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Scars of recession:
the long-term costs of the Finnish economic crisis

Jouko Verho

WORKING PAPER 2008:9

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Scars of recession: the long-term costs of the Finnish economic crisis*

Jouko Verho†

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Abstract

This study evaluates the long-term cost of unemployment in Finland by focusing on the deep recession period of the early 1990s. The number of plant closures increased sharply during the recession and the unemployment rate rose by more than 13 percentage points. In the analysis, prime working-age men who face unemployment due to plant closure are matched to those who remained employed during the recession. The average effect of being unemployed during the recession is estimated for a 6 year follow-up period. After 6 years, there is a 25% annual earnings penalty for being unemployed. Months in employment recover steadily after the recession but are still 10% lower after 6 years. The estimated wage loss is 14%.
JEL: J65, J64
Keywords: Unemployment, plant closings

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1 Introduction

The development of the Finnish economy in the 1990s provides a unique setup for studying the costs of unemployment. After a boom in the late 1980's, the economy fell into a deep recession and the GDP dropped dramatically by 10.5% between 1990 and 1993. Consequently, the unemployment rate rose from 3.2% to 16.6%. The economy started to recover in 1994 but unemployment remained persistently high.

This study estimates the effect of becoming unemployed on future earnings and employment. This is done by analysing prime working-age men who were employed in a plant that closed down during the Finnish recession. The key idea is that plant closures provide an exogenous source of variation in unemployment as large groups of workers are displaced at once. The strategy mitigates the selection problem arising from employers' incentives to lay off the least productive workers first.

The studied outcomes are annual earnings, employment and wages in the post-recession period 1994–1999. These outcomes measure the deteriorating effect of unemployment on human capital and future employment prospects which are often referred to as scarring. This also includes the lost firm specific human capital which is typically the main focus in the displacement literature.

Mass layoffs and displaced workers have been analysed in a number of previous studies. These studies generally focus on situations where individuals are re-employed quickly and relatively little emphasis is placed on the macroeconomic conditions. The approach has not been used to study economic losses associated with severe recession previously.

The Finnish recession was an extreme economic event. The crisis provides ample possibilities to understand the consequences of a sudden increase in unemployment. A possible drawback is that the severity of the recession reduces the generalisability of results. However, it is important for governments to understand the implications of severe recession if a similar event is ever to recur. Also similar structural changes take place in less severe economic downturns and studying a more extreme case is useful for understanding the mechanisms.

The analysed data set is a representative 10% sample of Finnish workers followed from 1987 to 2000. The register data includes detailed information on labour market histories and annual earnings and contains a rich set of other individual characteristics. The key variable provides information

on the reason for unemployment. It is obtained when displaced workers register as job seekers at a labour office and it is checked by the case workers. Using these data it is possible to identify plant closures. Such information is typically not available in register data. The data provide firm characteristics but do not contain a firm identifier.

Considering the validity of empirical analysis, the Finnish recession has several useful aspects. Many firms closed down during the recession making it possible to use plant closures instead of a broader definition of mass layoffs. The events leading to the recession were unexpected and took place quickly. This reduces the possibilities of firms and workers to anticipate the events which often weakens the validity of the analysis based on displacements. In the analysis, the individuals unemployed due to plant closure are compared with individuals who remained employed during the recession period.

To construct a valid comparison group, individuals are matched by the pre-recession income quantiles and a propensity score of being unemployed that is estimated using other characteristics. Matching accounts for compositional differences between the groups and for the fact that only displaced workers who register as unemployed are observed. A potential sorting bias arises from those who are able to find a new job before or immediately after the plant closure. It is argued that the severity of the recession makes the selection problem much smaller than during normal economic fluctuations. To informally test for selection on unobservables, the differences between the analysis groups are compared in the period before the recession.

The annual earnings, months in employment and wages of the individuals are observed until the end of 1999. The plant closure group suffers large and long-lasting losses in annual earnings. In 1999, the annual earnings penalty is 25% when compared with the mean earnings in the matched employed group. Most of the losses are explained by lower employment in the plant closure group than in the comparison group. The employment level is 10% lower and the estimated wage loss is 14% in 1999. This indicates strong unemployment persistence and noticeable wage scarring.

The paper is organised as follows. The next section discusses the related literature briefly. Section 3 presents the economic environment focusing on the institutional framework and the recession in Finland. The data are described in Section 4 and the empirical strategy is discussed in Section 5. Section 6 presents the results and the last section concludes.

2 Related studies

This study is related to two different branches of literature. Several recent British studies attempt to identify the causal effect of unemployment. Both Arulampalam (2001) and Gregory & Jukes (2001) analyse the effect of unemployment on men's hourly wages and use panel data methods to overcome the selection problem. Arulampalam (2001), for example, estimates a scarring effect of 14% three years after unemployment. Arulampalam (2002) uses a similar approach but focuses on unemployment persistence which she finds to be strong especially for older individuals.

Gregg (2001) and Gregg & Tominey (2005) study the effect of youth unemployment on adult labour market outcomes by using the local unemployment rate at age 16 as an instrument. The first study estimates that 3 months of youth unemployment leads around 1 month of unemployment 10 years later whereas the second study estimates a wage scar of 13–21% at the age of 42. The impact of youth unemployment is also analysed by Nordström Skans (2004) using Swedish data covering the same recession period analysed in this study. Using a model with family fixed effects, he finds that experiencing unemployment after completing vocational education reduces annual earnings by 17% after 5 years.

Most of the U.S. studies focus on the effect of displacement rather than unemployment in general. This may be partly explained by the fact that unemployment durations are much shorter in the U.S. than in Europe. These displacement studies estimate a somewhat different parameter than unemployment scarring studies. Yet it is interesting to compare the results. A regression framework where displaced individuals are compared with employed individuals was introduced by Jacobson, LaLonde & Sullivan (1993) and it has been later applied in a number of studies. They analyse quarterly earnings using data from Pennsylvania which suffered from declining manufacturing at the time. The study finds 25% long-term loss from displacement which is a relatively high estimate compared with other studies from the U.S.[1]

Kuhn (2002) provides an overview of displacement analyses and includes several international studies. For example, Bender, Dustmann, Margolis & Meghir (2002) perform a descriptive analysis on displaced workers in France and Germany. They find association between displacement and earnings losses when it takes longer than a year to find a new job. Although

[1] Fallick (1996) and Kletzer (1998) provide surveys on the U.S. studies.

displaced workers have shorter unemployment durations than other separating workers, they still suffer from strong unemployment persistence.[2]

Huttunen, Møen & Salvanes (2006) analyse displaced workers in Norway. They find that displacement increases the probability of exit from the labour force but reduces annual earnings relatively little. The earnings loss is 5% after 2 years but disappears after 7 years. The Swedish displacement study by Eliason & Storrie (2006) employs non-parametric matching estimators similar to this study. They follow displaced workers for 12 years and find a persistent effect on unemployment which is around 4 percentage points.

3 Economic environment

3.1 Institutional framework

The institutional framework affects both labour supply and demand decisions.[3] The legislation dictating how quickly firms are able to adjust the number of employees is particularly important for this analysis. Moreover, the unemployment insurance system and the wage setting are essential in determining unemployed individual's incentives for re-employment.

