of workers with secondary technical education. Overall, the table supports the established view that workers with more education have more general human capital than workers with less education. The table also indicates that technically educated workers have slightly more industry-specific human capital than non-technically educated workers.

In order to investigate the importance of firm and industry specific human capital in more detail, we follow Neal (1995) and run regressions looking at how earnings vary with pre-displacement tenure. We run separate regressions for each group of movers, and the results are reported in Table 5. If high-tenure workers experience a larger earnings loss than otherwise similar workers with low tenure making the same move, this suggests that firm- or industry-specific human capital is important. Our tenure variable is censored at 13 years.[22] We present both a specification with a linear tenure term and one with a second-order term. From columns (1) and (2) we see that there is no significant relationship between earnings and tenure for workers that are recalled to their previous plant, or stay with the firm they were displaced from. Workers who move to another firm within the same two-digit industry, however, experience an earnings loss that increases with their pre-displacement tenure. This suggests that they have lost a firm-specific component of their human capital. We would expect this effect to be more pronounced for workers who move to another two-digit manufacturing industry, but in fact the coefficient is smaller and not significant. This lack of precision could be due to a small sample. Moving on to workers who leave manufacturing altogether, however, we see that the negative effect of tenure increases. Workers lose about NOK 2,350 per year of pre-displacement tenure. For a worker with 13 years of tenure, this amounts to about NOK 30,000 or 11%. This is consistent with the view that human capital is partly firm specific and partly industry specific. Given this, we would expect short-tenure workers to have the highest propensity to change industry, and this is exactly the pattern we observe in the descriptive Table 1. Displaced workers who stay within the firm have on average 10.5 years of tenure; workers who move to a different firm within the same industry have on average 8.8 years of tenure; workers who move

22. This is due to data limitations, however, it seems reasonable to assume that the difference in firm-specific human capital between workers with 13 years tenure and workers with more than 13 years tenure is fairly small.

TABLE 4. Employment status for displaced workers in year 2 by education

Education	Not employed (1)	Same plant (2)	Same firm (3)	Same Industry (4)	Other Manufacturing (5)	Private services (6)	Public services (7)	Total % (8)	Total No. (9)
Unskilled	29.2	6.7	14.5	29.3	4.4	14.5	1.5	100	8273
Technical Sec. Edu.	16.7	7.7	16.8	34.0	4.5	18.4	2.0	100	14460
Non technical Sec. Edu.	20.5	6.0	13.6	31.1	3.3	23.6	2.0	100	5010
Non technical, below Master	13.2	4.4	11.7	30.4	3.9	31.2	5.4	100	935
Non, technical, Master	13.3	8.2	11.8	16.0	3.8	41.6	5.3	100	450
Scientist, engineers, below Master	13.5	7.2	13.4	30.2	2.9	30.9	2.0	100	2696
Scientist, engineers, Master	10.3	4.8	18.3	24.0	2.8	37.3	2.5	100	1277
Total	6,530	2,292	5,062	10,369	1,340	6,837	671		33,101
%	19.7	6.9	15.3	31.3	4.1	20.7	2.0		100.00

The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are from whole calendar years, therefore, the first year where all earnings are entirely from post-displacement jobs is year 2. The sample includes only workers in the labor force.

TABLE 5. Effect of pre-displacement tenure on earnings in year 2 by employment status for displaced workers

	Same plant (1)		Same firm (2)		Same industry (3)		Other manufacturing (4)		Private services (5)		Public services (6)	
Tenure	−0.108	0.555	−0.155	−0.098	−1.958	−2.080	−1.178	−0.324	−2.354	−2.080	−2.172	−3.549
	(0.15)	(0.61)	(0.29)	(0.19)	(7.13)**	(6.22)**	(1.28)	(0.31)	(5.14)**	(3.38)**	(1.70)	(2.14)*
Tenure^2		−0.031		−0.002		0.005		−0.043		−0.015	−0.012	0.083
		(1.25)		(0.19)		(0.72)		(1.78)		(0.70)	(0.21)	(1.00)
Experience	3.679	3.708	4.042	4.036	4.660	4.655	5.192	5.269	9.318	9.300	4.554	4.552
	(3.11)**	(3.13)**	(4.60)**	(4.57)**	(9.20)**	(9.19)**	(3.09)**	(3.14)**	(10.05)**	(10.09)**	(2.65)**	(2.65)**
Experience^2	−0.064	−0.065	−0.059	−0.059	−0.084	−0.084	−0.094	−0.094	−0.170	−0.170	−0.077	−0.076
	(3.03)**	(3.04)**	(3.64)**	(3.59)**	(8.92)**	(8.92)**	(2.81)**	(2.82)**	(10.29)**	(10.35)**	(2.16)*	(2.15)*
Observations	2,290	2,290	5,057	5,057	10,352	10,352	1,340	1,340	6,816	6,816	671	671
R-squared	0.29	0.29	0.31	0.31	0.30	0.30	0.29	0.29	0.24	0.24	0.41	0.41

*significant at 5% **significant at 1%.

