Employment retention in the recession: Microeconomic effects of the Short-Time Work Programme in Germany

Stefan Speckesser[&]

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Abstract

The short-time work programme in Germany allows firms in a recession to avoid redundancies due to reduced business activity and to claim short-time work compensation for a working-time reduction, i.e. a fractional unemployment benefit. The payment is often topped up to 100% of the previous net wages. Over the recent recession, the number of workers covered by the programme soared to an unprecedented average of more than one million.

Although the programme is very substantial, little is known about individual or firm effects and long-term outcomes apart from the monitoring of deterring effects on open unemployment. This paper extends the available short-term evidence and reports the results of empirical estimates of some microeconomic effects. It provides long-term programme effects for short-time workers and for firms implementing the scheme during the 1993/94 recession, which had a similar impact on the programme uptake as the most recent recession. In applications of non-parametric matching approaches, a transitory employment effect lasting for three months has been found and significantly lower wages for short-time workers in the long run. The analysis of firms implementing the scheme shows some negative effects on growth and investment activity, but these only affect the companies for a limited period of time.

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[&] Westminster Business School, University of Westminster,
35 Marylebone Road, London, NW1 5LS, Email speckes@wmin.ac.uk

Contents

1 Introduction[1]

By the second quarter of 2009, the Gross Domestic Product in Germany had fallen by almost 7% in real terms compared to the previous year, a decline never experienced after the Second World War. In East Germany, too, where output declined between 1989 and 1991 by 30% due to a fast introduction of the Deutsche Mark in 1990, but grew dynamically until the mid 1990's, an equally severe decline in economic activity has not been seen since the end of communism. The government responded to the recession by deficit spending and temporary adjustment schemes initiating direct demand for the building sector, a generous scrappage programme for the car industry and in particular by relying on the instrument of "short-time work compensation".

Short-time work exists in several countries (see Mosley and Kruppe 1996), but is particularly important in the continental type of welfare states, where there are important incentives for employment retention because of employment protection laws. In Germany, employers can temporarily reduce the working time and the salaries of their employees. A fractional unemployment benefit is then paid instead to compensate the wage reduction. Short-time work needs to be approved by the (usually union-dominated) Workers Councils (*Betriebsräte*) and often topped up by collective agreements to 100% of the net wages.

Short-time work is extensive in recessions covering 1.43 million workers in June 2009, with an estimated employment effect of 435,000 full-time equivalents resulting from a 35% reduction of the working time (Bundesagentur für Arbeit 2009a). Given the importance of the programme, very little research exists apart from descriptions of the incentive design and the deterring effect on unemployment. Some papers points towards the problem of the programme delaying structural change (Eichhorst and Marx 2009), but do not provide empirical evidence.

This paper summarises findings of some microeconomic outcomes of short-time work. Based on data of the German Socio-Economic Panel (GSOEP) for workers covered by the scheme during the recession in 1993/94, empirical estimates of employment and wage effects of short-time work for up to 6 years after the programme are provided. The analysis shows short-lived employment effects and negative and significant wage effects.

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[1] The analysis of individual employment outcomes of short-time work in this study is based on data from the German Socio-Economic Panel (user contract 1681) provided by the German Institute for Economic Research (via Cornell). The effects of short-time work on the performance of firm were studied using the IAB Establishment Panel, Waves 1993 - 2007. Data access was provided via on-site use at the Research Data Centre of the German Federal Employment Agency at the Institute for Employment Research and remote data access (project number FDZ-293).
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A second empirical analysis based on data of the German Establishment Panel Data (IAB Establishment Panel) find evidence of negative effects on business volume and investment for firms implementing the programme.

These findings are of great significance in the context of the welfare reforms of recent years both in Germany and internationally. Most Western economies increased labour market flexibility significantly since the mid 1990's, but – with no instrument similar to short-time work – countries like Britain and the US experienced a rapid response of the labour market to the economic downturn with severe effects on household incomes and spending. However, the evidence of the German short-time work programme suggests that deferring lay-offs delays a necessary reorganisation of production and the reallocation of workers to firms with more favourable prospects in the long-run growing more dynamically and paying higher wages.

This paper summarises the empirical findings of short-time work starting with institutional descriptions and the macroeconomic/political circumstances in Section 2. Section 3 describes the data, showing that the programme is primarily used in manufacturing. Section 4 outlines the empirical evaluation design, which relies on an identification assumption and a semi-parametric estimation method, and shows the effects of the programme. Section 5 concludes.

2 The regulation and reach of short-time work in a recession

2.1 Programme design: compensation for reduced working hours

The programme consists of seasonal, transfer and cyclical short-time work all being regulated in German Social Law Book III (*Sozialgesetzbuch* III).

- Seasonal short-time work is targeted to construction and the agriculture in order to compensate reduced working times due to adverse weather (§175 SGB III).
- Transfer short-time work is used in sectors/companies with a foreseeable permanent decline in the volume of work and usually combined with re-training of the affected workers, support for self-employment or other programmes (§ 216b SGB III).
- Cyclical short-time work compensates for the temporary reduction of working-time due to a significant reduction in "business activity" (§ 169 ff. SGB III).

Cyclical short-time work allows firms to retain staff in an economic downturn that would have otherwise been made redundant, keeping specific human capital and processes knowledge, which otherwise would not be economically viable.

Working time reduction has to be in excess of 10% and for at least one third of the employees of the firm[2]. Management and employee representation (i.e. the workers' council) must approve the application to the local employment agency in order to obtain the compensation for up to six months. The Federal Minister for Labour can extend the maximum duration during recessions, and did so 1993 (to 12 months) and 2009 (to 24 months, see Crimmann and Wiessner 2009).

In 1993/94, short-time work allowance only contributed towards wages while workers and employers continued to pay full contributions to the social insurances. In 2009, social insurance contributions were included in the payment (up to 50% for the first six months, 100% thereafter). Conditional on firm agreements payments are often topped up to 100% of the previous net.

2.2 Welfare reform context

Short-time work – unlike unemployment benefits – does not require a previous minimum duration of employment. In case a lay-off follows the end of the programme, short-time work does not reduce individual entitlements for unemployment benefit, which can still be granted for up to 12 months depending on the previous employment. As a consequence, the use of the programme increases the potential pay-offs of the unemployment insurance for workers at risk of being laid off compared to a direct dismissal.

This particular design of the programme gained importance following recent welfare reforms for the long-term unemployed. Until 2005, most benefit payments for the working age population were related to previous earning levels: Unemployment benefits (paid for up to 12 months) corresponded to 60% or 66% of the previous net salary. For the longer-term unemployed, a means-tested benefit of 53% or 57% of their previous net pay was granted open-ended. Following welfare reforms in 2004, the income-dependent long-term unemployment benefit was replaced by a universal benefit of € 351 per month for all long-term unemployed, in public and by tabloids described as to reduce the expected value of unemployment benefits in case of dismissal relative to benefits aligned to previous earnings.

Short-time work alleviates the consequences of this welfare reform: Equally high as unemployment benefits and like those paid out of social-insurance contributions, the programme does not reduce the maximal duration of individual unemployment benefit. In principle, it could be paid for 2 years at 100% working-time reduction and yet employees being laid off after would retain full entitlements of a one-year unemployment benefit.

[2] The Federal Minster of Labour and Social Affairs temporarily reduced this minimum requirement: Until end 2010, short-time work can also be implemented if a reduction in business activity affects only one worker (see Crimmann/Wiessner 2009).

Short-time workers are expected to be ready for job placements, but the programme does neither enforce a rigorous job seeker regime like unemployment benefits nor does it sanction non-compliance. If granted for long duration and significant working time reduction, it increases the level of unemployment benefits and is likely to affect individual job search behaviour.

Finally, the extension of the maximum duration of short-time work in June 2009 may also have been influenced by general elections to the German Bundestag looming that were held in September 2009. As in 1993/4, the labour market response to an economic downturn would have been maximal at the time of the election had there been no extension of the programme and unemployment remained low until after the elections.

2.3 Microeconomic effects of short-time work

2.3.1 Short-term and long-term production costs

Unemployment rises in recessions because of an increase in the number of workers being laid off. The higher the job destruction rates result from the reorganisation of the production due to changes in the business profitability and costs following cyclical changes in demand as discussed in Davis and Haltiwanger (1999):

- Aggregate shocks intensify reallocation activities, in particular for production that fails to recover the long-term average costs: While short-term revenues may exceed short-term costs for high levels production in boom periods, a decline in production levels may no longer permit satisfactory profitability. Unless a positive option value of retaining a particular production structure exists, the firm will terminate production permanently and the change in the business cycle results in a reallocation of labour and capital employed.
- Recessions also lower the costs factor re-allocation because the opportunity costs of foregone production are lower in a recession than in a boom when production levels and profitability are high. Consequently, reorganisation is more likely in recessions.
- The reduced credit availability in recessions results in investment cutbacks and less employment, in particular for firms experiencing smaller cash flows at the same time. A key instrument in cost reduction in order to restore profitability is the reduction of labour costs.

The primary effect of short-time work is a reduction of labour costs and an increase in short-run profitability. However, on expiration of the subsidy, adjustment and permanent lay-offs follow. Without a sustainable effect on costs, the programme may be implemented only because of an active demand by workers representatives/unions because of the increased pay-off from the unemployment insurance for the expected lay-offs.

However, if an extensive use of short-time work reduces long-term costs, even a particular production that failed to recover the long-term average costs can remain profitable for some time. Following the end of the recession, such firms will resume a profitable production due to increased business volumes, but will require lowering costs in the long run, including labour costs. Consequentially, employment retention in these firms is very likely to result in less dynamic wage growth than in firms without a long-term cost problem.

In contrast, there are potentially positive effects of the reduction of short-term costs facilitating production reorganisation by saving unnecessary costs for lay-offs and re-hiring. If savings on labour costs are substantial, short-time work could also moderate the consequences of investment cut-backs for firms as they alleviate the consequences of smaller cash flows. Such effects can increase long-term profitability for firms participating in the programme.