Finnish employers must provide a justified reason to lay off workers. The law allows displacing workers if there is an economic or production related reason or if a plant or an office is closed down. These reasons cannot be temporary and it must be the case that the employer is not able to offer other jobs for the workers. In practise, this prevents filling similar vacancies at least for three months. An advance notice of displacement must be given to the workers from one to six months before the layoff depending on the length of work history in the firm. In the case of bankruptcy, the advance notice must be given two weeks before the layoff.

At the time of the recession, displaced workers were eligible for earnings related unemployment benefits for 500 working days if they had worked more than six months (10 months since 1997) and were members of an unemployment fund. For the median income worker with earnings related benefits, the benefit level was 55% of pre-unemployment income (in 2003, gross income 1,178 euros/month). Otherwise they received the basic allow-

[2] Other German studies include Burda & Mertens (2001) and Couch (2001).

[3] See Koskela & Uusitalo (2006) for more details on the Finnish labour market institutions.

ance which is substantially lower. For example, in 2003 the basic allowance without child supplements was 23 euros per working day.

Unemployed individuals must register to the labour office to receive benefits. Employees who have quit face a waiting period before they receive unemployment benefits. Before 1993 the period was six weeks but it has been increased since. Displaced unemployed individuals received benefits after a one-week waiting period. These rules create an incentive for unemployed to register. In addition, the information should be reliable in the relevant cases because a document about the displacement is required.

Displaced workers with long employment histories were eligible for a severance pay at the time of recession. A one-off payment varied depending on the employment history and it was typically slightly higher than a monthly salary. At the time of recession, the eligibility criteria for the severance pay were 43 years of age (45 years since 1995), five years continuous employment history and to be registered as unemployed.

Elderly people have an option for an early retirement scheme that affects considerably their re-employment incentives. Before 1997, individuals older than 53 years of age were entitled for earnings related benefits until retirement. The age limit was raised to 55 years in 1997. To account for this, all individuals in the analysis data are under 46 years of age at the end of 1990 which means that they are not entitled to early retirement scheme during the analysis period.

Wage setting in Finland is dominated by the collective agreements between trade unions and employer organisations. Over 80% of the workers belong either to a union or an unemployment insurance fund. During the 1990's, the coverage of agreements was around 95% of workers which is among the highest rates in the OECD. Between 1987 and 1999, the wage setting was collective at the national level in nine years and at the industry level in four years. As the nominal wage increase is linked to the productivity increase across the whole economy, wages may reflect sector specific productivity changes poorly. There is no minimum wage legislation but collective labour contracts contain a set of job-complexity and education specific minimum wages.

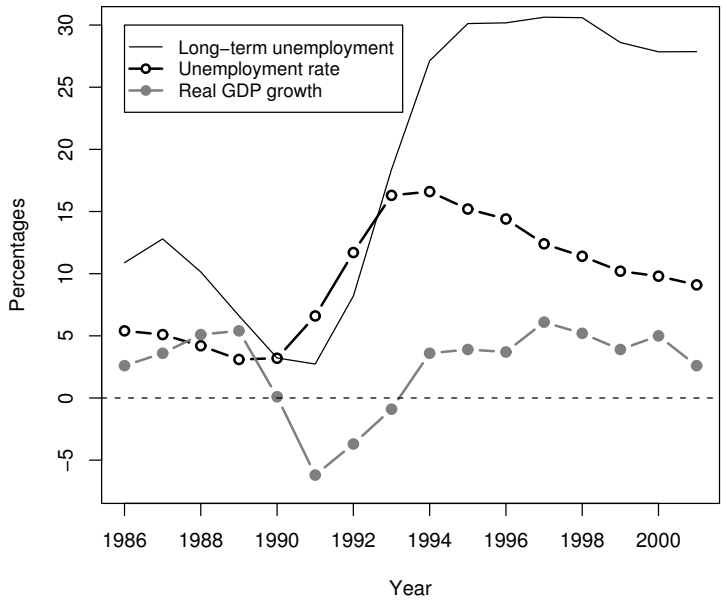

Figure 1: Unemployment rate, long-term unemployment (over 12 months) and real GDP growth in Finland (Statistics Finland; Labour Force Survey).

3.2 The Finnish recession

The Finnish economy experienced dramatic events in the early 1990's.[4] In the late 1980's, the economic growth was rapid, 3.4% on average. As illustrated in Figure 1, the unemployment rate was low. Long-term unemployment was a rare event mainly because of active labour market policy. Before the recession started at the end of 1990, the economy was overheated. This was partly due to financial deregulation which led to an increase in private borrowing and risk taking. The tax system favoured debt financing of investments. In addition, firms had incentives to acquire foreign debt due to the difference between foreign and domestic interest rates.

Finnish currency, the markka, had a fixed exchange rate in the 1980's. In March 1989, the markka was revaluated as a late response to foreign

[4] A more detailed discussion on the recession can be found, for example, in Honkapohja & Koskela (1999).

capital inflow. The fixed markka started to face growing speculative pressure from 1990 onwards and the defence of markka led to an increase in the real interest rates. At the same time, the German unification raised interest rates in Europe which raised the rates in Finland even further. This caused serious trouble for heavily indebted firms. Also domestic demand declined and the export sector suffered from loss in price competitiveness.

The collapse of the Soviet Union in 1991 also contributed to the decline in the economy. The bilateral trade, which was 15% of total exports, dropped by 70%. In November markka was devaluated. As the recession started to become deeper, reductions in asset values and liquidity variables caused private consumption and investment to drop. This, combined with the drop in bilateral trade and high interest rates, forced many firms to be closed down. Especially firms with high foreign debt had problems.

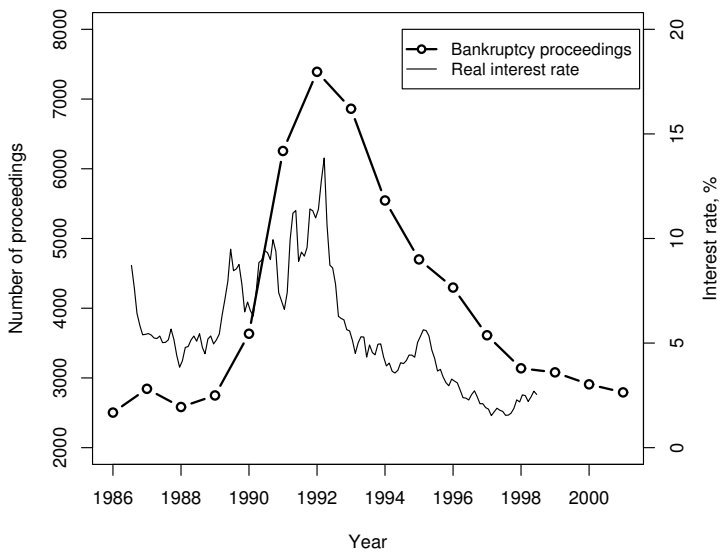

Figure 2: Number of started bankruptcy proceedings and the real interest rate (3 month Helibor - Consumer Price Index) in Finland (Statistical Year Book 2005; Bank of Finland).

