DISCUSSION PAPER SERIES

IZA

IZA DP No. 6652

More Hours, More Jobs? The Employment Effects of Longer Working Hours

Martyn Andrews
Hans-Dieter Gerner
Thorsten Schank
Richard Upward

June 2012

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

More Hours, More Jobs? The Employment Effects of Longer Working Hours

Martyn Andrews
University of Manchester

Hans-Dieter Gerner
Institute for Employment Research (IAB)

Thorsten Schank
Johannes Gutenberg University of Mainz and IZA

Richard Upward
University of Nottingham

Discussion Paper No. 6652
June 2012

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 6652
June 2012

ABSTRACT

More Hours, More Jobs? The Employment Effects of Longer Working Hours*

Increases in standard hours have been a contentious policy issue in Germany. Whilst this might directly lead to a substitution of workers by hours, there may also be a positive employment effect due to reduced costs. Moreover, the response of firms differs between firms which offer overtime and those which do not. For a panel of German plants (2001-2006), we analyse the effect of increased standard hours on employment. Using difference-in-difference methods we find that, consistent with theory, overtime plants showed a significant positive employment response, whilst for standard-time plants there is no difference at all between plants which increased standard hours and those which did not.

JEL Classification: C23, J23, J81

Keywords: working time, employment, plant-level data, difference-in-differences

Corresponding author:

Thorsten Schank
Johannes Gutenberg-Universität Mainz
Jakob-Welder-Weg 4
55128 Mainz
Germany
E-mail: schank@uni-mainz.de

* The authors thank the IAB for financial support of Hans-Dieter Gerner during his PhD. We also thank Claus Schnabel for comments and suggestions. We also thank participants at: (a) workshops at the IAB; (b) seminars at the Universities of Erlangen-Nürnberg, Regensburg, and York; (c) the Work and Pensions Annual Labour Conference at the University of Nottingham, July 2009; and (d) Tagung der Deutschen Arbeitsgemeinschaft Statistik (DAGStat), 2010, University of Dortmund. The data were kindly supplied by the Institut für Arbeitsmarkt- und Berufsforschung, Nürnberg.

1 Introduction

Worksharing was an important and contentious policy issue in Europe in the 1980s and 1990s. The policy stems from the belief that a reduction in working time would increase employment, based on the idea that a fixed amount of worker–hours can be spread amongst a larger number of workers. The basic policy tool was to change 'standard hours', the stipulated weekly working time excluding overtime.[1] In this paper we revisit this issue, but instead of examining worksharing, we estimate the effect of the *increase* in standard hours which occurred in some firms in Germany in the early 2000s. If worksharing works, then, by symmetry, an increase in standard hours should reduce employment.

The canonical labour demand model suggests that a reduction in normal hours increases the marginal cost of employment, since a larger fraction of the costs per employee has to be compensated at a premium overtime rate, but leaves the marginal cost of an hour unchanged. Hence, there is a substitution from employment towards hours. On the other hand, many workers do not work overtime. If firms choose weekly hours at exactly the standard workweek, a cut in standard hours will necessarily increase employment if output is fixed. However, labour costs may increase for standard-time workers due to the existence of quasi-fixed costs, while firms offering overtime will pay extra overtime premia. In either case, if the firm's output is not fixed, the increase in costs leads to lower output and a reduction in employee-hours. Thus, at best, the employment effect of reducing standard hours is ambiguous and even then only for firms which do not offer overtime. At worst, employment will fall. Moreover, if, in addition, the policy seeks to keep workers' weekly income unchanged, the reduction in standard hours necessarily means a rise in the hourly wage rate (so called wage compensation), and therefore an additional fall in labour demand that makes the overall impact even less favourable to worksharing.

There is only a small microeconometric literature examining whether the policy of worksharing does actually increase employment. Crepon & Kramarz (2002) provide the first worker-level evidence, and look at the effects of the mandatory reduction of the working week, from 40 hours to 39, in France in 1981, and find that employment losses vary between two and four percent. In France, workers'

[1] Synonyms for standard hours are normal working time, standard working time, standard hours, normal hours and the standard workweek.

weekly income was guaranteed, and so it is possible that the resulting increase in the hourly wage (wage compensation) led to job losses. Later, the French socialist coalition government cut the length of the workweek from 39 to 35 hours for large firms in 2000, and for small firms in 2002. Using a difference-in-difference estimator, Estevão & Sá (2008) found that the policy slightly decreased usual weekly hours, raised hourly wages (with ambiguous effects on total income), raised job turnover, and did not boost employment. A third study that uses worker-level data is Raposo & van Ours (2010), who examine the effects of the reduction of the standard workweek from 44 hours to 40 in Portugal in 1966. They find wage compensation in that the hourly wage rate increased so that monthly earnings were unaffected. However, they find that workers are less likely to separate from their employer.

Hunt (1999) uses German industry level data between 1985 and 1994, and concludes that cuts in standard hours may have led to falls in employment, with the caveat that that wage compensation is also an issue in her study. Andrews, Schank & Simmons (2005) use the same German establishment-level panel data as in this paper, for an earlier time period, and find no evidence of positive employment effects in general. Using the same data, Schank (2006) finds almost full wage compensation for Germany.