2.3.2 Reservation wages and job search

In standard job search models (Mortensen and Pissaridis 1999), unemployed jobseekers accept offered vacancies if the wages exceed a level of reservation wages $w \geq w^R$. In the simplest form, these models assume that a jobseeker obtains one job offer in each period, which can be accepted or rejected, and there are substantial search costs. Assuming the individual probability density *f(z,w)* of a job offer with wage *w* given individual characteristics *z*, then the probability of the job seeker to accept the job offer is

$$(1) \qquad p(z,w) = \int_{w^R}^{\infty} p(z,w)dw = p\left(w \geq w^R\right)$$

A job offer is generally taken if the marginal benefits of continuing the job search are believed to no longer recover the marginal costs. A change of the reservation wage affects the probability of acceptance with

$$(2) \qquad \frac{\partial p\left(z,w^R\right)}{\partial w^R} < 0$$

With an increasing duration of the job search, the expected value of receiving a job offer exceeding the reservation wage increases, too. With (2) extending the duration of the job search, it follows that

$$(3) \qquad \frac{\partial E\left[w \mid w \geq w^R\right]}{\partial w^R} > 0$$

Unemployment benefits affect the reservation wage by reducing the costs of continued job search, in particular the opportunity costs of foregone income. Higher unemployment benefits increase effect the reservation wages as they lower the search costs.

In job search models, short-time work reduces search costs for participants only if there are expectations about a layoff following the end of the short-time work. Participants – even when still employed – would then consider short-time work as the signal to start the search process and would benefit from the increased unemployment benefit – compared to the alternative of a direct dismissal without previous short-time work.

It is unlikely that short-time work affects all participants in this way. The majority of workers would be retained in employment in the absence of the programme. But the programme is substantial and some participants clearly gain due to the higher pay-offs of the unemployment insurance raising reservation wages and job search duration compared to a dismissal.

In an alternative view, Buechel and Pannenberg (1992) expect the programme also to affect the job offer arrival rate, which may reduce the duration of job search: On-the-job search of (formally employed) short-time workers may yield more favourable job offers than job search of the unemployed. An appropriate job offer may appear earlier, reducing overall search time and increasing the quality job matches.

2.4 Programme size and costs

Short-time work is highly cyclical with the exception of the transformation of East Germany to the market economy, when it was used to delay dismissals in declining sectors and combined with re-training and other programmes (Figures 2 and 3). In West Germany, short time work covered more than a million employees between February and April 1993 (Figure 2), when output decreased by 1.2% on an annual basis. Throughout 1993, participant numbers remained high with 500,000-600,000. In 1994, participation decreased and unemployment rose by 500,000, remaining high until the end of the 1990's. Short-time workers decreased to less than 100,000 on average. Over the recent recession of 2009, short-time work in West Germany increased rapidly to 632,000 in February 2009, while unemployment increased moderately to 2.3 million in January 2009 and then remained constant.

Monitoring reports publish the employment effect of the programme as the full-time equivalent of the hours compensated without an estimate how many full-time equivalents would have been retained without the programme. The average reduction of the working time of 34% corresponds to 435,000 full-time equivalents in June 2009 (Bundesagentur für Arbeit 2009a). The working-time reduction is similar to that observed in the recession 1993 (Mosley and Kruppe 1996).

Expenditure is very substantial in years of recession (Table 1): In 1993/1994 an annual average of 766,000 individuals participated in West Germany and 181,000 in the East resulting in total expenditure 2,175 million €. Annual spending declined to 300-700 million € after the recession and less than 200 million € just before the most

recent recession. Short-time work increased to an average of 1.4 million individuals in 2009, with expenditure expected to be in excess of 3 billion €[3].

2.5 Earlier analyses of short-time work

Evidence on the microeconomic effect of short-time work in Germany or countries with similar programmes like France or Italy is limited, presumably due to the problem of observing individual participation: Unlike other benefits, the compensation is granted to *firms* and does not translate into a benefit reported in individual social insurance records. In addition, the available microeconomic evidence refers to the situation of the East German transition and not to the cyclical use of the programme in recessions. The following paragraphs provide a brief summary.

Buechel and Pannenberg (1992) compare estimated effects of short-time work and unemployment episodes on occupational biographies in the East German transition. The authors find evidence that a downgrading of employment (i.e. accepting job offers with lower wages) was relatively less widespread among former short-time worker compared to unemployed. When excluding individuals remaining in their firms after the end of short-time work, this difference between short-time workers and unemployed became insignificant. The authors conclude that short-time work is only beneficial to workers with a long-term perspective with a firm.

Calavrezo, Duhautois and Walkowiak (2009) use establishment data for France and estimate the relationship between short-time work uptake by firms and the redundancy behaviour of firms for the period 1996-2004. Controlling for endogeneity in their explanatory variable, selection bias and unobserved heterogeneity, the authors do not find an effect of the programme on the firms' redundancy behaviour any more.

Apart from these two studies with estimations of programme effects, there is no further study analysing the microeconomic impact of short-time work so far. A number of papers discuss the institutional design and incentive effects of the programme (Deeke 2009, Crimman and Wiessner 2009, Eichhorst and Marx 2009, Sell 2009) or calculate employment effects in full-time equivalents (Flechsenhaar 1979, Mosley and Kruppe 1996, Henner Will and Brautzsch 2009). Such evidence is descriptive and does not evaluate the microeconomic effect: In the short, full-time equivalents do not correspond to the net impact of the programme because some employment retention would have also happened in the absence of the programme. In the long, full-time equivalents do not provide an understanding of the likely impact of the programme on important microeconomic variables of firms (long-term costs, production reorganisation).

[3] Based on the 1.51 billion € spent in the first six months of 2009 (Bundesagentur für Arbeit 2009a).

3 Characteristics of individuals and firms

Information on successful grants of short-time work compensation is only recorded for firms. The detailed social insurance data, which have been used in a number of other studies on individual effects of labour market programmes in Germany do not provide individual information on short-time work (see also Deeke and Ohlert 2009

Due to this problem, this paper samples individuals from general household panel data for the entire labour force and provides descriptive comparisons between short-time workers and the remaining labour force. The causal analysis in part four of the paper additionally considers the selectivity of programme participants and provides estimations of the programme impact on individuals.

More information can be found for a firm level analysis: The IAB Establishment Panel allows comparing firms implementing the programme to other firms from 1993 onwards. As for individuals – and more so because very informative covariates – a causal analysis can account for the differences in observable characteristics between firms with and without short-time work to allow for impact estimates.

Linked data of participants and firms implementing the programme are only available for recent years, but require further assumptions on identifying individual participants. As they are only available for the mid-cycle recession of 2002/03 and not for a similar decline in business activity as in 1993 or 2009, these data will not be used for this paper.

3.1 German Socio-Economic Panel: Employment biographies

This paper uses data from the German Socioeconomic Panel (GSOEP), a representative longitudinal study of private households and individuals. It started in 1984 and currently samples roughly 11,000 households and more than 20,000 persons. The many topics include household composition, occupational biographies, employment, earnings, health and satisfaction indicators.[4]

This study uses the sample of 1994 in combination with the longitudinal employment and wage information. There are various advantages of the GSOEP:

- Short-time work was only included as "the dominant employment status" in month-by-month information on individual employment biographies until end of 1993, i.e. the year when it was primarily used as a response to the recession in West Germany.
- The GSOEP allows for a credible estimation of the non-participation outcome for participants because it is rich in a number of covariates, including some firm/workplace information.

[4] Further information on the GSOEP can be found in many synoptic articles published in journal, for example Wagner, Frick and Schupp (2007).

- Although the decline in economic activity was less severe 1993 than 2009, the intervention was similar and allows considering outcomes likely to materialise long after the end of the programme: Instead of using short-time work, firms may decide to lay-off staff, stop renewing fixed-term contracts or reduce working times without additional compensation. While such adjustments alter the employment outcomes of non-participants in the short run, long-term outcomes are more informative. The same long-term effects are important for an analysis of wages because reduced salaries are often topped up to 100% of the net. The analysis of the causal effects should consider the time after such arrangements have expired.

The advantages of GSOEP are being contrasted by the small number of individual short-time workers that can be found. The survey of 1993 covers 12,315 individuals in East and West Germany. Participation can occur in any of the calendar months of 1993 conditional on covariates of 1992 (i.e. the previous wave, N = 11,210.[5] The second restriction to the working-age population (16-65) results in 10,766 persons, of which there are 149 short-time workers. Due to missing values in some of the covariates the total number of participants used in the analysis is 139, while 10,066 individuals of the working age population unaffected by the programme.

In the data selected, short-time work may start in any of the calendar months of 1994: There are 39 persons starting in January 1993, 14 in February, etc.[6] As a consequence, there may be different cyclical or seasonal circumstances affecting the possible employment outcomes due to the related differences in labour demand. Such differences are being controlled for in the causal analysis by adding covariates on the calendar time and by aligning the time axis, so that outcomes of participants and the non-participation outcome correspond to exactly the same calendar time.

GSOEP suffer from very little panel mortality: Out of 139 short-time workers, roughly 110 can be observed at least for 5 years after the beginning of the programme and 100 remain observable for 8 years.[7]

3.2 Characteristics of short-time workers

Due to the particular institutional design involving Workers Councils/unions, the programme was taken up primarily in sectors with strong unionisation: Two thirds of all short-time workers were employed in non-metal manufacturing, the chemical industry and basic materials, which correspond to only 10% of total non-participants. Note that the sector of activity is related to the 1992 variable, which may be missing for persons not employed then (Table 2). When excluding individuals without valid in-

5 Table A2 in the Technical Appendix shows the details on the selection of participants.

6 An illustration of the case selection can be found in table A2 in the Technical Appendix.

7 Figure A1 in Technical Appendix shows how many individuals are available the month-by-month when conditioning on the beginning of the short-time work represented by month 1.

formation in the sector variable, the non-metal manufacturing sector accounted for 18% of total employment and for 71% of all short-time workers. 33% of the non-participants work private sector services, but only 6% of the short-time workers. 54% of all employment is service sector work compared to a share of 10% among short-time workers.

There are slightly more short-time workers with secondary or other school degrees than non-participants, and there are clear differences in the required levels of qualification for the workplace: Excluding individuals without employment in 1992, the share working at lower levels of qualification is higher amongst short time workers (39% with introduction/on-the-job training compared to 28% of the other workers). Both groups show roughly the same share of employees with completed vocational training. Degree holders, including those from a technical college, are underrepresented among short-time workers (6%) compared to others (16%).