The number of firm closures grew sharply when the recession started. Figure 2 shows the number of bankruptcy proceedings together with the short-term real interest rate in Finland. The number of proceedings more than doubled from the pre-recession level. One of the key factors caus-

ing problems for the indebted firms was the high real interest rates. The peak of 14% coincides with the year with the largest number of bankruptcy proceedings. As the firms had problems and laid off workers, the unemployment rate rose from 3.2% to 16.6%, in just three years.

4 Data

The dataset used in this study is based on the Employment Statistics database of Statistics Finland. It is a representative 10% sample of 12 to 75 years old individuals living in Finland in 1997.[5] The information in the data is combined from several administrative registers. In most cases information is reported annually for all individuals from 1987 to 2000.

4.1 Analysis sample

In the analysis, the focus is on men in prime working-age with stable employment in a private sector firm before the recession. The analysis sample consists of 22,474 men from 25 to 45 years of age at the end of 1990. They have worked more than 21 months between 1989 and 1990 with earnings information in the data for both years. They have not been unemployed between 1987 and 1990. In addition, it is required that individuals have been classified as workers and the employer is a private firm at the end of 1990. This implies that entrepreneurs, self-employed, farmers, students and public sector workers are excluded.[6]

The main reason for restricting the analysis sample is that the effect of unemployment is likely to depend on individual characteristics, like age and gender. Young unemployed individuals are more likely to exit from the labour force and continue to study. On the other hand, displaced elderly people have an option for early retirement. Women are generally more loosely attached to the labour markets than men.

[5] The population is sampled in 1997 which means that emigration from Finland is not observed. High emigration because of the recession would be problematic for the analysis. However, the average annual proportion of 24–54 years old individuals emigrating between 1990 and 1997 was only 0.19% (approximately 4400 individuals, Statistics Finland).

[6] The original dataset includes 72,552 men aged 25 to 45 years. 29,816 of them are employed in private sector, 26,353 of them had the required number of months in employment. Further, 2,877 are removed because of previous months in unemployment and 1,002 had missing information.

Only private sector workers are included in the sample because public sector workers are much less likely to face displacement. A stable work history with no unemployment is used to exclude new labour entrants from the sample. The main motivation for excluding previously unemployed individuals is that the interpretation of the results becomes easier when the analysed unemployment spell is the first in the observation period. In addition, unemployment before the recession was low.

4.2 Variables

The structure of the sample selection and the definition of the treatment variable, the covariates and the outcomes are illustrated in Figure 3. Individuals unemployed due to plant closure are the main treatment group but descriptive statistics is also provided for all unemployed. The variable providing information on plant closure is available in the data since 1991 and it is collected when displaced workers register as job seekers at the labour office. Unemployed individuals need to register in order to qualify for benefits.

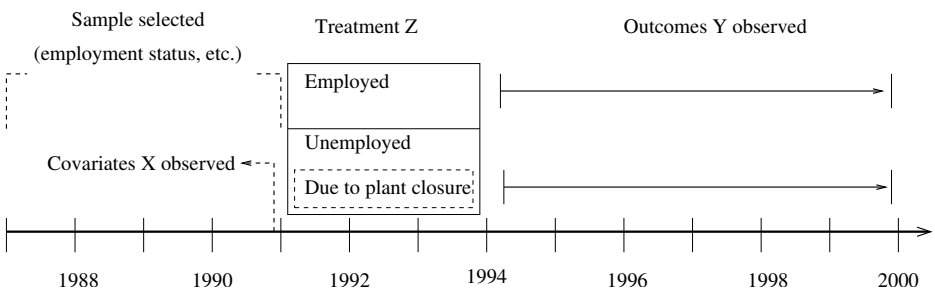

Figure 3: Construction of analysis sample and the definition of treatment variable Z, covariates X and outcomes Y by calendar year.

The information on the reason for unemployment is not complete. The reason is missing roughly for 15% of the individuals who had a work spell before the unemployment spell. The missing data are likely due to multiple records in the job seeker register. The data are typically linked to the last record of a given year which does not necessarily contain all the information. This causes misclassification of some individuals who belong to the plant closure group but they are still identified as unemployed.

Table 1 shows the distributions of the reason for unemployment. The

reasons are quit by own request, the end of probation period, the end of fixed-term contract, displacement due to individual reasons, an economic or production related reason and the closure of plant or office. The most common reason during the recession is economic or production related. The number of displacements not related to individual reasons drops after the recession while the number of other reasons for exits vary less. Between 1991 and the end of 1993, 6,257 individuals in the analysis sample experience unemployment and 371 individuals lose their jobs due to plant closure.

Table 1: Annual frequencies of the different reasons of unemployment in the analysis sample.

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Own request	80	127	65	61	39	39	35	62	44
End of probation	6	10	9	11	7	17	10	25	13
Fixed-term contract	383	582	422	607	280	334	233	243	178
Displaced (other)	41	52	16	21	19	29	23	31	21
Production related	964	1641	789	273	209	226	168	177	161
Plant closure	95	182	94	45	13	22	12	18	16

The outcome variables, months in employment and earnings, are observed annually. As illustrated in Figure 3, the follow-up continues until the end of 1999. The earnings information is obtained from tax registers and it is decomposed into wage and entrepreneur income. When averages are computed, also zero earnings are included. To account for variation in employment, monthly wages are computed by dividing annual earnings by months in employment. Weakness with this definition is that it does not take part time work into account. It is also inaccurate for those who have worked only for one or two months per year. Unfortunately more accurate measures, like the hourly wage, are not available in the data.

The rich set of covariates in the data makes it possible to control for various dimensions of firm and worker heterogeneity. All covariates used in the analysis are observed at the end of 1990. In the main analysis, Statistics Finland's two-digit industry classification (69 categories) is used for the employing firm. When the descriptive statistics are provided, 17 broad industry categories are used for illustrative purposes. The firm location is described by 15 economic regions and by the statistical grouping of the area's degree of urbanisation.

In addition to labour market history variables, earnings and age, there is detailed information on other individual characteristics. Education is classified into five levels, socio-economic status has three levels as well as the native language variable. Family status indicates whether an individual is married, has children or has a partner. House ownership is used as a proxy for wealth and willingness to move to get a job. A detailed variable description is provided in the Appendix.

5 Empirical strategy

5.1 Plant closures as a source for variation

Individuals displaced due to plant closures have been analysed in a number of studies. Generally, it is thought that by focusing on mass layoffs there is less selection. In regular downsizing, employers have incentives to displace the least productive workers first. When the whole plant is closed down, all workers are displaced. Gibbons & Katz (1991) construct a theoretical model based on this idea.

There are, however, potential flaws in using plant closure information. Firstly, it is possible that workers are sorted by some unobserved characteristics to firms that are going to be closed down. For example, plant closure firms could have systematically hired less productive workers than other firms that are similar in observed characteristics. This may be a relevant factor especially when the economic environment is stable. Nevertheless during the Finnish recession, the far most important reason for plant closures was the excess risk taking of firms and the large demand shocks.