One study where wage compensation is not an issue is Skuterud (2007), who analyses the effects of a reduction in the statutory working week in Quebec between 1997 and 2000, from 44 hours to 40. Skuterud finds that the policy failed to raise employment at either the provincial level or within industries where hours of work were affected the most. In short, there is no evidence for positive effects of worksharing in any of these studies.

At the turn of the century western Germany had one of the shortest standard work-weeks in the OECD.[2] The economic environment changed in the early 2000s, when some firms reversed recent trends and increased standard hours. Well-publicised examples included Siemens, Daimler-Chrysler and Volkswagen. The European Economic Advisory Group (2005, p.56) (EEAG) note that these increases in standard weekly hours were not accompanied by pay compensation, and were introduced in order to reduce labour costs in response to increased competitive pressures; such increases were agreed at company rather than sectoral level. What

[2]See Carley (2004). Average collectively agreed normal weekly hours in western Germany in 2003 was 37.4, compared to an EU-15 average of 38.1.

is less clear is the subsequent impact on employment and output. The EEAG note that views in the public debate "diverge fundamentally" between those who believe that increased working hours will increase employment (e.g. Sinn 2003) and those who believe the opposite.

We estimate the effect of this increase in standard hours on employment, using a sample of German plants from 2001–2006, using both standard regression and propensity score matching in a difference-in-differences framework. We compare those plants which increased standard hours between 2002 and 2004 (the treatment group) with plants for whom standard hours did not change between 2001 and 2006 (the control group). The data we use is an annual panel of plants collected by the *Institut für Arbeitsmarkt- und Berufsforschung* (the IAB Establishment Panel) which covers 1% of all plants in Germany.

To interpret our results as a causal impact of standard hours on employment, two key identifying assumptions are required. The first is that German plants adjust employment and overtime but not standard hours in response to short-term demand shocks. Instead, plants change standard hours only in response to permanent demand shocks. We argue that this is the case here. Changing standard hours is relatively infrequent in these data — the weighted proportion of plants who did not change standard hours at all in the six years of our sample period is 0.78.[3] The second assumption is that employment trends would have been the same in both treated and control plants in the absence of treatment. To test this assumption we compare employment trends in treated and control plants before increases in standard hours occur.

The standard theory of the firm suggests that the response of plants to a change in standard hours will differ between those which offer overtime and those that do not. We therefore stratify the sample according to the use of overtime. Finally, we note that in some cases plants which increased standard hours offered "employment guarantees" to their existing workforce. It is therefore useful to consider both the hiring and separation response to changes in standard hours, since firms which offered employment guarantees, and which wished to reduce employment, could still reduce hiring.

We find, consistent with theory, that plants which offered overtime increased employment after standard hours were increased, while plants which did not offer

[3]This implies that the probability of not changing standard hours in any given year is 0.95.

overtime had no employment effect. These effects are measured relative to a control group of similar plants which did not increase standard hours. Because increasing standard hours does not reduce employment, our results provide another piece of evidence that a worksharing policy will not increase employment.

In Section 2, we provide more details on the institutional background. This suggests that, in Section 3, the appropriate theoretical framework is the standard theory of the firm, embedded in a union-firm bargaining model for unionised firms. In Section 4 we describe the data, in Section 5 we discuss our difference-in-difference methodology, and in Section 6 we discuss our results. Section 7 concludes.

2 Institutional Background

Figure 1 illustrates the decline in standard hours in Germany in the 1980s and 1990s. It refers to standard hours covered by bargaining agreements, collected by the Tarifregister of the Bundesministerium für Wirtschaft und Arbeit.[4] Standard hours have remained roughly constant since 1998 in western Germany and since 2002 in eastern Germany. Because only about half of all plants in Germany are covered by bargaining agreements, Figure 2 uses the IAB Establishment Panel to show the trend in standard hours for all plants from 1996 onwards, stratified by bargaining agreement and plant location.[5] 50% of western German plants are involved in bargaining agreements; of these 45% occur at the industry level and very few (5%) at the firm level.[6] For eastern Germany, only 29% of plants are involved in bargaining agreements: 21% occur at the industry level and 8% at the firm level. Thus, for a substantial proportion of plants in Germany, standard hours are effectively set by the firm. The workweek is about one hour longer in western Germany and about 30 minutes longer in eastern Germany when standard hours are not determined by collected bargaining.

The key features of the increase in working time in the early 2000s are as follows.[7] It is argued that agreements to lengthen standard hours were an attempt

[4]Received upon personnel request from the German Federal Ministry of Labour and Social Affairs (BMAS).

[5]In this section, we shall refer to both firms and plants, because the IAB Establishment Panel is not a firm-level dataset. In Section 3 we refer only to firms.

[6]All these sample averages are weighted by employment and refer to 2004.

[7]See Section 2 of The European Economic Advisory Group (2005) for fuller details.