5% of the short-time workers work less than 20 hours weekly, compared to 12% of all others. 18% of the short-time workers report a standard working time of more than 40 hours weekly under normal conditions, twice as many as the group not affected by short-time work. Age and gender of short-time workers compared to the rest of the working age population point towards a predominantly male group of participants, in the primary age group between 36 and 55 years of age.

Short-time work is primarily used in sectors with well-established industrial relations. Differences in the standard working time between both groups indicate that the group not affected by short-time work generally works smaller hours and possibly buffers to some extent cyclical variations through alternative arrangements or adjustments in the agreed hours.

3.3 German Establishment Panel Data: Longitudinal data for firms

The firm effects of short-time work are estimated on the basis of data from the German Establishment Panel, which is an annual panel survey of representative German firms carried out by the Institute for Employment Research at Nuremberg (IAB Establishment Panel). This panel started in 1993 with 4,300 establishments in West Germany and in recent years had sample sizes increased of around 16,000 in all branches and of all sizes surveyed in East and West Germany. Data cover a wide range of firm characteristics, including the overall business development, investment activity and expectations with a particular focus on firm employment policy. It is primarily used to inform the public employment policies and in particular the job placement activity of the Federal Employment Agency, indicating changes in firm labour demand and qualifications.[8]

[8] Data are sensitive and confidential and can only be used following an approved data request that the research complies with data protection regulations. Following an initial on-site use at the data ware-

This study used the first survey if the IAB Establishment Panel (1993), sampling 4,265 firms. This initial number of firms is reduced due to some missing value in observable characteristics, in particular due to the non-response in one of the dependent variables (business volume/turnover in €, -96 firms), information about the technical state of the firm (-129), missing values in information about the total wage sum (-726) and missing information of the existence of fixed-term employment in the firm. Some additional cases are excluded due to missing values in further covariates, resulting in 2,905 firm included in the study. While numerous firms were lost, the descriptive statistics of the final sample is very similar with respect to the characteristics of the initial sample comparing covariates that are non-missing[9].

3.4 Firm characteristics

An analysis of the characteristics of firms implementing the programme repeats what has been found for individual participants. Table 3 shows that 86% of all firms implementing short-time work belong to the materials (i.e. primary the chemical industry) and manufacturing sectors. Manufacturing firms represent roughly 20% of all non-participating firms, but 60% of all the firms implementing the programme. The share of service sector firms, mining and agriculture using short-time work is below 8%, but represent two thirds of all other firms.[10]

Companies implementing short-time work are either capital corporations (26%) or owned firms (74%) and virtually no firms among this group are publicly limited or other legal forms. Compared to this, there are 17% of all firms without short-time work publicly limited and 6% other corporations. There exists a workers' council in 90% of all firms with short-time work, compared to 54% among all other firms. 44% of the firms implementing the programme have more than 1,000 employees, while this share is 16% among the other firms. 54% of all firms without short-time work employ less than 100 individuals, while the share among firms implementing it is 15%. Short-time work is implemented in firms with a higher share of staff being subject to social insurance payments and firms showing generally declining levels of staff.

The share of white collar workers is lower among firms with short-time work (28% compared to 46%) corresponding to the selectivity found at the level of individuals. There are some informative covariates on profitability and expectations of

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house of the Federal Employment Agency, revised programmes were processed remotely by researchers at IAB. Descriptions of the data are available primarily in German, although increasingly used for English publications. A concise overview of the data can be found in Bellmann (2007).

[9] Table A2 of the Technical Appendix shows the mean values of the most important characteristics before and after the selection of firms included in this study. A description of further variables is available on request.

[10] Note that some of the cells of Table 3 show "n.r." entries to represent that such values are not reported as firm numbers remain below 30, which is the lower threshold of data descriptions transferred from the IAB.

the development of the business volume. These figures included in Table 3 indicate a use of the programmes by firms with generally lower profitability and a negative development of business activities in the past.

As for the individual level data description, a microeconomic effect of the programme can not be estimated without considering the differences in such observable characteristics, in particular on experienced and expected profitability and business development and the characteristics of the workers affected. At the same time, firms have functional equivalents as they can lay-off staff or let fixed-term contracts expire. Given similar characteristics, the non-programme outcome of short-time work can be estimated based on the group of firms not taking it up.

4 Microeconomic effects of short-time work

4.1 Empirical strategy

The most important question is how much the programme stabilises individual employment and earnings, which are the chief objective of the programme. In addition, the impact on the firms implementing the programme is estimated based on IAB Establishment Panel data.

Simple comparisons between participating and non-participating individuals or firms do not provide credible estimates of the programme effects because of differences in observed characteristics. If allocation was random, there would be no such differences and the non-participating groups would be a good comparison group. However, with a programme in principle accessible to all firms/individuals, firms in a more difficult situation will implement the programme while relatively better performing firms will not.

In the absence of random allocation, the measure of comparison representing what would have happened in the absence of the programme can only be taken from the non-participating firms and individuals. This can be justified if covariates are sufficiently informative to balance the differences in important observable characteristics at the time of the programme beginning. Due to the rich sets of covariates of the GSOEP and IAB Establishment Panel, such an empirical strategy is feasible: Based on non-participants, the outcome of short-time workers had they not participated can be estimated. For firms, too, informative covariates allow estimating the comparison outcome because – even in the presence of a substantial subsidy – numerous firms do not implement the programme and decide for alternative adjustment under similar conditions.

4.2 Potential outcome approach

While individuals and firms affected by short-time work can be easily identified, the hypothetical situation of what would have happened to the exactly these workers/firms had the programme not been implemented cannot be observed. In order to

estimate a causal effect, this hypothetical situation would correspond to the correct non-programme outcome for either firms or individuals.

Like all causal studies applying such a potential outcome approach (Rubin 1974), the problem of estimating causal effects lies in the non-observation of this non-participation outcome. As short-time workers cannot be compared to other workers due to their apparent dissimilarities in covariates, considering non-participants as the non-participation outcome is misleading as the recession is likely to affect non-participants differently. A simple before-after comparison is equally misleading, because the outcome from before the recession does not represent a credible non-participants outcome in the recession. As a result, any research on outcomes of the programme requires assumptions about what can be identified if the situation of non-intervention is not observable.

For many programmes of active labour market policy participants come from unemployed job seekers, so that non-participants among the unemployed at the same calendar time can to some extent help identifying the non-participation outcomes of participants (e.g. Sianesi 2004), however requiring additional correction for selection bias in order credibly estimate the non-participation outcomes of participants.

For short-time work aiming at the continuation of the employment programme, the likely group representing the non-participating outcome of the treated must come from the remaining group of employees. The programme implementation is based on firm characteristics, and conditioning on firms' characteristics is particularly important to estimate a credible non-participation outcome for short-time workers.

4.3 Conditional independence and observable characteristics

The microeconomic effect of the programme for participants or firms can only be identified by comparing the results of a programme (YT) for the participating individuals or firms after the programme $(D=1)$ with the hypothetical situation of the same individuals/firms if they had been no programme $(YC|D=1)$, represented as

(4) $$E\{YT|D=1\}-E\{YC|D=1\}.$$

Since $E\{YC|D=1\}$ cannot be observed, it has to be estimated based on groups not affected by the programme as long as characteristics of these groups are comparable (Conditional Independence Assumption). More precisely, non-participation outcomes for individuals or firms are the same as the outcome of the non-participating individuals/firms conditional on characteristics X :

(5) $$E\{YC|D=1,X\}=E\{YC|D=0,X\}$$

Based on this assumption, the programme effect for the group of the participating individuals or for the firms implementing the programme can be estimated as:

$$(6) \qquad \frac{1}{N_1} \sum_{i \in \{D=1\}} \left(YT_i - \sum_{j \in \{D=0\}} w_{N_0,N_1}(i,j) YC_j \right)$$

where $j \in \{D=0\}$ represents employees unaffected by the programme or firms not implementing short-time work. A weight $w(i,j)$ is attached to all individual observations *j* of the non-programme samples with regards to the particular characteristics of an individual participant in the programme or the firm implementing it. The weighted average of the non-participation group represents the non-participation outcome of this particular individual or firm *i*, which can be subtracted from the observed outcome *YT*. The mean value of these differences for total sample of participants N_1 shows the microeconomic effects of the programme for *i* individuals or firms.

Non-programme outcomes are estimated based on kernel matching, specifying (6) as

$$(7) \qquad w_{N_0,N_1}(i,j) = \frac{K_{ij}}{\sum_{j \in \{D=0\}} K_{ij}}$$

where $K_{ij} = K\left(\left(X_j - X_i \right) / h \right)$ is a weighting function that down-weights distant observations X_j from X_i and h is a bandwidth parameter (Heckman et al. 1998: 1024).

Potential outcomes are estimated semi-parametrically at i individual/firm on the basis of all non-programme observations available at the same calendar time j based on a weighted average of all non-treated individuals $j \in \{D=0\}$ using local linear regressions.

4.4 Implementation details

The observable characteristics X used in matching should ideally summarise all factors relevant for a particular individual's or firm's participation on the programme. However, this might result in a "curse-of-dimensionality" and it may be difficult to identify exact matches for one particular individual or firm with respect to a high-dimensional vector of X.

Therefore, this paper follows the result of Rosenbaum and Rubin (1983) that the CIA in equation (5) also holds with respect to the probability of participation (propensity score) $P(X)$ as a function of the observable characteristics X, i.e.

$$(8) \qquad E\{YC | D=1, P(X)\} = E\{YC | D=0, P(X)\}.$$

On the one hand, this result allows matching using the one-dimensional probability as the weighting scheme applied to equation (7) and reduces the problem of finding ade-

quate matches. On the other hand, the propensity score is itself estimated, and the sampling variability of the estimation needs to be considered in the inference statistics. This paper obtains robust inference using a bootstrap method re-sampling at the level of individual observations.[11]

Propensity scores are estimated in probit models explaining individual or firm participation in the programme in 1993. For individual short-time workers, this model includes the most important characteristics of the firm (sector, size of the firm and required qualification at the workplace) and the individual (working times, East/West/foreigner, age, gender and years of work experiences) from the 1992 data of the GSOEP. The probit model chosen resulted from benchmarking numerous different models were estimated with regards to their explanatory power. The specification chosen can be found in Table A4 in the Technical Appendix to this paper.