The second problem is that plant closure can be a time-consuming process and its starting point is difficult to define. Firms may have tried to improve the average productivity before the plant is finally closed. This would cause the treatment group to contain too many high type workers. Alternatively, it may be easier for high type workers to leave the firm before closure which is often referred to as the early leaver problem. The advance notification is the only documented way to provide information on the forthcoming closure. At least in case of bankruptcy, the required two weeks notification period is short in Finland.

Potential sorting is the main reason why only plant closures are used here instead of a broader definition of displacement. Here the recession

period is good as it provides sufficient number of cases. Moreover, the fact that the Finnish economy turned unexpectedly and quickly from boom to recession reduces the potential sorting problem. It was difficult for firms to anticipate the events and hence to adjust the number of workers beforehand. During a normal economic fluctuation, there is more time to restructure organisation and it is also easier to get extra funding.

Displacement analysis is often done using linked employer-employee data with relative inaccurate information on firm exits and displacements. A false firm death refers to a classification error where individuals have been incorrectly defined as displaced. In this analysis setup, plant closure cases are identified when individuals register at a labour office which means that the problem of false firm deaths is avoided. The early leaver problem is common to all studies but in this setup it is further required that individuals register as unemployed. If individuals face unemployment, the information in the data is likely to be correct as the registering is needed for the benefits and the reason for unemployment is checked by the case worker.

Without a firm identifier it is difficult to study the potential sorting problem. However, a comparison of job-to-job worker flows gives some descriptive evidence. Figure 4 presents worker flows in the Finnish manufacturing industry.[7] The number of firm changers is quite stable during the recession. If those who worked in the firms that closed down were able to find a new job without experiencing unemployment, one could expect to see larger variation in this flow. Instead, the number of exits and new entrants seem to be more sensitive to the macroeconomic conditions. Thus, this can be interpreted as an indirect evidence that it was difficult to change a job during the recession.

5.2 Comparison of groups

The composition and outcomes of three groups are compared in the following. The groups are defined by their employment status between the beginning of 1991 and the end of 1993. The employed group consist of those who did not become unemployed. The unemployed group consist

[7] The share employed working in manufacturing industry was 22% in 1990 and it decreases significantly during the period because of structural change in the economy. Between 1990 and 2000, the number of workers in the data decreases by 30%. The paper industry is excluded since a large merger took place in 1991 that affects the data considerably.

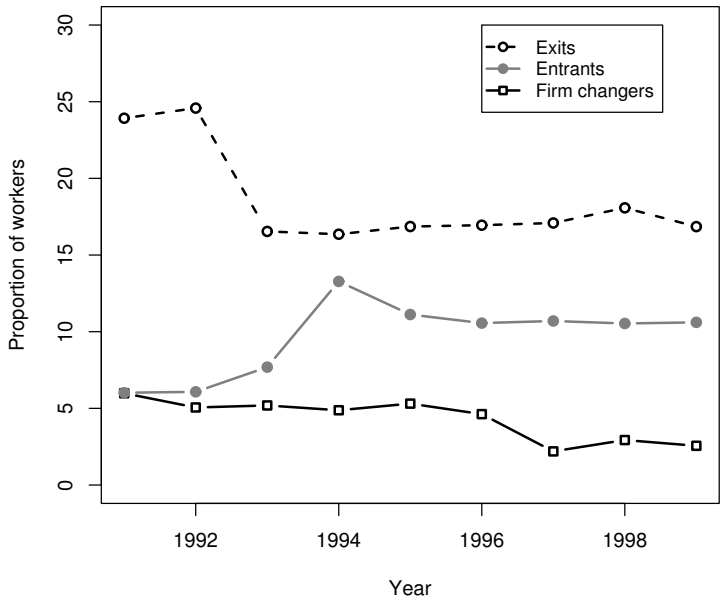

Figure 4: Number of firm changers, new entrants and exits from Finnish manufacturing industries (excluding paper industry, data: wage records of Finnish industrial employers, own calculations).

of those who had at least some unemployment. The plant closure group consist of a subset of all unemployed individuals who became unemployed because of plant closure.

First the descriptive statistics of the control variables are presented for the groups. As Table 2 shows, the groups are quite similar in terms of the key background variables. Descriptive statistics for the other control variables are provided in the Appendix. The pre-recession earnings in the employed group has over 10% higher mean and larger standard deviation than the two other groups. However, the earnings distributions are still quite similar and the difference is mainly due to more frequent high earnings among the employed group. This difference is also reflected in other variables. Employment before the recession does not show much variation because it is one of the sample selection criteria.

Table 2: Means of pre-treatment outcomes, individual characteristics and unemployment during the treatment period in three groups.

		Employed	Plant closure	Unemployed
Pre-treatment period 1989–90				
	Employment (mo)	23.97	23.96	23.92
		(0.21)	(0.22)	(0.34)
	annual earnings (1000 mk)	136.83	122.21	118.09
		(58.32)	(50.37)	(43.83)
Covariates observed at the end of 1990				
	Age	35.65	34.71	34.94
		(5.86)	(5.79)	(5.97)
Education	base	0.27	0.28	0.31
	high school	0.04	0.04	0.03
	vocational	0.38	0.43	0.45
	lower tertiary	0.16	0.16	0.13
	higher tertiary	0.15	0.1	0.08
Socio-economic status	blue collar	0.52	0.6	0.67
	white collar low	0.25	0.22	0.2
	white collar high	0.23	0.18	0.13
Area type	urban	0.76	0.71	0.71
	semi-urban	0.12	0.12	0.14
	rural	0.12	0.17	0.15
Industry	other	0.02	0.01	0.02
	primary prod	0.02	0.02	0.02
	mfg consump prod	0.06	0.04	0.03
	mfg wood prod	0.09	0.07	0.05
	mfg metal prod	0.05	0.09	0.06
	mfg machinery	0.08	0.08	0.07
	mfg technical prod	0.07	0.06	0.06
	mfg other	0.07	0.1	0.08
	house construction	0.03	0.05	0.15
	other constrion	0.04	0.08	0.11
	wholesale trade	0.1	0.09	0.07
	other trade	0.1	0.12	0.11
	transportation	0.06	0.04	0.05
	communications	0.06	0.05	0.02
	financial services	0.04	0.01	0.01
	business services	0.06	0.08	0.07
	other services	0.05	0.02	0.02
Treatment period 1991–1993				
	Unemployment (mo)	0	10.72	10.54
	N	16162	371	6253

Note: standard deviations in parenthesis (calculated after taking averages over years).
Broad industry categories are derived based on Statistic Finland's two-digit classification.
Plant closure group is a subset of unemployed.

The employed group is on average slightly older, more educated and more often in white collar work. Their employer in 1990 was more often located in urban areas. The plant closure group is educated better on average than all unemployed which reflects partly the industry composition. The employed individuals worked more often in the manufacturing of consumption good and wood industries as well as in financial and other service industry. The construction industries were more common among the unemployed individuals.

Figure 5: Average nominal annual earnings (1000 mk) in the groups.