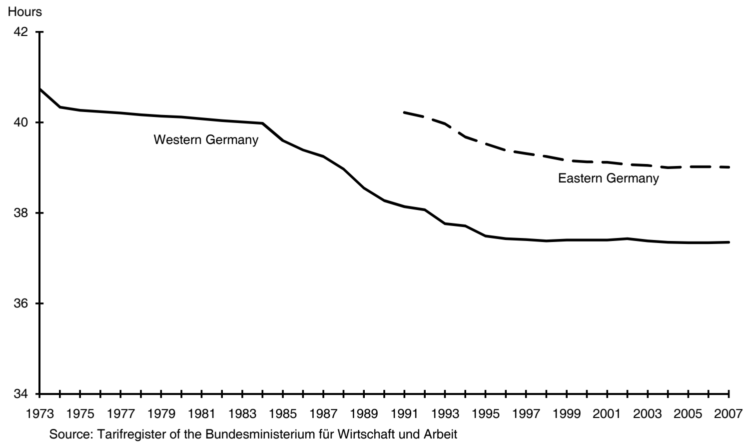


Figure 1: Standard hours determined by collective bargaining

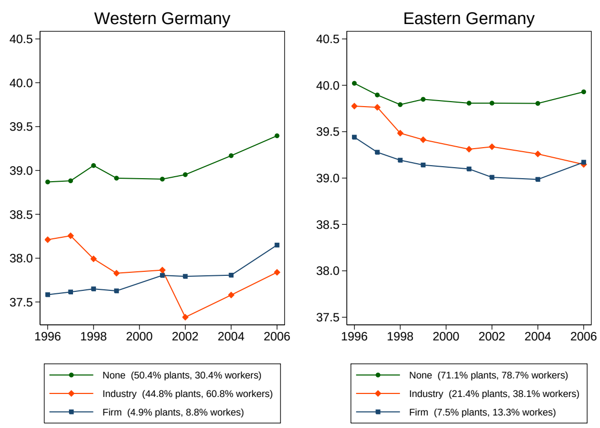


Figure 2: Standard hours at the plant level, by bargaining agreement, weighted (Source: IAB-Establishment Panel)

to reduce labour costs in the face of increased competition, and came about at the company rather than sectoral level.[8] In addition to Siemens, Daimler-Chrysler, and Volkswagen, other well-publicised agreements were negotiated at Deutsche Bahn, MAN, Thomas Cook, Lufthansa, and many other small and medium sized firms. In addition, state governments increased working time for civil servants in Bavaria and Hessen.In some notable cases — for example Siemens, Daimler-Chrysler, and Volkswagen — some form of employment guarantee from the employer was agreed.

For those plants involved in sectoral bargaining, so-called 'opening clauses' in bargaining agreements allowed plants to deviate from the standard hours originally negotiated. In the 2005 Wave of the IAB Establishment Panel, 13% of plants had such opening clauses, and, of these, 52% actually made use of them. Opening clauses were used mostly for making standard hours adjustments. Furthermore, many of the agreements made did not involve any compensation in weekly pay, thereby lowering pay per hour.

The employment guarantees mentioned above are a reason why employment reductions in response to increased standard hours might not be observed in the short run. However, employment guarantees to existing employees do not prevent firms lowering employment, since firms are still able to reduce hiring (Abowd, Corbel & Kramarz 1999). For this reason, it is useful to decompose employment changes into separate hiring and separation responses. We are able to link the plant-level data to worker-level data from the employment statistics register of the German Federal Employment Agency (BA), which allows us to decompose a change in employment into hires and separations.

3 Theoretical considerations

We start with the neoclassical demand for hours model to illustrate whether or not an increase in standard hours leads to lower employment. We extend such a model of labour demand by modelling the firm's choice of overtime regime endogenously. This draws heavily on Leslie (1984), Hart (1987), Calmfors & Hoel (1988) as well as Andrews et al. (2005) and references within. We then discuss what happens when we extend the model to a union-firm bargaining framework.

[8]According to The European Economic Advisory Group (p.56), employees were "exposed to credible threats from employers that production sites will be closed down and jobs outsourced abroad".

3.1 The theory of the firm

Consider a firm free to choose both the level of employment, N, and weekly hours, H, per employee. All workers work the same number of hours. The firm's cost function is given by

$$C = N(wH + z) \qquad \text{if } H \leq \bar{H}; \tag{1}$$

$$C = N[w\bar{H} + \gamma w(H - \bar{H}) + z] \qquad \text{if } H > \bar{H}. \tag{2}$$

Weekly hours may be greater than the standard workweek, in which case overtime hours $V \equiv H - \bar{H}$ are strictly positive. Each hour up to $\bar{H}$ is paid w; overtime hours are paid at premium rate γw, where $\gamma > 1$. z represents quasi-fixed labour costs, in other words those fringe costs which are independent of hours worked, imputed on a per-period basis (typically they represent hiring and firing costs). The isocost contour in (N, H) space comprises two convex segments which form a kink at $H = \bar{H}$, for example $A_0B_0D_0$ in Figure 3. The firm's strictly concave revenue function is denoted by $\theta R(H, N)$, where θ is a demand shock.