The propensity score estimations for firm data additionally include many more indicators of the legal form of the firm, the presence of a workers' council, the particular skill distribution of the employees working in the firm and business volume and investment variables. The models also control for information about the business development over the current business year, the expected future development and related HR requirements (overstaffed, lack of skilled labour, etc.). The estimations for firms are much more informative in explaining the take up of the programme by firms compared to the model of the propensity score at the individual level (Table A5, Technical Appendix).

Matching is only successful if there are non-programme observations that can represent the participating individuals and firms (Smith and Todd, 2005). Local participants and firms have been removed from the analysis if there were no similar non-participating firms and the propensity score was outside the range of non-participating firms (lack of support). This affected only three firms and none of the individual short-time workers.[12]

A particularly crucial parameter for the non-parametric estimation of the conditional mean function in (7) is the bandwidth. This paper follows a weighted cross-validation applying a leave-one-out method considering the locality of participating firms or individuals (see Galdo, Smith and Black 2009). This "nearest neighbour" bandwidth selection minimises the mean squared error of the matching estimator by choosing non-treated observations that mimic local observations amongst participating firms or individuals with regards to individual employment outcomes or business volume per head. The procedure works as follows:

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[11] While Abadie and Imbens (2006) show that the bootstrap is generally not valid for nearest neighbour matching, a local linear estimator as applied in this analysis provides a consistent estimator of the sampling variability of the estimator, see also Bergemann, Fitzenberger and Speckesser (2009).

[12] The support of participants/non-participants and firms implementing the programme and the other firms is shown in figures A2 and A3 of the Technical Appendix.

1. Nearest neighbours of local treated individual and firms are identified among the comparison samples. These can be used more than once if they represent local programme group observations well.
2. The bandwidth selection minimises the sum of squared prediction errors, leaving this nearest neighbour in the non-programme group out:

$$\frac{1}{n_1}\sum_{i=1}^{n_1}\left[Y^0_{nn(i)} - \hat{m}_{-nn(i)}\left(\rho_{nn(i)}, h\right)\right]^2$$

where n_1 corresponds to the number of participating individuals or firms, $Y^0_{nn(i)}$ is the outcome of the nearest neighbour for the local participant or firm in the non-participation samples and $\hat{m}_{-nn(i)}\left(\rho_{nn(i)}, h\right)$ being the local prediction of the non-parametric regression in a sample of non-treated individuals excluding this nearest neighbour $nn(i)$. $\rho_{nn(i)}$ is a weighting function and h the bandwidth parameter of the particular functional implemented here.

As a test for the quality of matching, a standard t-test is implemented for the observable characteristics resulting from the local linear regressions as these are used for outcomes. If the matching works effectively, there should be statistical difference between the characteristics of individuals/firms and the predicted non-programme characteristics resulting from the matching. The results of the tests are shown in Tables A6 and A7 of the Technical Appendix. For the matching of a non-participation outcome to individual short-time workers, the balancing properties show no statistical differences. There are some unbalanced dimensions in the sample of firm data, but most of the individual dimensions have been balanced out perfectly.

4.5 Estimated programme effects

4.5.1 Impact on individual employment and wages

When implementing the matching estimator outlined in (6), the different calendar months of the beginning of short-time work in 1993 are considered by aligning the time axis according to the local person's starting date of the programme.

1. The first month of the intervention can be any of the months of 1993. Since the estimated effects may consist of programme effects as well as the differences in calendar time, the estimation of (6) controls the starting time of short-time work within a regression framework.
2. The timing of participation also affects the choice of the non-participants used in the matching. For participation starting in a particular calendar month, all observed non-participants in this particular calendar month are used in order to estimate the non-participation outcomes. Accordingly, the outcome of the second month after the beginning of short-time work is estimated based on all non-participants observed in the following calendar month. This procedure is

repeated for all 72 months following the beginning of the programme. The post-participation period therefore varies according to the calendar time of the beginning of the programme.

With the flexible alignment of the time axis according to the beginning of the programme, participants and matched non-participation outcomes should not be affected by calendar time effects other than effects resulting from the different beginning dates of short-time work, which are then controlled for.

In addition to the months following the intervention, there is also an estimation of non-participation outcomes for the months before the programme and a systematic evaluation of any differences before the programme beginning. This pre-programme test (see Heckman and Hotz 1989) indicates that matching was successful and there are no further systematic differences between participants and estimated non-participation outcomes in the period before the programme, which have to be controlled for.

Figure 5 shows the employment rate of short-time workers and the estimated non-participation outcome for the period 12 months before and 72 months after the beginning of the programme. The employment rate of 98.5% of the participants in the year before the participation is very similar to the matched non-participation outcome. Although being slightly lower in the graph, differences in employment rates before participation are not significant.

After the beginning of the programme, the employment rates of participants are higher than the matched non-participation outcomes. The differences are 3% points in the first and second month following the beginning of short-time work. After month 3, the difference of 2% points is insignificant.

While Figure 5 describes the outcome for all participants in West and East Germany, Figures 6 and 7 summarise only the effect of short-time work in West Germany. Figure 6 shows the average difference between short-time workers and the matched control outcome for all participants in West Germany. This difference is significant only for the first three months after the beginning of the programme, and a later effect of the programme cannot be found.

Since the majority of the participants are male, a separate analysis of only male workers in West Germany in Figure 7 shows that the effect found for the total group of short-time workers in West Germany is mainly driven by this particular group of participants. The employment effects shown in Figures 6 and 7 are almost identical. A further breakdown (available upon request) of the results by gender and geographical location (East/West Germany) did not reveal significant effects for any of the other subgroups, but these are also very small groups of participants.

Effects of short time work on individual wages are summarised in Table 9. The differences are small and insignificant in the period before the programme. Following the participation in short-time work, the programme group shows consistently smaller average wages in all years until 2000 than the matched non-participation outcome. This gap is increasing for the later years 1998-2000 as compared to the years immediately after the beginning of short-time work.

4.5.2 Impact on business volume and investment

The analysis of firm data evaluates the impact of short-time work on total business volume and total investment as well as business volume and investment per employee. Business volume corresponds to turnover in 1,000 € per financial year for all firms included in the study – firms from banking and insurance, organisations and the state with alternative definitions of business volume have been removed from the sample as there are no firms in these sectors implementing the programme in 1993. Investments correspond to total investment in the financial year in the establishment in 1,000 €. Both values are also related to total employment of the firm as of June.

Table 5 shows the results of the analysis of firm outcomes of the programme[13]. While there are no significant differences in business volumes in 1993 – the year the programme was implemented – the difference in total business volume remains insignificant in the years until 1998. When analysing business volume per head, there is no difference between firms implementing the programme and matched control outcomes in 1993, but in the following years. However, when implementing bootstrapped standard errors, the results are only significant at the 10% level and also only for the year 1995, two years following the implementation of the programme.

Firms using the programme then show roughly € 80,000 lower revenues per head. The gap narrows for later years and is not significantly different from zero until the end of the period of observation.

There is a similarly weak negative effect on investment: While total investment of firms on the programme is similar to the estimated non-programme outcome, the total investment per head differs for the year 1995, two years after the programme. Between € 5,000 and € 6,000 are being invested less in firms using the programme compared to the estimated non-programme outcomes, again this is only significant at the 10% level if the estimates implement a bootstrap. The effect on investment disappears for later years and is no longer significant in the years following 1995.

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[13] It must be noted that these results are preliminary and will change slightly for the final version of the paper in that the standard errors will then be based on bootstrapping as described previously (programmes have not yet run).

5 Conclusion

Short-time work is an extensive programme in Germany. It allows firms in a recession to retain their staff and to claim short-time work compensation for the working-time reduction. While the programme is seen as to ease the consequences of the recession and to retain employment levels up until the economy is growing again, there is hardly any research about economic outcomes of short-time work, apart from contributions analysing the incentive structure of the programme and its deterring effect on open unemployment.

This paper present some findings on some microeconomic outcomes of short-time work for individual workers based on the German Socio-Economic Panel (GSOEP) for workers covered by the scheme during the recession in 1993/94. Employment and wage effects of short-time work for up to 6 years after the beginning of

short-time work show that the employment effect lasts for only three months. Following this, the employment rates between short-time workers and the matched control outcomes are virtually the same.

However, there is some evidence of an increasing difference between the wages of short-time workers and comparable other workers, with much lower wages for short-time workers in the long run.

It is likely that the negative wage effect arises from an alteration of the long-term average costs of production through the programme: With short-time work achieving a significant cost reduction, the firm may continue a profitable production in the short run and after the end of the recession. Such a production would have not been retained in the absence of the programme. However, these firms may need to continue lowering costs in the long run, including labour costs, and may therefore not increase wages as much as firms reorganising production. It is also more likely that such firms grow slower in the long.

The analysis of firm data reveals ambiguous programme effects on firms: While the total number of employment, the sum of business volume and investment are not significantly lower due to the implementation of the programme, there are some significant differences in turnover and investment per employee. The firms implementing the programme seems to grow less dynamically and invest significantly lower per employee compared to the estimated non-programme outcome – all this considering the selectivity of the programme, which was controlled for in matching models. However, these negative programme effects do no longer prove statistically significant for most years between 1994 and 1999 when estimating inference statistics based on bootstrapping.

The conclusion is the implementation of short-time work adverse affects the long-term prospects of the firm compared to alternative mechanism chosen in firms in

similar circumstances (e.g. lay-offs or termination of temporary employment) – which however may have employment relations helping to opt for alternative adjustments.