Figure 5 shows the average nominal earnings for the three groups between 1987 and 1999. As the same individuals are followed, cohort effects and time trend are present. In addition, inflation causes an increasing trend, especially in the late 1980. However, these confounding factors do not affect the differences between the groups. Before the recession period, the differences between the groups are stable. The mean earnings in the two groups of unemployed individuals drop during the recession but recover at a stable rate afterwards. However, the gap between the unemployed and the employed group remains large even 6 years after

recession in 1999. The magnitude of the difference is large which suggests scarring or stigmatisation.

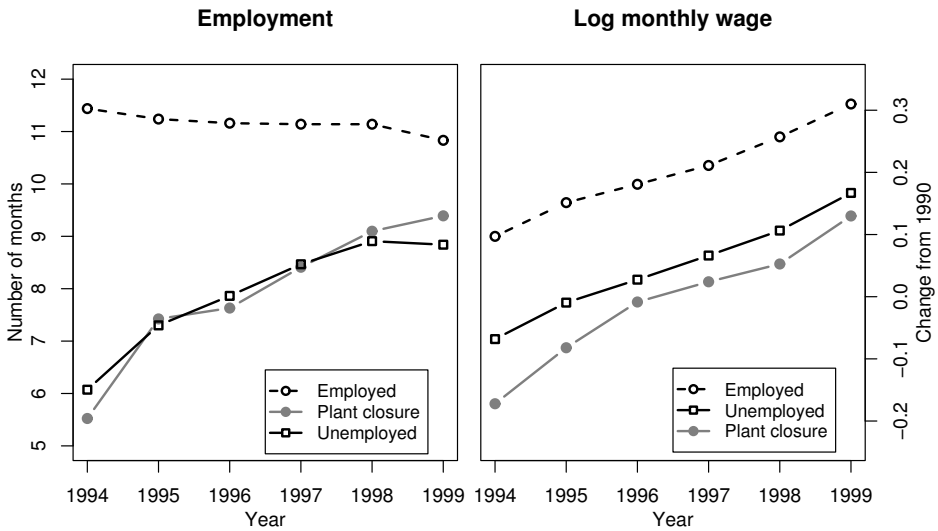

Figure 6: Average number of months in employment and change in log nominal wages since 1990 for the groups. Wages are only observed for those who work.

The patterns of other outcomes after the recession are shown in Figure 6. The average months in employment is decreasing for those who did not experience unemployment during the recession.[8] This is due to natural flow to unemployment and out of labour force. Unemployed individuals experience on average 3.5 months of unemployment per year during the recession. They start with very low employment in 1994 and their employment increases roughly by half a month every year until 1999.

As noted earlier, wages are observed only for those who work. In 1994, wages are missing for 2% of the employed group, 28% of the unemployed group and 35% of the plant closure group. At the end of the period in 1999, the numbers are 6%, 15% and 12%, respectively. As expected, those who

[8] Alternatively it is possible to use binary employment classifications instead of months per year. Using the binary definitions of 12 months and 6 months per year in employment do not change the profiles.

did not experience unemployment have the highest nominal wage growth since 1990. Both the unemployed and plant closure groups have lower average nominal wages in 1994 than in 1990. The growth between 1994 and 1999 is quite steady in all groups.

The comparison of the individual characteristics between the groups shows that they are surprisingly similar. Interestingly, the means of the control variables in the plant closure group are typically between the means of the employed and unemployed groups. Similarity of the groups reflects the fact that the recession affected the whole economy. There are also no notable differences in the other variables shown in the Appendix. Even the regional compositions of the groups are nearly identical. However, there is an obvious difference between the groups in the average pre-recession earnings. To construct a valid comparison group for the plant closure group, the compositional difference of the employed individuals is adjusted by matching.

5.3 Matching estimator

A single outcome variable Y is used in the notation for simplicity, although there are three outcomes of interest: annual earnings, months in employment and log wages. The treatment indicator D takes value 1 if an individual has experienced unemployment during the recession period and 0 otherwise. The potential outcome Y_1 denotes the individual outcome if unemployed and Y_0 denotes the outcome if employed. As only either Y_1 or Y_0 is observed for every individual, it is only possible to compare the difference in average outcomes. The vector X describing the characteristics of the individuals and the employing firms is observed before the recession.

The effect of interest is the mean difference in outcomes when experiencing unemployment relative to remaining employed for the unemployed group. The estimated parameter is the average treatment effect on the treated. If the effect is heterogeneous, the estimated parameter differs from the average effect for all private sector workers. This could be the case, for example, if the industry composition of the firms displacing workers is not representative. Formally the parameter of interest is:

$$\Delta^{TT} = E(Y_1 - Y_0|D = 1).$$

The average treatment effect on the treated is estimated by a matching estimator. The basic idea is that each unemployed individual is compared

with employed individual with similar background characteristics.

The key assumption required for the identification of the parameter is the Conditional Independence Assumption (CIA) which can be formally denoted by $(Y_0 \perp D) \mid X$. It states that, conditional on the observed individual and firm characteristics, the treatment status is independent of the outcome if employed. Thus, there can be no selection on unobserved characteristics. The variation in employment status due to plant closures is typically thought to provide an exogenous source of variation. Further, the fact that the analysis period is a severe recession probably increases the random component in the layoffs.

Yet it may well be that the conditioning set X does not include all relevant variables that determine treatment status and outcomes. It is also possible that only a selected group of plant closure cases have registered at the employment office. Because the annual earnings in $D = 0$ state are observed for all in the pre-recession period, it is possible to indirectly assess the validity of the CIA on that period. An informal test is done by matching on earlier covariate information that is not used in the information set of the main analysis. If there is no difference in the pre-recession earnings between individuals who later experience unemployment and those who remain employed, it provides support for the CIA. Note that the pre-recession earnings are included in the information set of the main analysis.

The second important requirement for matching is the common support assumption. It states that a counterpart must be found for each unemployed individual among the employed individuals, formally $\Pr(D = 1|X) < 1 \, \forall \, X$. This condition is not restricting in this case because the employed group is far bigger than the unemployed group. However, when the conditioning set X has high dimensionality, the number of subgroups grows quickly.

The propensity score matching provides a simple method to reduce the dimension of the conditioning set. The idea is to estimate a balancing score $\Pr(D = 1|X)$ which gives each individual the probability of experiencing unemployment. Rosenbaum & Rubin (1983) show that it is sufficient to balance on the propensity score instead of X. The common support assumption for propensity score can be checked by comparing the probability distributions of scores between unemployed and employed individuals.

The key conditioning variable in the analysis is the pre-recession earnings. To ensure that individuals in the same income category are compared, exact matching is done with respect this variable. This also makes

it possible to study the heterogeneity of the treatment effect across the earnings categories. For other covariates, a propensity score is estimated by logistic regression where all variables are categorical except age which is included with a quadratic term. To avoid compression of values around zero, matching is done on the linear predictor $X\hat{\beta}$.

With respect to the propensity score, individuals are matched by the nearest neighbour method. To increase the efficiency of the estimator, several controls are used if they all match a treated individual. A tolerance value 10^{-5} is used to determine the acceptable distance. The heteroskedasticity-consistent standard errors are estimated following Abadie & Imbens (2006).