The profit-maximising firm faces different costs for both segments. More precisely, the firm chooses H and N to maximise $\theta R(H, N) - C$, where C is given by (1) if $H \leq \bar{H}$ and (2) if $H > \bar{H}$. We assume that the firm does not offer its employees hours of work lower than the standard workweek, because short-time working is not observed very often in the sample period (part-time working is usually seen as a supply-side phenomenon). In general, the profit-maximising solutions are written:

$$\left.\begin{array}{l} N = N_1(w/\theta, \bar{H}, z/\theta) \\ H = \bar{H} \end{array}\right\} \qquad \text{if } H = \bar{H} \tag{3}$$

$$\left.\begin{array}{l} N = N_2(w/\theta, \bar{H}, z/\theta) \\ H = H_2(w/\theta, \bar{H}, z/\theta) \end{array}\right\} \qquad \text{if } H > \bar{H} \tag{4}$$

If $H_2(w/\theta, \bar{H}, z/\theta) < \bar{H}$, then the firm operates on the kink and all its employees work the standard workweek. Firms with $H = \bar{H}$ are hereafter labelled as 'standard-time firms'. Otherwise, if

$$H_2(w/\theta, \bar{H}, z/\theta) > \bar{H}, \tag{5}$$

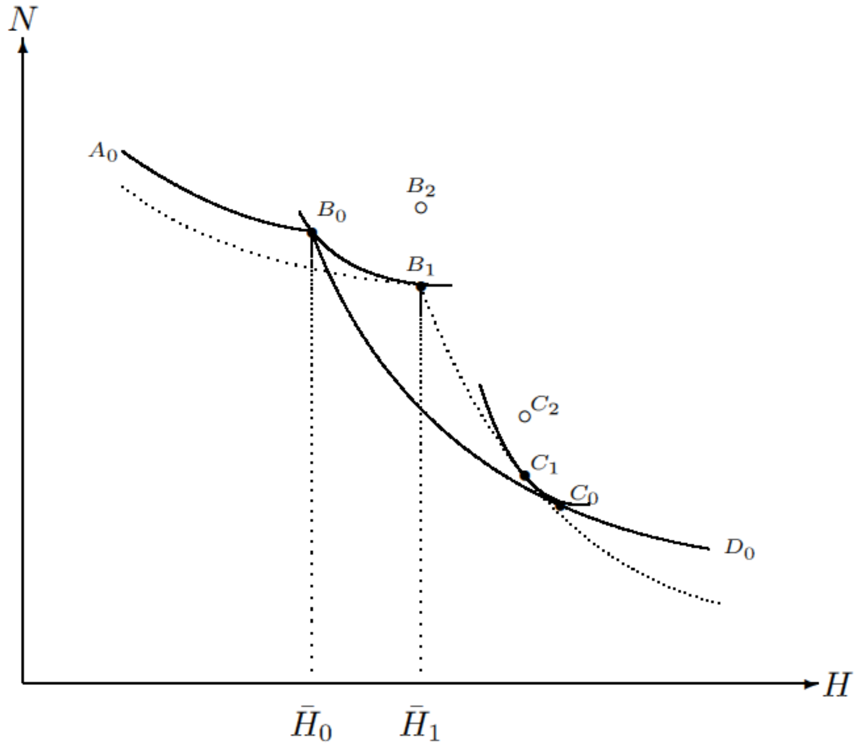


Figure 3: Substitution and scale effects of an increase in standard hours. An increase in $\bar{H}$ moves the isocost line from $A_0B_0D_0$ to $A_1B_1D_1$. The substitution effect moves standard-time firms from B_0 to B_1 and overtime firms from C_0 to C_1. Scale effects are positive for both types of firm.

then the firm operates on the upper segment and all its employees work overtime. These firms are hereafter labelled 'overtime firms'. The two possible solutions (or 'working-time regimes') are drawn in Figure 3. For $A_0B_0D_0$, these are points B_0 (standard-time firms) and C_0 (overtime firms) respectively. Even though $N_1(\ )$ and $N_2(\ )$ have the same arguments, they are different functions. In particular, the effect of standard hours on employment varies between overtime and standard-time firms.

Overtime firms

For a firm to optimally offer overtime to all its employees, Equation (5) suggests that it must face relatively low standard hours. The demand for employment and hours functions are given by Equation (4), whose properties depend, in part, upon the underlying technology generating the revenue function $\theta R(H, N)$.

Consider an increase in standard hours, $\bar{H}$. In Figure 3, this is from $\bar{H}_0$ to $\bar{H}_1$, and the new dotted isocost contour becomes $A_1B_1D_1$. For given output, the marginal cost of an employee (the so-called extensive margin) falls but the marginal cost of an overtime hour (the intensive margin) remains constant, and so the firm substitutes away from hours towards employment (C_0 to C_1 in Figure 3). Allowing output to vary, there is an additional scale effect, for example from C_1 to C_2, whereby the firm demands more hours and employees, because costs have fallen. The overall effect of a increase in standard hours on employment is unambiguously positive ($N_{\bar{H}} > 0$). The firm reduces expensive overtime as the workweek is increased. Recall that this is exactly the motivation for German firms increasing standard hours in the early 2000s.

Standard-time firms

If it is optimal for the firm to operate at the kink, effectively employment is chosen conditional on the exogenously determined workweek, $H = \bar{H}$. The firm's problem can be more simply stated as

$$\max_{N} \theta R(\bar{H}, N) - (w\bar{H} + z)N. \tag{6}$$

This generates the labour demand Equation (3). The variables that enter are the same as for the overtime regime (see Equation 4); it is the comparative static effects that are different. It is clear from (6) that $\bar{H}$ is a price of employment, in direct contrast to the overtime model above. Just like an increase in the wage, an increase in $\bar{H}$ increases the marginal cost of an extra employee. On its own this decreases employee demand. However an increase in $\bar{H}$ also affects marginal revenue; only if the cross-partial is sufficiently positive, in other words if marginal revenue increases by more than marginal cost, does employment actually increase.