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Appendix

Table 1 Average annual short-time workers and total spending on short-time work

	West		East		Total	
	Annual average participants (‘000)	Expenditure in Mill. €	Annual average participants (‘000)	Expenditure in Mill. €	Annual average participants (‘000)	Expenditure in Mill. €
1992	283	485.73	370	1,356.46	653	1,842.18
1993	767	1,705.16	181	469.88	948	2,175.04
1994	275	818.07	97	255.65	372	1,073.71
1995	128	309.84	71	216.79	199	526.63
1996	206	527.65	71	222.41	277	750.07
1997	133	395.74	49	138.56	183	534.30
1998	81	246.95	34	88.96	115	335.92
1999	92	253.60	27	60.84	119	314.44
2000	62	272.01	24	76.18	86	348.19
2001	96	339.00	27	76.00	123	415.00
2002	166	501.00	41	103.00	207	604.00
2003	161	585.00	35	102.00	195	687.00
2004	122	589.00	29	83.00	151	672.00
2005	101	559.00	25	76.00	126	635.00
2006	32	n.a.	8	n.a.	41	199.00
2007	31	n.a.	8	n.a.	39	181.00
2008	37	n.a.	9	n.a.	46	131.00
2009*	n.a.	n.a.	n.a.	n.a.	1,040	1,151.00

* Spending only January-June 2009, forecast of annual average.
Source: Annual reports of Bundesagentur für Arbeit 1997-2009)

Table 2 Comparing short-time workers and the remaining labour force

		Participants in short-time work	Remaining labour force	Excluding unemployed workforce and missing values	
Sector of industry	No information, unemployed or out of labour force	7%	43%	Participants in short-time work	Remaining labour force
	Agriculture	1%	1%	1%	2%
	Mining	1%	0%	1%	1%
	Non-metal manufacturing	66%	10%	71%	18%
	Metal and electric manufacturing	11%	7%	12%	13%
	Construction and utilities	5%	7%	5%	12%
	Private sector services	6%	19%	6%	33%
	Public sector services, organisations, education and others	3%	12%	4%	21%
Required qualification of employ-ment	No training or N/A at interview	12%	43%		
	Intro. To Job	17%	8%	20%	14%
	On-The-Job Training	17%	8%	19%	14%
	Courses	5%	4%	5%	7%
	Vocational Training	44%	28%	50%	49%
	Technical School	2%	3%	2%	5%
	College	3%	6%	4%	11%
Working time	Not in work, no information	8%	38%		
	Weekly working time 0-20 hours	1%	4%	1%	6%
	Weekly working time 20-30 hours	3%	4%	4%	6%
	Weekly working time 30-40 hours	71%	32%	77%	51%
	Weekly working time 40 hours +	17%	23%	18%	37%
Level of qualification	Secondary School Degree	42%	39%		
	Intermediate School Degree	27%	29%		
	Technical School Degree	4%	3%		
	Upper Secondary Degree	3%	13%		
	Other Degree	15%	8%		
	Dropout, No School Degree	8%	8%		
	No School Degree Yet	0%	1%		
Age/gender	Male	73%	49%		
	Female	27%	51%		
	16-25 Years of age	16%	22%		
	26-35 Years of age	30%	25%		
	36-45 Years of age	27%	21%		
	46-55 Years of age	23%	19%		
	56-65 Years of age	4%	14%		
N		149	10627		

Source: GSOEP, Calendar wave K (1994), Characteristics Wave I (1992), own calculations

Table 3 Firms using short-time work compared to remaining firms

	Firms not implementing short-time work	Firms implementing short-time work
Sectoral distribution		
Agriculture	2%	0%
Mining	2%	n.r.
Materials	9%	27%
Manufacturing	20%	59%
Building	7%	6%
Trade	19%	n.r.
Credit/Insurance	6%	0%
Other service	26%	n.r.
Organisation	3%	0%
State	6%	0%
Legal form (%)		
Owned	67%	74%
capital corporation	10%	26%
Public corporation	17%	n.r.
Other corporation	6%	n.r.
Industrial relations		
Works council (%)	54%	90%
Employment		
Persons employed in June 1993		
less than 100	54%	15%
More than 100, less than 250	13%	15%
More than 250, less than 500	8%	12%
More than 500, less than 1000	8%	15%
More than 1000, less than 2000	11%	26%
More than 2000	5%	18%
Employment subject to social insurance		
% share in June 1992	86%	97%
% share in June 1993	85%	98%
Employment growth 1992-1993	1%	-9%
Occupational status of employees (%)		
Apprentices 1993	5%	4%
Un- and semi-skilled blue collar 1993	29%	37%
Skilled blue collar 1993	20%	31%
Share of white collar/civil servant/proprietors 1993	46%	28%
Fixed term employment in firm 1993	44%	57%
Total employment		
Jun-92	521	1928
Jun-93	516	1764
Labour turnover in first half of 1993		
New entries % of June total	5%	1%
Leaving staff % of June total	6%	7%
Vacancies % of June total	2%	0%
Business volume and investment		
Business volume 1992 in nominal 1000 EUR	436019	237907
Total investment 1992 in nominal 1000 EUR	4694	27552
Expected profitability expectations in business year 1993		
very good	3%	n.r.
good	21%	5%
fair	30%	17%
satisfying	16%	28%
poor	9%	48%
unknown	21%	n.r.

Table 3 continued

Business development		
Development of business volume 1992-93 (expected)		
unknown	3%	n.r.
minus 10 or more	10%	39%
one digit negative	15%	30%
zero	33%	16%
one digit positive	21%	n.r.
plus 10 or more	17%	11%
Development of business volume 1991-92 (experienced)		
unknown	0%	0%
minus 10 or more	5%	18%
one digit negative	9%	24%
zero	27%	22%
one digit positive	25%	13%
plus 10 or more	33%	23%
Development of business volume 1993-94 (expected)		
unknown	25%	21%
minus 10 or more	4%	7%
one digit negative	9%	12%
zero	33%	38%
one digit positive	17%	10%
plus 10 or more	13%	12%
Total number of firms	2,452	453

Source: IAB Establishment Panel, Wave 1993, own calculations

Table 4 Individual wage effects of short-time work

	Participants in short-time work	Matched Non- Par-ticipation outcome	Difference	N observed
1991	3,265.80	3,216.94	48.85	128
1992	3,376.79	3,407.02	-30.23	130
1993	3,457.57	3,606.16	-148.59*	134
1994	3,617.05	3,822.15	-205.10*	118
1995	3,850.53	4,014.50	-163.97*	102
1996	3,977.58	4,125.73	-148.15*	102
1997	4,212.90	4,266.45	-53.55	90
1998	4,112.35	4,288.41	-176.06*	88
1999	4,188.28	4,488.25	-299.97*	81
2000	4,158.57	4,609.69	-451.13*	76

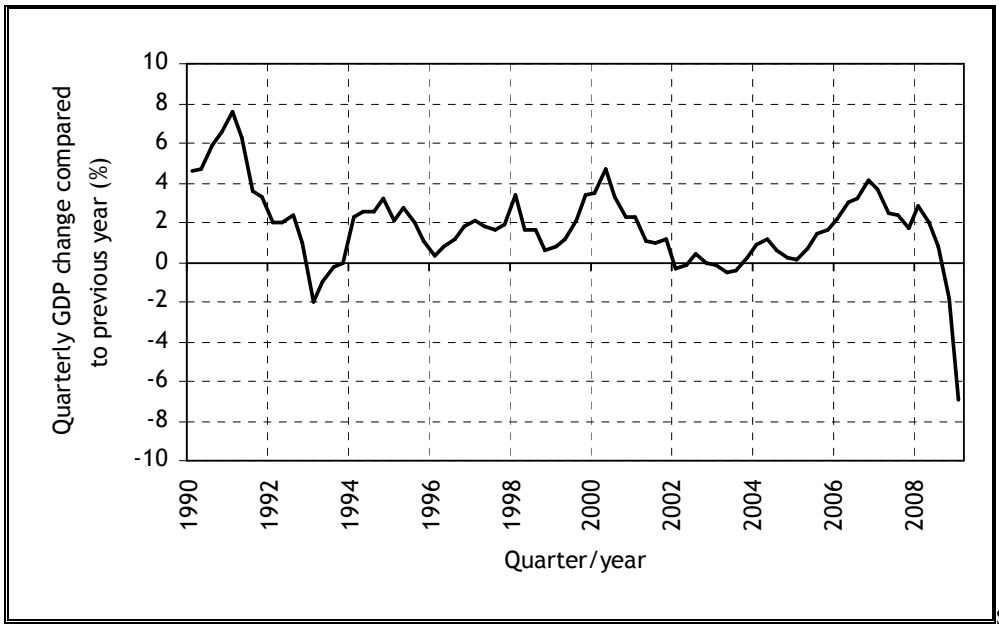
Source: GSOEP, Waves I-R (1992-2000), own calculations

Table 5 Outcomes of short-time work on business indicators

	Year	Firm implementing short-time work	Matched control out-come	Difference	T-stat	T-stat (BS)	N
Total business vol-ume in 1,000 €	1993	205,238	177,921	27,966	0.78		290
	1994	217,945	188,623	30,714	0.68		247
	1995	229,522	229,864	1,259	0.02		223
	1996	239,061	207,963	30,727	0.54		196
	1997	265,540	205,684	59,606	0.94		175
	1998	265,488	220,848	45,295	0.64		155
Total business vol-ume per employee in 1,000 €	1993	167	171	-4	-0.15	-0.09	290
	1994	133	169	-36	-6.35	-0.92	247
	1995	143	224	-80	-12.72	-1.82	223
	1996	149	186	-37	-5.39	-1.00	196
	1997	154	204	-50	-6.86	-1.22	175
	1998	166	204	-36	-3.79	-0.89	155
Total investment in 1,000 €	1993	15,355	13,359	1,829	0.52		263
	1994	13,399	12,637	658	0.21		223
	1995	12,465	13,943	-1,511	-0.45		222
	1996	9,241	9,257	-9	0.00		198
	1997	9,448	9,351	91	0.05		177
	1998	13,909	12,190	1,747	0.36		157
Total investment per employee in 1,000 €	1993	7	11	-5	-7.90	-1.23	263
	1994	7	9	-3	-4.86	-0.80	223
	1995	6	12	-6	-11.82	-1.71	222
	1996	5	7	-2	-3.85	-0.37	198
	1997	6	11	-5	-10.98	-1.35	177
	1998	7	8	-1	-1.37	-0.32	157