5.4 Matching and covariate balance

Exact matching is done by the 15-quantiles of 1989–90 earnings from the plant closure group.[9] As the objective is to find a counterpart for the unemployed individuals, those who worked in an industry with no plant closures are excluded from the comparison group.

The propensity score is estimated by a logit-model for the other control variables measured in 1990. The complete model output is presented in the Appendix. Then the Conditional Independence Assumption (CIA) and the common support assumption are assessed. The CIA can be informally tested by comparing the outcomes of the groups in the pre-recession period. The common support can be evaluated by comparing the balancing score across the groups.

Table 2 indicates that the employed individuals have, on average, higher 1989–90 earnings than others. A t-test shows that the employed group is significantly ($t = 6.01$, $p < 0.01$) different from the plant closure group. An indirect test of the CIA is done by matching individuals using 1988 covariate information. If the difference in 1989–90 earnings remains between the treatment and the control group after matching, it suggests that the CIA does not hold. Again exact matching is done using the 15-quantiles of earnings and the same balancing score specification is used as in the main analysis to the extent that the covariate information is available. After matching, the difference between the plant closure and the employed group reduces from -14.62 to -1.07 with p-value 0.50. Thus, this gives

[9] 15-quantiles were chosen because they provide sufficiently accurate matching and make it possible to study heterogeneity by earnings quintile.

support for the assumption that the data include sufficiently rich set of conditioning covariates for the CIA to hold.

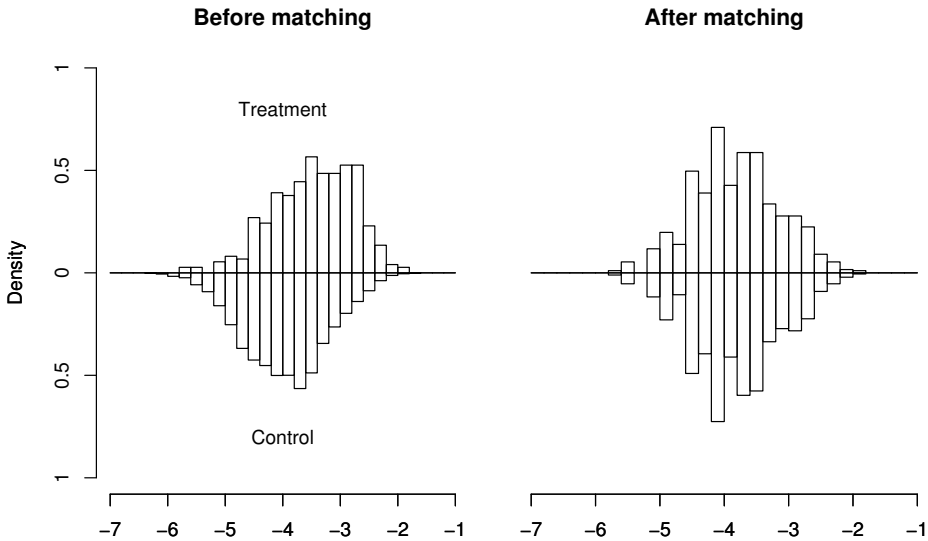

Figure 7: Distributions of estimated propensity score before and after matching in the treatment and the control groups. Matching is done on the linear predictor from a logistic regression (i.e. on log-odds ratio).

According to Table 2 the analysis groups have relatively similar composition. Also the fact that the employed group is much larger than the plant closure group suggests that limited common support is not a problem in this study. Figure 7 shows the distributions of the linear predictions from logistic regression before and after matching. The distribution of the control group covers the range of treated individuals and matching creates practically identical distributions for both groups.

6 Results

6.1 Main results

The effect of experiencing unemployment during the recession period 1991–1993 is studied on annual earnings, months in employment and wages. The

two latter outcomes are simply obtained by decomposing annual earnings. However, they provide some insight on whether the earnings difference is due to persistent unemployment or wage scarring. The complete matching estimates are shown in the Appendix.

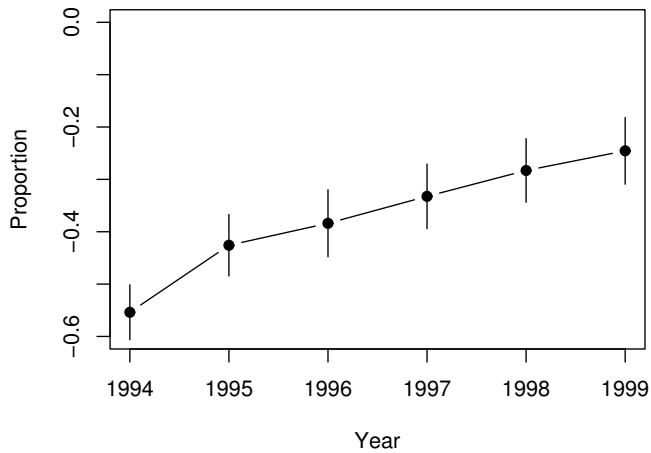

Figure 8: Effect on annual earnings (ATT) as a proportion of earnings in the control group by year. Vertical bars denote 95% confidence intervals.

Figure 8 presents the treatment effect on annual earnings from 1994 to 1999. The earnings losses are shown as a proportion of the average earnings in the matched comparison group. The initial losses are large, around 50% in 1994. In the following years, the earnings difference is reduced at a slow pace. Six years after the recession in 1999, the earnings loss is still 25%. This pattern is not entirely similar to the raw means shown in Figure 5 where the gap is more persistent. The result exceeds the losses estimated in most of the previous studies which is not surprising as they do not focus on a deep recession. However, a similar estimate is obtained by Jacobson et al. (1993) who report a 25% earnings loss 6 years after displacement for Pennsylvania which was heavily dependent on a declining manufacturing industry at the time.

The large earnings losses in the years following the recession are mostly explained by the high level of unemployment in the treatment group. The effect of unemployment on future months in employment shown in Figure 9 is relatively similar to the difference in average employment. In 1994 the difference is again 50% but in 1999 it has reduced to 10%. The reduction of

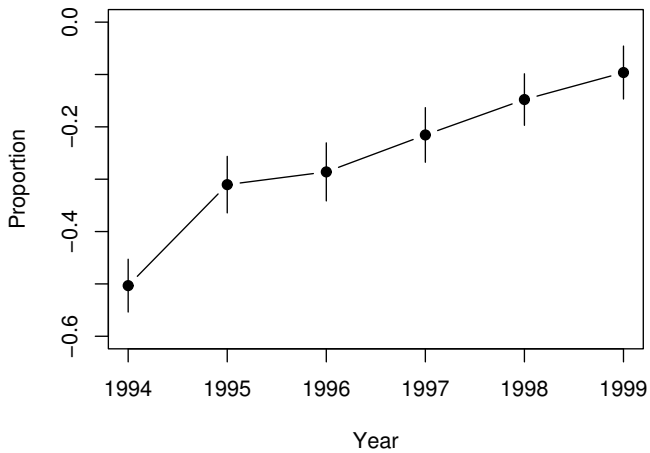

Figure 9: Effect on months in employment (ATT) as a proportion of employment in the control group by year. Vertical bars denote 95% confidence intervals.

employment difference takes years and implies strong unemployment persistence. Indeed, almost a half of individuals not working in 1994 remain without work in 1995.