Figure 3 illustrates the pure substitution effect of an increase in standard hours from $\bar{H}_0$ to $\bar{H}_1$, which moves standard-time firms from B_0 to B_1, reducing N. The scale effect moves the solution above B_1 (for example to B_2), which illustrates the ambiguity in the partial derivative. Overall, negative employment effects from increasing standard hours ($\partial N/\partial \bar{H} < 0$) will be observed for standard-time firms providing the substitution effect dominates. This model formalises the notion that worksharing may work because reducing $\bar{H}$ can increase N if the substitution effect dominates.

Whether increasing standard hours reduces employment therefore depends on the extent to which firms offer overtime. Clearly, it is essential to distinguish between firms which offer overtime and those which do not, and examine whether $\partial N/\partial \bar{H}$ varies with the firm's working-time regime. We discuss the prevalence of overtime firms in the context of our data in Section 4.

3.2 Negotiating over standard hours

It is important to model employment and standard hours outcomes in the presence of bargains, especially because the initial drive for longer standard hours happened in the larger well-known firms where workforces were unionised. To do this, there are well-developed union-firm bargaining models that analyse how standard hours are negotiated; see Booth (1995) and Andrews & Simmons (2001) and references within. These models are still relevant even when firms do not explicitly bargain with a union.

A key assumption in the literature is that standard hours and wage negotiations occur less frequently than changes in employment and hours. This is the assumption that firms 'retain the right-to-manage'. Once standard hours and the hourly wage have been determined in the outcome of a bargain, effectively both variables are 'exogenous' for employment and hours, which means that the traditional hours demand model discussed above is appropriate.

In a typical union-firm bargaining model, a Nash bargain is set up with both the firm's profit function and the union's utility function having standard hours $\bar{H}$ and the hourly wage rate w as the variables negotiated over. The solution lies on a contract curve, defined by the tangency of isoprofit and isoutility contours, and a bargaining power parameter locates where the solution is on the contract curve. The contract curve need not be the same for standard-time firms and overtime firms because both the profit function and utility function differ. Thus we write the contract curves as $\lambda_1(w, \bar{H}; p)$ and $\lambda_2(w, \bar{H}; p)$ for standard-time firms and overtime firms respectively, where $0 \leq p \leq 1$ is the exogenous bargaining power parameter. As firms become more powerful, as happened in the sample period, the solution moves towards the competitive outcome, with the hourly wage rate falling, and, if the contract curve is downward sloping, standard hours increasing, as also happened in the sample period.[9]

[9]In passing, we expect the contract curve is downward sloping because there is a very large lit-

'Wage compensation' — an important issue in the empirical literature discussed in the Introduction — is the idea that weekly income is negotiated to be constant when standard hours are cut, meaning that the hourly wage necessarily increases. Symmetrically, 'wage concession' occurs when standard hours increase. Both wage compensation and wage concession are easily modelled in these Nash bargains.

Substituting the two contract curves, now written $w = w_j(\bar{H}, p)$, into Equations (3) and (4), we get

$$N = N_j[w_j(\bar{H}, p)/\theta, \bar{H}, z/\theta],$$

and so the overall effect of changes in $\bar{H}$ on N comprises a direct and indirect effect, which can be written as $N^j_{\bar{H}} + N^j_w w^j_{\bar{H}}/\theta$, where each term is a partial derivative and $j = 1, 2$ for standard-time and overtime firms respectively. Thus in principle we cannot disentangle the direct effect on the firm's labour demand schedule from an indirect effect that arises because the hourly wage rate may have been negotiated downwards (in turn because firms have become more powerful). However, from a policy point of view, it is the total impact that matters. It is important to recognise there might be differences between standard-time and overtime firms, and that any differences will reflect differences in the labour demand response *or* differences in the slope of the contract curve *or* both. (For example, suppose the contract curve is downward sloping, which means the indirect effect is positive; the slope of the contract curve might vary by plant type.) More important, recognising that wage compensation is an issue possibly explains why the existing empirical literature has been unable to detect positive employment effects of reducing standard hours. Section 3.1 predicts that the employment response holding the hourly wage rate w constant is likely to be negative; allowing for increases in w in Section 3.2 makes this effect even stronger. In short, worksharing is simply not a prediction of standard theory.

4 Data description

There are two data sources. The first is the *Institut für Arbeitsmarkt- und Berufsforschung (IAB) Establishment Panel*, an annual survey of approximately 10,000

erature on positive union/non-union wage differentials and a smaller literature reporting negative hours differentials between the two sectors (Andrews & Simmons 2001).

plants located in the former West Germany and an additional 5,500 plants in the former East Germany. The survey started in 1993 and is ongoing. It covers 1% of all plants and 7% of all employment in Germany, and is therefore a sample weighted toward larger plants. Information is obtained by personal interviews with plant managers, and comprises about 80 questions per year, giving us information on, for example, total employment, bargaining arrangements, standard hours, total sales, exports, investment, wage bill, location, industry, profit level and nationality of ownership. A detailed description of the IAB Establishment Panel can be found in Fischer, Janik, Müller & Schmucker (2009).