The dependent variable is annual earnings in NOK 1,000 (1998). Tenure is censored at 13 years. The sample consists of males who in year 0 (base years 1991–1998) are aged 25–65, employed in manufacturing and who have been working at least 20 hours a week and not been displaced from their jobs in year −5 to 0. Displacements happened between May (November) in year 0 and May (November) in year 1. Annual earnings are from whole calendar years, therefore, the first year where all earnings are entirely from post-displacement jobs is year 2. The sample includes only workers in the labor force. The model is estimated separately for each pre- and post-displacement year using OLS. Control variables included, but not reported, are experience, experience squared, years of schooling, tenure in base year, marital status in base year, plant size in base year, size of the regional labor market in base year, pre-displacement industry, pre-displacement region dummies and time dummies. Huber-White robust standard errors allowing for clustering of errors by individuals are in parentheses.

to a different two-digit industry within manufacturing have on average 7.7 years of tenure; workers who move to the private service sector have 7.3 years of tenure, and workers who move to the public sector have on average 6.8 years of tenure. Workers who are recalled to the plant they were displaced from, however, do not fit this pattern. Like workers moving within the firm to a different plant, we would expect them to have quite a bit of specific capital, but they have on average only 7.4 years of tenure. However, recall is only possible for workers displaced from a downsizing plant, and as discussed in Section 4 it is common to emphasize tenure when deciding who has to leave when a plant is downsizing. The relatively low tenure for workers recalled to the same plant is therefore likely to reflect a principle of "last hired, first fired".

7. Concluding Remarks

In our study, we have examined the impact of displacement on workers' employment and earnings using census data covering the entire Norwegian population regardless of their labor market status. We have focused on workers displaced by plant closure and workers separating from plants that downsize by 30% or more in the years 1991–1998. Within a regression framework we have estimated the effect of displacement by using workers in firms not exiting or downsizing significantly as the control group. First, we have explicitly analyzed the probability that workers leave the labor force permanently after being displaced. Next, we have estimated the earnings loss for workers staying in the labor force. We have been able to make an assessment of how large the loss after displacement is when workers leave the labor force and see early retirement as a viable alternative. Another novelty is that our data have allowed us to identify both plants and firms. Many workers are displaced from plants that belong to multi-plant firms, and some of these workers are re-hired within the firm. Studies based solely on firm level data will therefore underreport displacements, while studies based solely on plant level data will mix the costs of displacement for workers that are rehired within the firm with the costs of displacement for workers that are not rehired within the firm. We have used an extension of the framework suggested in Neal (1995) to identify plant and firm specific capital in addition to industry specific capital.

We have found that on average displacement increases the probability of leaving the labor force by 3.4 percentage points. This represents a 31% increase in the exit probability. However, our analyses show that there is much heterogeneity. Older workers, aged 58–65 leave the labor force to a much higher degree than younger workers, and with a drop-out rate from the labor force that is particularly high in the first years following displacement. The long-term effect is largest for middle aged workers (age 45–57). They experience a 4.5 percentage point increase in the probability of being out of the labor force seven years after displacement.

Our results suggest that displacement studies with a sample restricted to workers in the labor force may severely underestimate the costs of displacement. In an international context, our results may perhaps be considered an upper bound on the probability of permanently leaving the labor force. First, labor force attendance is very high in Norway as compared to most countries, something which may imply

many *marginal workers* in the labor force. A shock such as a displacement incident may, therefore, push them out. Second, our finding regarding the size of the earnings loss before leaving the labor force, is consistent with the view that generous support provided by disability pensions and early retirement, combined with the tax system, spur workers to leave the labor force early. This also suggests that the effect of displacement on leaving the labor force may be somewhat specific to the Northern European countries with similar social security schemes.

We see from our analyses that the average effect of displacement on earnings for those who remain in the labor force is moderate. The earnings of displaced workers start to deteriorate four years prior to the displacement incident. The earnings dip is largest in year 2 after displacement. The year 2 earnings loss is 4.8% relative to the average earnings of non-displaced workers. After seven years the loss is 3%. When splitting displaced workers on within- and between-firm movers, we find that the earnings loss is entirely driven by between-firm movers.

When further exploiting the mobility patterns between plants within firms, across firms within two-digit manufacturing industries and across industries, we find no support for plant-specific human capital. Our results, however, support the view that human capital is partly firm specific and partly industry specific. Our most surprising finding is that the large share of workers that leave manufacturing and start working in the private services sector have no earnings loss. We would expect that this group should have lost their industry-specific human capital. One interpretation is that human capital is not really industry specific, but rather job specific. When assessing the educational composition of each group of moving workers, we see that private services are the most common post-displacement status for all categories of workers with higher education, and the sector recruits a particularly large share of workers with a non-technical master's degree.

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