Also some previous European studies have found strong persistence. For example, Bender et al. (2002) report that more than 20% of those who are unemployed due to displacement remain unemployed after 5 years. A Swedish study by Eliason & Storrie (2006) also finds a long-lasting effect on employment as it is visible up to 12 years. They estimate around 4 percentage points effect for all displaced of whom not all experience unemployment.

The differences in wages are illustrated in Figure 10. Here the aim is to measure wage scarring. However, this outcome is observed only for employed individuals who are likely to be a selected group of the analysis sample. The employment increases in the plant closure group from 1994 to 1999 which reduces the comparability of the estimates since the population of the treated varies over time.

This limitation in mind, it is interesting to note that the estimates change less over time than in the case of employment. Wages are 23% lower in 1994 and 14% lower in 1999 than in the comparison group. At the same time, the percentage of treated individuals with more than one

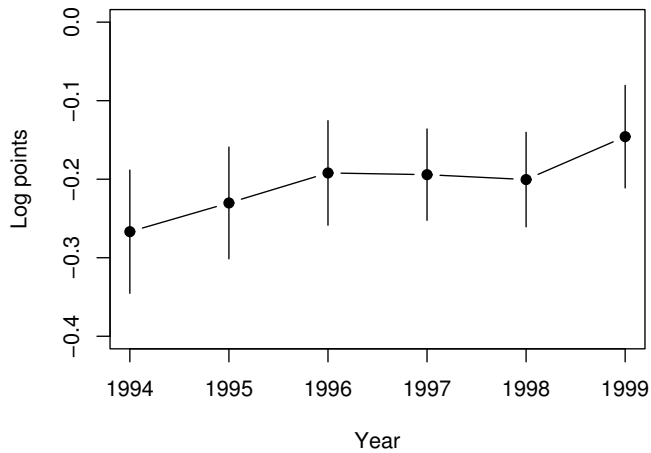

Figure 10: Effect on log wages (ATT) by year. Vertical bars denote 95% confidence intervals.

month in employment grows from 65 to 87. This indicates that there is notable wage scarring which recovers relatively slowly over time.

The estimated wage scar in 1999 is relatively similar to what has been found in other studies. The British studies focusing on the effect of unemployment provide the closest point of comparison. Arulampalam (2001) estimates a 14% loss after three years. Gregg & Tominey (2005) find a very long-lasting wage scar from youth unemployment which is in the order of 13–21% at the age 42. Also some displacement studies estimate similar numbers. For example, using U.S. data, Stevens (1997) estimates a 12% loss in hourly wages in the first year after displacement and observes this loss to diminish only slightly over a ten-year period. On the other hand, Bender et al. (2002) finds the opposite as French and German workers face a negligible wage loss. However, they note that those who remained unemployed over year after displacement faced a penalty when re-employed.

6.2 Heterogeneous responses

It is likely that some individuals are more prone to scarring. For example, in some industries firm-specific human capital is more important than in others. Alternatively, some individuals may suffer less from long-term un-

employment than others. This creates variation in the treatment effect given the time in unemployment. In addition, there is variation in the duration of unemployment. The longer the unemployment continues the larger losses are expected. However, it is important to note that the duration of unemployment is observed in the post-treatment period and the variable suffers from selection bias as less employable individuals are probably also more prone to scarring.

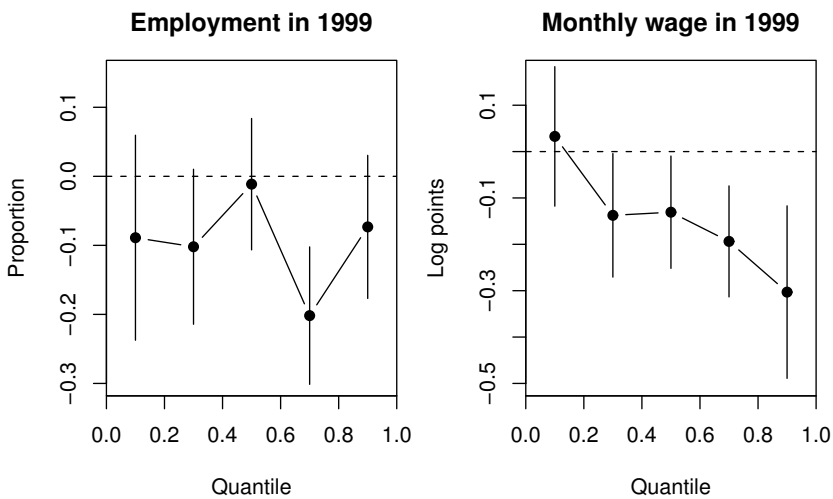

Figure 11: Treatment effects by pre-treatment earnings (1989–90) quantile. Vertical bars denote 95% confidence intervals.

Figure 11 illustrates the effect of treatment by pre-treatment earnings in 1989–90. The matching estimates are computed separately for individuals in each 5-quantiles of the data. Only the results for 1999 outcomes are shown as the profiles are very similar for earlier years. As the number of treated individuals is relatively low when split between the quantiles, the standard errors are large. The effect on employment in 1999 does not show any systematic trend.

For wages there seems to be a negative relation between losses and pre-treatment earnings even though the confidence intervals are again wide. In the lowest quantile, there is no wage loss whereas in the highest quantile the point estimate corresponds to a 26% loss. It is likely that the job specific minimum wages prevent wage losses in the lowest quantile. Because the

same propensity scores are used as in the main analysis, the estimates by quantile approximately add up to the pooled estimates.

Previous studies have explored several sources of treatment heterogeneity. Gregory & Jukes (2001) and Burda & Mertens (2001) report a similar negative relation between earnings losses and earnings quantile. Eliason & Storrie (2006) study heterogeneity by age. They find some indication that older individuals have less favourable labour market outcomes. When outcomes are studied by age, similar, although not significant, results can be found in this sample (results not shown).

7 Conclusions

The recession in 1991–1993 generated a severe unemployment problem that has affected the Finnish economy over ten years. This study has estimated the long-term costs of unemployment that began during the recession. The identification relies on the variation in unemployment created by plant closures. The idea behind this identification strategy is that the deep recession was caused by unexpected shocks, like mistakes in monetary policy and the collapse of the Soviet Union, which caused many firms to close down that would have survived the normal economic fluctuation. The analysed sample consists of men between 25 and 45 years of age in 1990 who had a stable work history in the private sector and no unemployment before the recession. They are expected to stay in the labour force even when the labour market situation is weak.

The key assumption in the analysis is that individuals who remained employed during the recession can be used as a comparison group for the plant closure group. Employed individuals were matched by a rich set of covariates. Because the reason for unemployment is available only for individuals who register as unemployed, there is a risk of selection on unobservables. The difference in outcomes during the pre-recession period was examined to address this problem. The matched plant closure group passed this informal test.

Annual earnings and months in employment of the individuals were observed until the end of 1999. Monthly wages are obtained by dividing annual earnings by months in employment. The plant closure group suffered large and long-lasting losses in annual earnings. Although annual earnings recover, the effect of working in a plant that closed down is a 25% reduction in annual earnings compared with not working in this plant

during the recession. The low level of employment in the plant closure group explains most of the initial earnings losses. After the recession, the effect on employment months is 50% but the difference reduces to 10% in 1999.