The second source of data is the employment statistics register of the German Federal Employment Agency (BA); this so-called *Beschäftigtenstatistik* covers all workers or trainees registered by the social insurance system. The register covers about 80% of workers in western Germany and about 85% in eastern Germany. Information on workers includes basic demographics, start and end dates of employment spells, occupation and industry, earnings, qualifications (school and post-school), and a plant identification number. A detailed description of the employment data can be found in Bender, Haas & Klose (2000). As almost all workers in the private sector are covered by the social insurance system, in fact we cover nearly 100% of workers.

From the IAB Establishment Panel, we construct a balanced panel of private-sector plants, indexed j, observed annually on 30 June for $t = 2001 \ldots 2006$. By using the plant identification number in the Beschäftigtenstatistik, we link each worker to a plant in the panel, selecting all workers who were employed by the surveyed plants on June 30th each year. From this, we compute the stock of employees N_{jt}. We can also compute hires h_{jt} and separations s_{jt} for plant j between 30 June in year $t-1$ and 30 June year t. When normalised by $\bar{N}_{jt} \equiv (N_{j,t-1} + N_{jt})/2$, these three variables are linked as follows:

$$\frac{\Delta N_{jt}}{\bar{N}_{jt}} = \frac{h_{jt}}{\bar{N}_{jt}} - \frac{s_{jt}}{\bar{N}_{jt}} \quad t = 2, \ldots, 6.$$

Thus we are able to estimate models for employment, the employment growth rate, the hiring rate and the separation rate.

The definition of standard hours $\bar{H}_{jt}$ in the IAB Establishment Panel is "How long is the agreed average standard working time for full-time workers in your plant?" and is observed in 2001, 2002, 2004, 2006. From this, we construct our control and treatment groups. The control group ($T_j = 0$) consists of all plants where $\bar{H}$ is constant in 2001, 2002, 2004, and 2006. The treatment group ($T_j = 1$) consists of all plants where standard hours are constant in 2001 and 2002; go up between 2002 and 2004; and are constant again in 2004 and 2006. This approach seeks to minimise measurement error, since we exclude any plants which report a temporary jump in $\bar{H}$. Figure 4 illustrates, where the averages for $\bar{H}$ are computed from the regression sample.

There are large variations in standard hours across plants in western Germany. Using employment weights from the IAB Establishment Panel, we find that for 10% of plants, standard hours are less than 35; for 45% of plants, they are between 37.5 and 38.5 hours; and for the remaining 25%, standard hours exceed 40. There is less dispersion in eastern Germany. To identify the model we estimate (see Section 5), it is not variations in standard hours that we need, but variations in its change. Standard hours for *some* plants have changed: of 11,898 plants in the IAB panel, 328 increased their standard hours and 174 decreased their standard hours between 2003 and 2004. A subset of these 328 plants form the treated sub-sample analysed later in this paper. 65% of plants did not change standard hours at all between 2001 and 2006, which supports our contention that changes in standard hours are not used to respond to short-term shocks.

The dummy variable V_{jt} records whether or not a plant offers overtime. The data actually record whether overtime is (a) 'paid for', (b) 'partly paid for, partly compensated by time off', (c) 'only compensated by time-off', or (d) 'neither paid for nor compensated by time off', and is observed in 2001, 2002, and 2006.[10] Because the crucial aspect of an overtime hour is whether it is paid a premium (the theory relies on $\gamma > 1$), we define $V_{jt} = 1$ only if (a) or (b) apply.[11] It is fixed at its 2002 value, but we examine what happens to the subset of plants where V changes in 2006 by dropping them our basic model, to see whether our results are robust to this change. The theory outlined in Section 3 suggests that, as standard hours increase, some plants will no longer offer overtime.[12]

[10]The definition of V in 2004 is not consistent with the definitions in 2001, 2002 and 2006 and cannot be used.

[11] Only 15% of workers in Germany were paid overtime in 2006 (IAB Establishment Panel), whereas 16.1% of (weighted) plants are 'overtime plants' in the same year.

[12]Of 414 plants that changed their overtime status, 240 changed from standard-time to overtime and 174 went the other way.

5 Econometric Methodology

Our methodology is a standard application of difference-in-differences (DiD) estimator for treatment effects, using both a regression framework and propensity score matching. If the decision to increase standard hours is in response to a permanent demand shock that occurs before the treatment window, then this method can recover the causal impact of the treatment because the demand shock can be differenced away. We also control for any (permanent or time-varying) sectoral demand shocks taking place within the treatment window.

In a regression framework, our basic estimating equation for employment is as follows:

$$\log N_{jt} = \gamma_0 + \sum_{k=2}^{6} \delta_k D_t^k + \sum_{k=2}^{6} \gamma_k D_t^k T_j + \mathbf{x}_{jt}\boldsymbol{\beta} + \lambda T_j + u_{jt}, \quad t = 1, \ldots, 6. \tag{7}$$

T_j is the treatment dummy, D_t^k is a time-dummy for year k, and $\mathbf{x}_{jt}$ is a vector of observed covariates. The selection effect is λ, which captures any differences in employment outcomes between treated and control plants before the treatment takes place, including any permanent (pre-treatment) difference in demand between the two groups. One can either estimate Equation (7) by OLS, or one can allow for plant-specific fixed effects θ_j, in which case the estimating equation is

$$\log N_{jt} = \gamma_0 + \sum_{k=2}^{6} \delta_k D_t^k + \sum_{k=2}^{6} \gamma_k D_t^k T_j + \mathbf{x}_{jt}\boldsymbol{\beta} + \theta_j + u_{jt}, \quad t = 1, \ldots, 6. \tag{8}$$