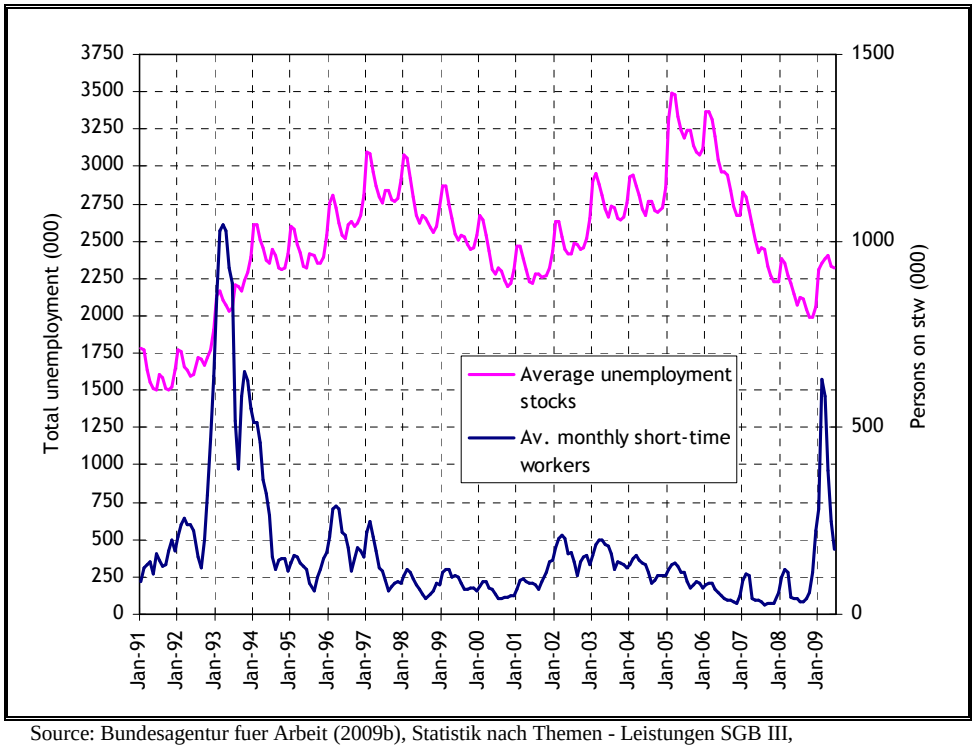
Source: IAB Establishment Panel, Waves 1993-1999, own calculations

Figure 1 Annual change of GDP in %, quarterly data



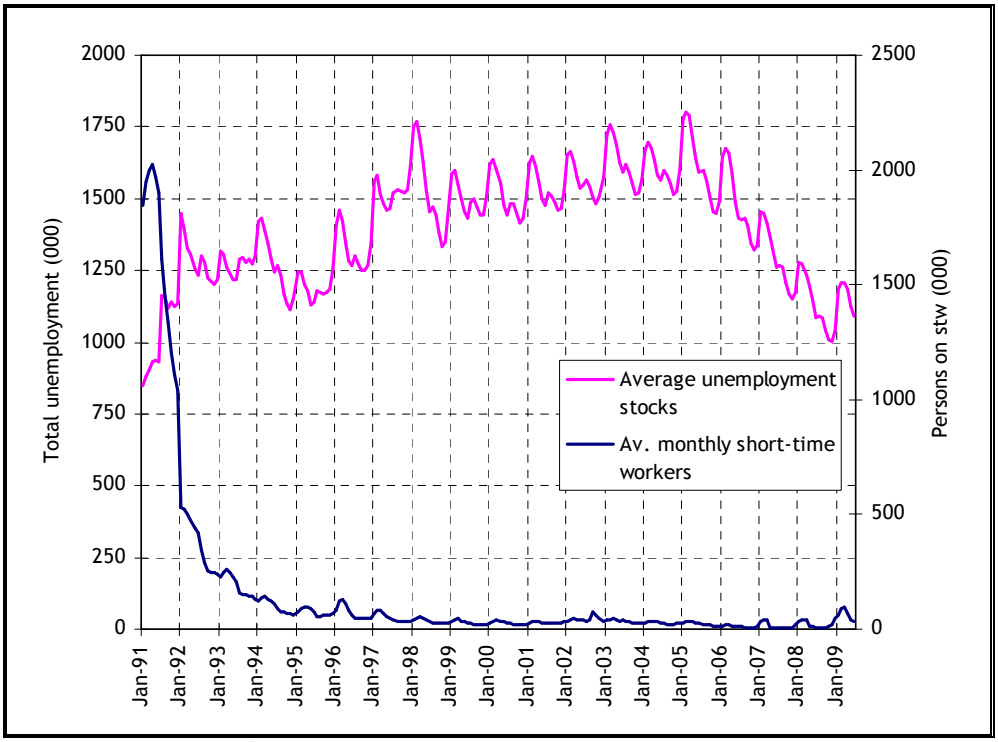
Source: Bundesbank (2009), Bruttoinlandsprodukt und Bruttowertschöpfung ausgewählter Wirtschaftsbereiche (http://www.bundesbank.de/statistik/statistik_zeitreihen.php?lang=de&open=&func=list&tr=www_s311_b40201), accessed 30 July 2009

Figure 2 Short-time workers and unemployment, West Germany



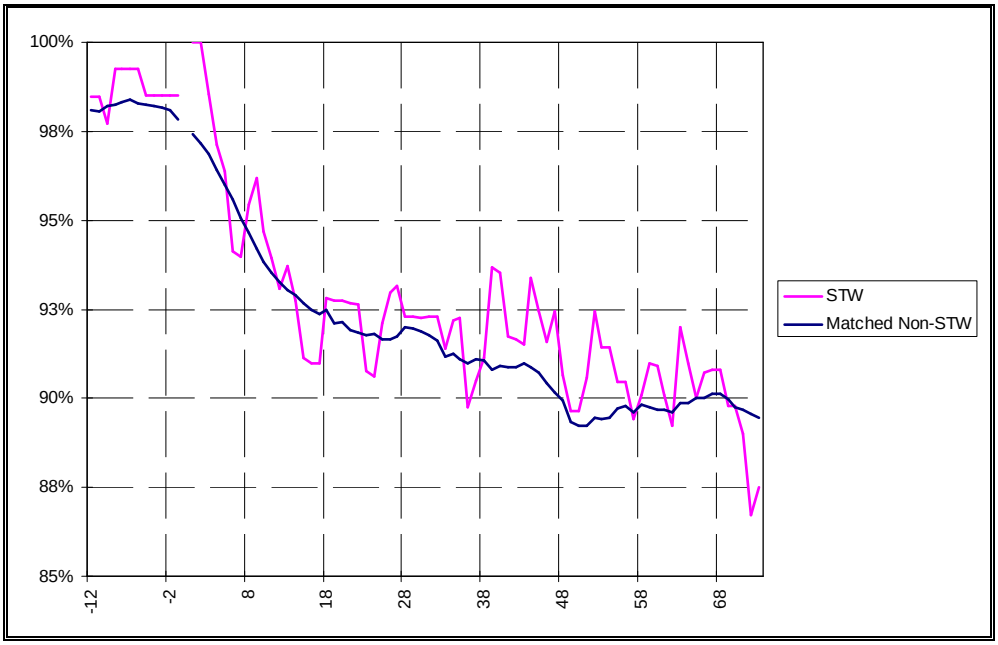
Source: Bundesagentur fuer Arbeit (2009b), Statistik nach Themen - Leistungen SGB III, (http://www.pub.arbeitsagentur.de/hst/services/statistik/detail/s.html?call=l), accessed 30 July 2009

Figure 3 Short-time workers and unemployment, East Germany



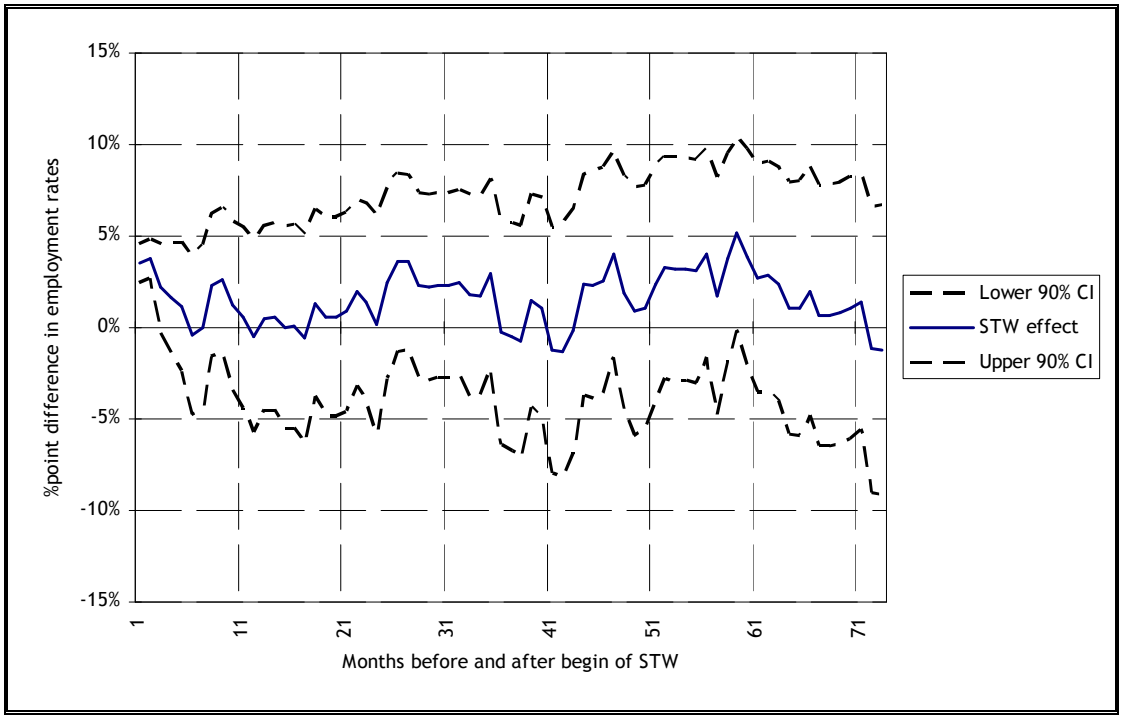
Source: Bundesagentur fuer Arbeit (2009b), Statistik nach Themen - Leistungen SGB III, (http://www.pub.arbeitsagentur.de/hst/services/statistik/detail/s.html?call=l), accessed 30 July 2009