The wage estimates change less, from a 23% penalty to a 14% penalty between 1994 and 1999. Although, wage estimates must be interpreted carefully, especially at the beginning of the period, as they are observed only for employed individuals. When the heterogeneity of treatment effect is studied, the wage loss is strongly related to pre-recession earnings as high earners suffer more.

The losses in annual earnings are large when compared to most of the previous studies analysing the cost of unemployment or displacement. This is not surprising as they do not analyse recession periods. Nevertheless, similar strong unemployment persistence has been observed also in other European studies. Moreover, the estimated wage losses are roughly in line with previous studies.

The centralised wage bargaining creates rigid wages, especially for low income earners, which probably reduces wage losses. This is also consistent with the observation that individuals with the lowest pre-recession earnings have no wage scar. Individuals with high pre-recession earnings have large wage scars which is possibly due to lost human capital.

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Appendix

Table 3: Employer's location, native language, family type and housing type at the end of 1990 in three groups.

		Employed	Closure	Unemployed
Region	Uusimaa	0.35	0.34	0.32
	Varsinais-Suomi	0.10	0.08	0.10
	Satakunta	0.06	0.06	0.05
	Häme	0.08	0.10	0.08
	Pirkanmaa	0.10	0.09	0.10
	Kaakkois-Suomi	0.08	0.07	0.07
	Etelä-Savo	0.02	0.02	0.02
	Pohjois-Savo	0.04	0.04	0.04
	Pohjois-Karjala	0.02	0.02	0.03
	Keski-Suomi	0.02	0.02	0.02
	Etelä-Pohjanmaa	0.03	0.05	0.04
	Pohjanmaa	0.05	0.04	0.04
	Pohjois-Pohjanmaa	0.04	0.04	0.06
	Kainuu	0.01	0.02	0.01
	Lappi	0.02	0.02	0.02
Language	Finnish	0.93	0.95	0.96
	Swedish	0.06	0.04	0.04
	other	0.00	0.01	0.00
Family type	other	0.23	0.28	0.28
	married	0.07	0.08	0.06
	married and children	0.60	0.53	0.54
	not married and children	0.06	0.08	0.07
	single parent	0.04	0.04	0.05
Housing	other	0.21	0.25	0.28
	owns flat	0.41	0.40	0.33
	owns house	0.38	0.35	0.39
	N	16162	371	6253

Table 4: Variable description.

Area type	statistical grouping of municipality where the employing firm is located: urban, semi-urban and rural.
Region	where the employing firm is located. 15 levels: Uusimaa, Varsinais-Suomi, Satakunta, Häme, Pirkanmaa, Kaakkois-Suomi, Etelä-Savo, Pohjois-Savo, Pohjois-Karjala, Keski-Suomi, Etelä-Pohjanmaa, Pohjanmaa, Pohjois-Pohjanmaa, Kainuu, Lappi.
Industry	two-digit classification of the employing firm (Statistics Finland 1988). The following broad classification is used in tables: other (two-digit codes 81–87, 92–99), primary production (01–04), manufacturing consumption products (11–13), wood products (14–15), metal products (07–09, 23–24), machinery, technical products (27–29), other manufacturing (21–22, 29), house construction (35), other construction (36–38), wholesale trade (41–42), other trade (43–48), transportation (51–56), communications (16, 57–58), financial services (61–62, 77), business services (71–76), other services (31–34, 65–67, 88, 91).
Age	in years.
Earnings	nominal annual wage and entrepreneur earnings in a given year or average over two years (in 1000 mk).
Education	primary, high school, vocational, lower tertiary, higher tertiary.
Socio-economic status	blue collar (manual workers), white collar low (lower level employees), white collar high (upper level employees).
Language	Finnish, Swedish, other native language.
Family type	other, married, married couple with children (under 18 years), not married couple with children, single parent.
Housing status	other, own house, own flat.

Table 5: Propensity score estimates from logistic regression (region and occupation coefficients omitted).

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	−3.8560	2.1534	−1.79	0.0734
semi-urban area	−0.0267	0.1761	−0.15	0.8795
rural area	0.2677	0.1679	1.59	0.1109
age	0.0848	0.1217	0.70	0.4860
age^2	−0.0015	0.0017	−0.85	0.3944
high school educ.	−0.1352	0.3154	−0.43	0.6682
vocational educ.	−0.0584	0.1355	−0.43	0.6663
lower tertiary educ.	0.0847	0.2022	0.42	0.6754
higher tertiary educ.	−0.3872	0.2852	−1.36	0.1746
white collar low	−0.2366	0.1678	−1.41	0.1586
white collar high	−0.0961	0.2314	−0.42	0.6778
Swedish language	−0.3306	0.2866	−1.15	0.2486
other language	0.5670	0.6291	0.90	0.3674
married	−0.1147	0.2202	−0.52	0.6023
married and children	−0.2371	0.1379	−1.72	0.0854
not married and children	0.1392	0.2185	0.64	0.5240
single parent	−0.1317	0.2959	−0.45	0.6562
owns flat	0.0648	0.1420	0.46	0.6484
owns house	−0.0769	0.1554	−0.49	0.6206

Table 6: Matching estimates.

	1994	1995	1996	1997	1998	1999
Annual earnings						
Proportion	-0.554	-0.426	-0.384	-0.332	-0.283	-0.245
95% CI	[-0.61,-0.5]	[-0.48,-0.37]	[-0.45,-0.32]	[-0.39,-0.27]	[-0.34,-0.22]	[-0.31,-0.18]
Estimate	-73.323	-58.545	-54.448	-48.848	-43.405	-37.982
S.E.	3.545	4.123	4.638	4.624	4.759	5.032
N controls	937	937	937	937	937	937
Months in employment						
Proportion	-0.503	-0.31	-0.286	-0.215	-0.148	-0.096
95% CI	[-0.55,-0.45]	[-0.36,-0.26]	[-0.34,-0.23]	[-0.27,-0.16]	[-0.2,-0.1]	[-0.15,-0.05]
Estimate	-5.596	-3.341	-3.057	-2.31	-1.579	-1
S.E.	0.286	0.297	0.302	0.285	0.268	0.268
N controls	937	937	937	937	937	937
Log wage						
Estimate	-0.267	-0.23	-0.192	-0.194	-0.2	-0.146
S.E.	0.04	0.036	0.034	0.03	0.031	0.033
95% CI	[-0.35,-0.19]	[-0.3,-0.16]	[-0.26,-0.13]	[-0.25,-0.14]	[-0.26,-0.14]	[-0.21,-0.08]
N controls	594	693	681	700	748	757

Note: Exact matching is done by the 15-quantiles of the mean 1989–90 earnings and propensity score matching with the nearest neighbourhood method is used for the other covariates: area type, region, industry, age, education, socio-economic classification, native language, family type, housing status (observed at the end of 1990). The proportions are calculated from the mean of matched employed group. Robust standard errors are estimated following Abadie & Imbens (2006).

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