The θ_j can be removed with either fixed effects (FE) or first differenced (FD) estimators. In the absence of covariates, and in a balanced panel, all three estimators (OLS, FE, FD) give identical results. In practice, with covariates, the results are very similar, and so we report OLS estimates. We report cluster robust standard errors, which are virtually the same for all three methods. The clustering takes account of any serial correlation in the u_{jt}. The number of plants/clusters is large enough for both sub-samples, there being roughly 1,000 plants in each sample. An alternative method, which matches on observed covariates, deals with potential possibility that some plants in the treatment or controls groups may not have a common support, or that the conditional expectation function may not be linear.[13]

[13] See Angrist & Pischke (2009) for a discussion on matching versus regression.

These are reported in the Appendix.

γ_5 and γ_6 are the two treatment effects (difference-in-differences) of interest, corresponding to 2005 and 2006, the two years in the data after the change in $\bar{H}$. Consider the OLS estimate of γ_6 in the absence of covariates:

$$\begin{aligned}\hat{\gamma}_6 &= (\overline{\log N_6^T} - \overline{\log N_1^T}) - (\overline{\log N_6^C} - \overline{\log N_1^C}) \\ &= \sum_{t=2}^{6} \left[(\overline{\log N_t^T} - \overline{\log N_{t-1}^T}) - (\overline{\log N_t^C} - \overline{\log N_{t-1}^C}) \right] \\ &\approx \sum_{t=2}^{6} \left[(\overline{\Delta N_t/\bar{N}_t})^T - (\overline{\Delta N_t/\bar{N}_t})^C \right]\end{aligned}$$

The superscript T denotes 'treated' and C denotes 'control'. Thus, this particular difference-in-difference is written as the approximate sum of five differentials — between treated and control plants — in the employment growth rates. Because we need to control for observables, these are actually estimated from:

$$\frac{\Delta N_{jt}}{\bar{N}_{jt}} = \sum_{k=2}^{6} \delta'_k D_t^k + \sum_{k=2}^{6} \gamma'_k D_t^k T_j + \mathbf{x}_{jt}\boldsymbol{\beta} + e_{jt} \quad t = 2, \ldots, 6. \tag{9}$$

The five differentials are $\gamma'_2, \ldots, \gamma'_6$.

There are analogous regression models for $s_{jt}/\bar{N}_{jt}$ and $h_{jt}/\bar{N}_{jt}$. From these, we can decompose the differentials in the employment growth rates into the same for hires and separations:

$$\hat{\gamma}_6 \approx \sum_{t=2}^{6} \left[(\overline{h_t/\bar{N}_t})^T - (\overline{h_t/\bar{N}_t})^C \right] - \sum_{t=2}^{6} \left[(\overline{s_t/\bar{N}_t})^T - (\overline{s_t/\bar{N}_t})^C \right]. \tag{10}$$

6 Results

We keep plants which are observed for all six years $2001, \ldots, 2006$, which correspond to the definition of treatment or control defined in Figure 4, and which have non-missing values for the required variables. This reduces the sample to 1,112 standard-time plants (68 treated and 1,044 control), and 907 overtime plants (43 treated and 864 control), making a total sample size of 2,019 plants.

In assessing whether there is overlap between the treated and control plants, we follow Imbens (2009), who suggests computing the following normalised difference in sample means,

$$z = \frac{\bar{x}^T - \bar{x}^C}{\sqrt{S_x^{2,C} + S_x^{2,T}}}, \tag{11}$$

where

$$\bar{x}^w = \frac{1}{n_w} \sum_{j \in w} x_j \quad \text{and} \quad S_x^{2,w} = \frac{1}{n_w - 1} \sum_{j \in w} (x_j - \bar{x}^w)^2 \quad \text{for } w = T, C.$$

Imbens suggests that if the difference in means is bigger than 0.25 standard deviations ($z > 0.25$), then linear regression methods may be problematic.

Table 1 shows that there are some significant differences in sample means between treated and control plants. The most important of these is that treated plants are less likely to be in eastern Germany: for standard-time plants, 63% of control plants but only 25% of treated plants are in eastern Germany. There is a similar difference for overtime plants (47% and 12% respectively). For the same reason, the regional unemployment rate is significantly higher in control plants. Given the earlier discussion on whether firms bargain with unions, and whether this has an impact on whether a plant is treated, note that, amongst standard-time plants, a significantly larger share of treatment plants had some collective bargaining (43% of treated compared to 62% of control plants had no collective agreement, with $z = 0.28$). The difference for overtime plants is much smaller ($z = 0.027$).

Overall there are only a few significant differences, and therefore it is not surprising that it makes no difference to our results below whether we use standard linear regression or propensity score matching. In what follows, we report and discuss the linear regression results; propensity score matching results are reported in the Appendix.