Figure 4: Employment rates STW and matched non-STW compared



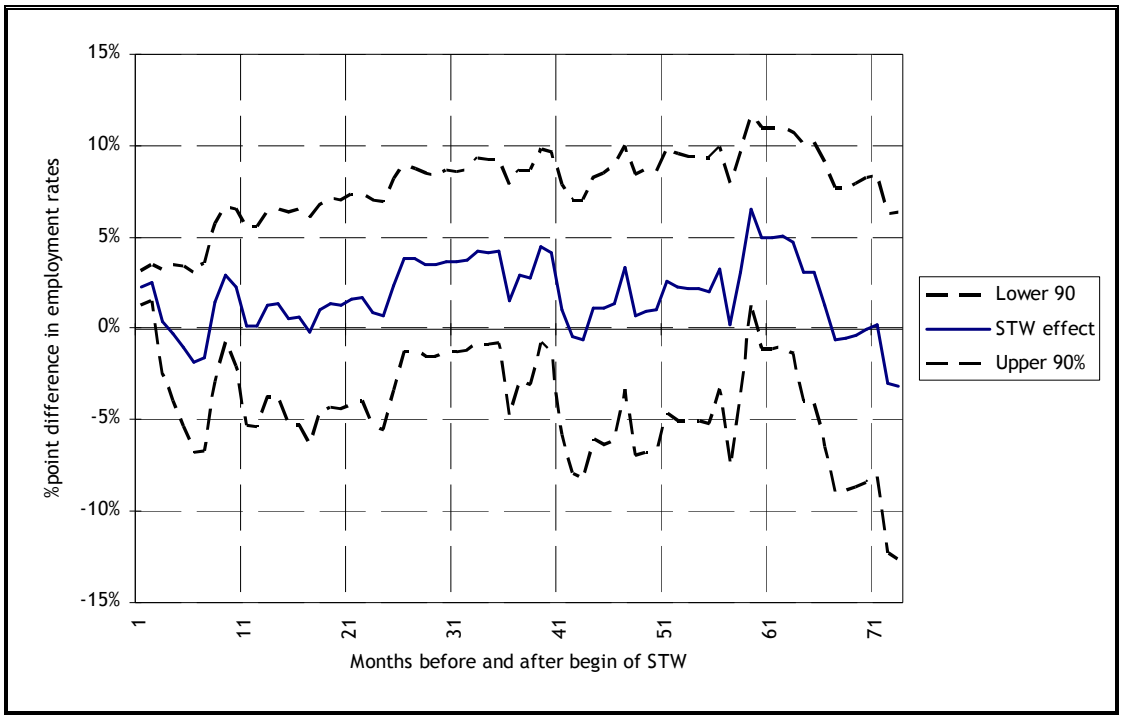
Source: GSOEP, Calendar waves K-R (1994-2000), Waves I/J/K (1992-94), own calculations

Figure 5: Differences in employment rates (STW and matched non-STW), West Germany



Source: GSOEP, Calendar waves K-R (1994-2000), Waves I/J/K (1992-94), own calculations

Figure 6: Differences in employment rates (STW and matched non-STW), West Germany, male participants



Source: GSOEP, Calendar waves K-R (1994-2000), Waves I/J/K (1992-94), own calculations

Technical Appendix (web link)

Table A1 Basic selection rules

Stages of selection	N
Individuals participating in 1994 survey with valid calendar information for 1993	12,315
Participants in 1992 wave (as required for variables on labour market status and demographics)	11,210
In Working age population (16-65 years)	10,776
Thereof: participants	149
After exclusion of observations with missing values in observable characteristics required	10,066
Thereof: participants	139

Source: GSOEP, Waves I/J/K (1992-1994), own calculations

Table A2 Selection rules and sample means for firm data

	Original sample		Sample following selection	
	N	Mean	N	Mean
Employment				
June 1992	4261	768.45	2905	740.55
June 1993	4265	741.11	2905	710.68
Employment subject to social insurance				
June 1992	4265	715.36	2905	704.77
June 1993	4264	685.90	2905	674.56
Occupational status of employees (%)				
Apprentices	4260	30.10	2905	29.99
Unskilled blue collar	4249	158.40	2905	157.78
Semi-skilled blue collar	4252	52.32	2905	48.83
Skilled blue collar	4252	173.58	2905	173.99
White collar	4254	315.24	2905	296.80
Civil servants	4255	2.77	2905	2.51
Proprietors	4255	0.56	2905	0.62
Business volume and investment				
Business volume in DM	2805	785000000	2157	789000000
Inputs as % of total business volume	1585	38.51	1287	38.69
Total investment in DM	2579	25900000	1983	23700000
Development of business volume (excluding +/-0)				
1992-1993	2758	12.76	2030	12.84
1991-1992	2467	12.70	1799	12.52
1990-1991	1515	10.21	1119	10.10

Source: IAB Establishment Panel, Wave 1993, own calculations

Table A3 Rolling observation window of long-term outcomes[14]

	N	Employment status observed until	…relative to begin of STW	Last wage observed	…relative to begin of STW
No STW	10627				
STW Jan-93	39	Jan-99			
Feb-93	14	Feb-99			
Mar-93	17	Mar-99			
Apr-93	17	Apr-99	+73 months	2000	approx. +7 years
May-93	17	May-99			
Jun-93	4	Jun-99			
Jul-93	9	Jul-99			
Aug-93	3	Aug-99			
Sep-93	6	Sep-99			
Oct-93	7	Oct-99			
Nov-93	8	Nov-99			
Dec-93	8	Dec-99			
Total	10776				

Source: GSOEP, Wave K (1994, calendar 1993), own calculations

[14] Short-time work is allowed to start in any of the calendar months of 1994, which can be seen in Table A2: There are 39 persons starting short-time work in January 1993, 14 in February, and so forth. Hence, participation takes place in a time window of 12 months, so that outcomes can no longer be clearly related to a particular observation window matching real time. When considering long-term outcomes of employment for a period of eight years following the programme, these may be related to a period from January 1993 to December 1999 for one individual, but from June 1993 to May 1999 for another, etc.

Table A4 Propensity score estimation for individual-level analysis

	Coef.	Std. Err.	z	P>|z|
Firm characteristics				
Sectoral distribution (base category: Non-metal manufacturing)				
Agriculture	-0.050572	0.389469	-0.129849	0.897
Mining	0.139401	0.439247	0.317363	0.751
Metal and electric manufacturing	0.850364	0.104583	8.13099	0
Construction and utilities	-0.18527	0.19144	-0.967774	0.333
Private sector services	-0.26574	0.146682	-1.81167	0.07
Public sector services, organisations, education and others.	-0.274153	0.182247	-1.5043	0.133
Firm size (base category: 201-2000)				
Not applicable or no information	-1.09595	0.276548	-3.96296	0
Less than 5	-0.839345	0.338234	-2.48155	0.013
6 - 200	-0.227252	0.096376	-2.35798	0.018
More than 2000	-0.108365	0.102382	-1.05844	
Education required at workplace (base category: On-The-Job Training)				
No training or out of job at interview	-0.06847	0.161907	-0.422894	0.672
Intro. To Job	0.116634	0.143302	0.813907	0.416
Courses	0.053942	0.194372	0.27752	0.781
Vocational Training	0.031389	0.122876	0.255453	0.798
Technical School	-0.149843	0.271756	-0.551386	0.581
College	-0.485498	0.23466	-2.06895	0.039
Individual characteristics				
Gender (1 = female)	-0.073638	0.093893	-0.784277	0.433
Age	-0.0062269	0.0092481	-0.673313	0.501
Years of work experience	0.0087682	0.0092473	0.948195	0.343
Working time (base category: 30 hours +)				
Not in work, no information	0.175383	0.17261	1.01607	0.31
Weekly working time 0-20 hours	-0.32629	0.361749	-0.901979	0.367
Weekly working time 20-30 hours	-0.029319	0.230435	-0.127232	0.899
Sample (base category: West)				
East	-0.0027099	0.100957	-0.026843	0.979
Foreigner West	0.127639	0.12057	1.05863	0.29
C	-2.02546	0.260026	-7.78946	0
Number of obs				10066
LR chi2(33)				321.55
Prob > chi2				0
Pseudo R2				0.06

Source: GSOEP, Waves I/J/K (1992-1994), own calculations

Table A5 Propensity score estimation for firm-level analysis

	Coef.	Std. Err.	z	P>|z|
Sectoral distribution (base category: other)				
Materials	1.24	0.44	2.83	0.01
Manufacturing	1.25	0.43	2.90	0.00
Building	1.17	0.45	2.59	0.01
Trade	0.34	0.46	0.74	0.46
Organisation	0.73	0.46	1.58	0.12
Legal form (base category: Private)				
Public corporation	-1.38	0.52	-2.63	0.01
Industrial relations (Base category: No employee representation)				
Workers council	0.44	0.15	2.82	0.01
Persons employed in June 1993 (Base category: More than 500, less than 1000)				
less than 100	-0.62	0.19	-3.22	0.00
More than 100, less than 250	-0.47	0.17	-2.79	0.01
More than 250, less than 500	-0.10	0.18	-0.58	0.56
More than 1000, less than 2000	0.03	0.17	0.19	0.85
More than 2000	0.34	0.21	1.67	0.10
Employment subject to social insurance				
% share in June 1993	0.36	0.44	0.82	0.41
Occupational status of employees (%)				
Apprentices 1993	-0.62	0.19	-3.22	0.00
Un- and semi-skilled blue collar 1993	-0.47	0.17	-2.79	0.01
Skilled blue collar 1993	-0.10	0.18	-0.58	0.56
Share of white collar/civil servant/proprietors 1993	0.03	0.17	0.19	0.85
Flexibilisation				
Fixed term employment in firm 1993	-0.24	0.11	-2.33	0.02
Freelance/temps in firm 1993	-0.66	0.48	-1.39	0.17
Share of part-time workers	-0.06	0.10	-0.58	0.56
Current HR requirements				
Overstaffed	0.27	0.10	2.71	0.01
Problems of attracting skilled employees	-0.22	0.10	-2.20	0.03
Business volume and investment				
Business volume 1992 in nominal 1000 EUR	0.00	0.00	-0.43	0.67
Total investment 1992 in nominal 1000 EUR	0.00	0.00	0.43	0.66
Profitability expectations in business year 1993 (Base category: satisfying)				
very good	-0.45	0.38	-1.20	0.23
good	-0.30	0.15	-1.92	0.05
fair	0.24	0.12	1.96	0.05
poor	0.60	0.12	4.81	0.00
Development of business volume 1992-93 (expected, base category: zero))				
unknown	-0.22	0.37	-0.61	0.54
minus 10 or more	0.69	0.13	5.33	0.00
one digit negative	0.16	0.13	1.22	0.22
one digit positive	-0.24	0.19	-1.26	0.21
plus 10 or more	0.20	0.15	1.36	0.18
Constant	250.23	153.73	1.63	0.10
Number of obs				1762.00
LR chi2(33)				710.16
Prob > chi2				0.00
Pseudo R2				0.40

Source: IAB Establishment Panel, Wave 1993, own calculations

Table A6 Balancing properties individual data

	Participant on short-time work	Matched control outcome	Difference	T-stat	N
Firm characteristics					
Sectoral distribution (base category: Non-metal manufacturing)					
Agriculture	0.01	0.02	-0.01	-0.58	139
Mining	0.01	0.02	-0.01	-0.58	139
Non-metal manufacturing	0.12	0.05	0.07	1.88	139
Metal and electric manufacturing	0.70	0.70	0.00	0.00	139
Construction and utilities	0.03	0.00	0.03	1.75	139
Private sector services	0.07	0.08	-0.01	-0.25	139
Public sector services, organisations, education and others.	0.02	0.03	-0.02	-0.82	139
Firm size					
Not applicable or no information	0.02	0.02	0.00	0.00	139
Less than 5	0.01	0.00	0.01	1.00	139
6 - 200	0.27	0.35	-0.08	-1.27	139
201-2000	0.40	0.38	0.02	0.27	139
More than 2000	0.31	0.25	0.05	0.87	139
Education required at workplace					
No training or out of job at interview	0.11	0.08	0.03	0.89	139
Intro. To Job	0.18	0.24	-0.06	-1.12	139
On-The-Job Training	0.18	0.20	-0.03	-0.50	139
Courses	0.04	0.03	0.01	0.34	139
Vocational Training	0.43	0.36	0.07	1.06	139
Technical School	0.03	0.05	-0.03	-1.02	139
College	0.03	0.03	0.00	0.00	139
Individual characteristics					
Gender (1 = female)					
Age					
Work experience in years	16.99	17.64	-0.65	-0.46	139
West	0.47	0.36	0.10	1.59	139
Working time (base category: 30 hours +)					
Not in work, no information	0.08	0.07	0.01	0.25	139
Weekly working time 0-20 hours	0.01	0.01	0.00	0.00	139
Weekly working time 20-30 hours	0.03	0.01	0.02	1.01	139
30-40 hours	0.00	0.00	0.00	.	139
40 hours +	0.89	0.92	-0.03	-0.66	139
East	0.31	0.36	-0.04	-0.69	139
Foreigner West	0.22	0.28	-0.06	-1.05	139

Source: GSOEP, Waves I/J/K (1992-1994), own calculations

Table A7 Balancing properties firm data

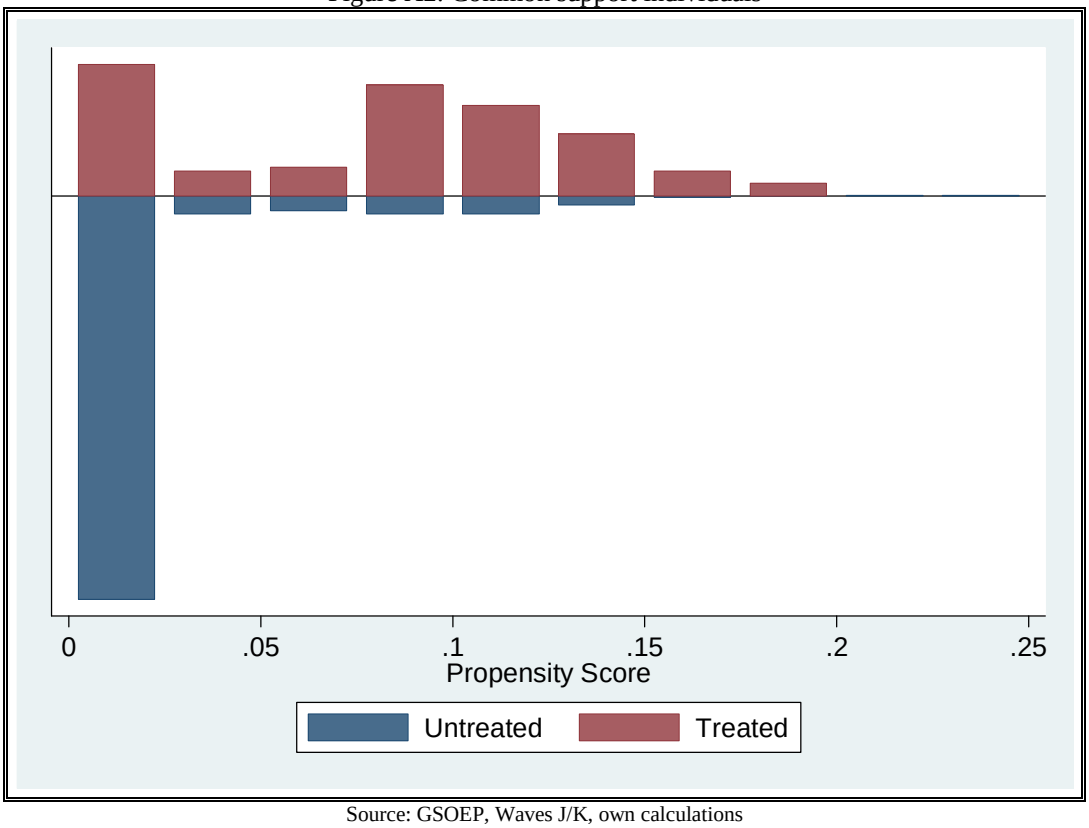
	Firm imple-menting short-time work	Matched control outcome	Difference	T-stat	N
Sectoral distribution					
Mining 1993	n.r.	0.00	0.00	0.90	353
Materials 1993	0.29	0.33	-0.03	-1.38	353
Manufacturing 1993	0.57	0.54	0.03	1.01	353
Building 1993	0.06	0.05	0.01	0.91	353
Trade 1993	n.r.	0.04	-0.01	-1.40	353
Other service 1993	n.r.	0.04	0.00	0.25	353
Legal form (%)					
Owned	0.75	0.77	-0.02	-0.77	353
capital corporation	0.24	0.22	0.02	0.91	353
Public corporation	n.r.	0.01	0.00	-0.90	353
Other corporation	0.00	0.00	0.00	.	353
Industrial relations					
Workers council	0.89	0.89	0.00	-0.08	353
Persons employed in June 1993					
less than 100	0.15	0.15	0.00	-0.01	353
More than 100, less than 250	0.14	0.14	0.00	0.17	353
More than 250, less than 500	0.14	0.18	-0.05	-2.43	353
More than 500, less than 1000	0.16	0.19	-0.03	-1.63	353
More than 1000, less than 2000	0.25	0.20	0.05	1.98	353
More than 2000	0.16	0.13	0.03	1.58	353
Employment subject to social insurance					
% share in June 1993	0.97	0.97	0.00	0.93	353
Occupational status of employees (%)					
Apprentices 1993	0.04	0.04	0.00	0.66	353
Un- and semi-skilled blue collar 1993	0.36	0.37	-0.01	-0.43	353
Skilled blue collar 1993	0.31	0.29	0.01	1.31	353
Share of white collar/civil servant/proprietors 1993	0.29	0.30	-0.01	-0.97	353
Flexibilisation					
Fixed term employment in firm 1993	0.57	0.56	0.01	0.44	353
Freelance/temps in firm 1993	1.00	1.00	0.00	.	353
Share of part-time workers	0.04	0.05	-0.01	-1.80	353
Current HR requirements					
Overstaffed	0.61	0.64	-0.03	-1.09	353
Problems of attracting skilled employees	0.21	0.19	0.02	1.10	353
Business volume and investment					
Business volume 1992 in nominal 1000 EUR	239100.50	165977.90	73122.58	1.67	353
Total investment 1992 in nominal 1000 EUR	29873.63	13812.47	16061.16	0.94	353
Profitability expectations in business year 1993					
very good	n.r.	0.01	0.00	-0.50	353
good	0.06	0.06	0.00	0.18	353
fair	0.18	0.14	0.05	2.26	353
satisfying	0.25	0.26	-0.01	-0.39	353
poor	0.48	0.51	-0.03	-1.42	353
unknown	n.r.	0.02	-0.01	-0.97	353
Development of business volume 1992-93 (expected)					
unknown	n.r.	0.01	0.00	-0.72	353
minus 10 or more	0.40	0.38	0.02	1.01	353
one digit negative	0.29	0.30	-0.01	-0.47	353
zero	0.17	0.17	-0.01	-0.29	353
one digit positive	n.r.	0.03	0.00	0.40	353
plus 10 or more	0.10	0.11	-0.01	-0.44	353

Source: IAB Establishment Panel, Wave 1993, own calculations

Figure A1: Observations for long-term outcomes[15]

Source: GSOEP, Calendar waves K-R (1994-2000), Waves I/J/K (1992-94), own calculations

Figure A2: Common support individuals



Source: GSOEP, Waves J/K, own calculations

15 Figure A1 shows the available short-time workers before and after the intervention. Starting with a sample of 139 for both East and West Germany, around 110 can be observed at least for 5 years after the beginning of short-time work. Around 100 observations remain for the very long-term outcomes 8 years after short-time work.

Figure A3: Common support firms

(to be included following choice of optimal bandwidth)

Source: IAB Establishment Panel, Wave 1993, own calculations