Our basic results for employment are reported in Table 2. The raw differences-in-differences are given in the third column, which are exactly the same when covariates are added, reported in the fourth column. (These are all the variables listed in Table 1 and sector dummies.) For standard-time plants, the DiD for 2005 is –0.030 (0.052) and for 2006 it is 0.009 (0.059). For overtime plants, these are much bigger: 0.113 (0.064) for 2005 and 0.158 (0.070) for 2006. To illustrate this result, Figure 5 plots the estimated conditional differentials for hires, separations, employment growth and employment for both plant-types. A comparison of the

Table 1: Unweighted sample means, pre-treatment (2001). The sample is exactly that used in the regressions. The z-statistic for testing equality of means is defined in Equation (11). Results for the matched sample are reported in Table A.1.

	Standard-time plants			Overtime plants		
Variable	$\Delta\bar{H} > 0$	$\Delta\bar{H} = 0$	z	$\Delta\bar{H} > 0$	$\Delta\bar{H} = 0$	z
Employment (N)	43.03	62.60	-0.085	1414.98	254.05	0.139
Standard-time ($\bar{H}$)	37.79	39.47	-0.810	37.44	38.67	-0.458
Hiring rate	0.126	0.179	-0.201	0.158	0.148	0.044
Separation rate	0.188	0.187	0.004	0.128	0.153	-0.143
Share of female employees	0.429	0.415	0.031	0.265	0.304	-0.117
Share of part-time employees	0.213	0.167	0.146	0.091	0.108	-0.082
Share of vacancies	0.007	0.018	-0.064	0.011	0.011	-0.000
Export share in total sales	0.023	0.046	-0.137	0.166	0.138	0.080
Very good or good profitability	0.324	0.324	-0.000	0.349	0.384	-0.051
No collective agreement	0.426	0.620	-0.277	0.442	0.422	0.027
Sector-level bargaining agreem't	0.500	0.327	0.251	0.442	0.465	-0.033
Firm-level bargaining agreement	0.074	0.054	0.057	0.116	0.112	0.009
Works council	0.206	0.152	0.098	0.442	0.466	-0.034
Plant located eastern Germany	0.250	0.629	-0.581	0.116	0.468	-0.588
Regional unemployment rate	0.106	0.134	-0.411	0.086	0.122	-0.551
Number of observations	68	1,044		43	864	

fourth panel in Figure 5 between standard-time and overtime plants shows that, for overtime plants, employment increases for the treatment group and reduces slightly for the control group, while for standard-time plants employment reduces for both groups.

These two panels also allow to assess whether the common trends assumption is plausible. Employment in standard-time plants fell at the same rate over the whole sample period, including the pre-treatment period. Employment in overtime plants has the same trend for both groups in the pre-treatment period; treatment plants did not increase employment until after 2002. The DiD estimates for 2002 in both regressions are completely insignificant, which also confirms that the common trends assumption is plausible.

Assuming our identifying assumptions (common trends and permanent shocks) allow us to interpret our estimates as causal, the results match the theory exactly. Overtime plants which increase standard hours increase their employment more than observably similar plants which did not increase standard hours. This does not happen in standard-time plants. In other words, for both types of plant, there is no evidence whatsoever for positive worksharing effects ($\partial N/\partial\bar{H} < 0$)

Table 2: Difference-in-difference estimates for the unmatched sample, standard-time and overtime plants separately.

	Raw differential			Conditional differential			
	$\overline{\log N}_t^C$	$\overline{\log N}_t^T$	DiD[a]	$\log N$[b]	$\frac{\Delta N_{jt}}{\bar{N}_{jt}}$[c]	$\frac{h_{jt}}{\bar{N}_{jt}}$	$\frac{s_{jt}}{\bar{N}_{jt}}$
(a) 1,112 standard-time plants (68 treated)							
2001	2.667	2.491					
2002	2.643	2.473	0.006	0.006	0.014	–0.018	–0.031
			(0.023)	(0.023)	(0.023)	(0.025)	(0.024)
2003	2.635	2.410	–0.048	–0.048	–0.046	–0.051	–0.005
			(0.032)	(0.032)	(0.028)	(0.020)	(0.026)
2004	2.628	2.432	–0.020	–0.020	0.030	0.069	0.039
			(0.048)	(0.048)	(0.037)	(0.033)	(0.028)
2005	2.594	2.389	–0.030	–0.030	0.007	–0.001	–0.007
			(0.052)	(0.052)	(0.036)	(0.021)	(0.032)
2006	2.546	2.380	0.009	0.009	0.042	0.003	–0.039
			(0.059)	(0.059)	(0.034)	(0.027)	(0.026)
Sum[d]					0.047	0.002	–0.043
No. obs.	6,672	6,672	6,672	6,672	5,560	5,560	5,560
(b) 907 overtime plants (43 treated)							
2001	4.205	4.409					
2002	4.185	4.398	0.009	0.009	0.010	0.018	0.009
			(0.035)	(0.035)	(0.033)	(0.022)	(0.022)
2003	4.180	4.429	0.046	0.046	0.035	0.011	–0.023
			(0.043)	(0.043)	(0.026)	(0.022)	(0.014)
2004	4.173	4.479	0.102	0.102	0.055	0.044	–0.011
			(0.053)	(0.053)	(0.029)	(0.027)	(0.017)
2005	4.141	4.458	0.113	0.113	0.010	0.030	0.020
			(0.064)	(0.064)	(0.034)	(0.023)	(0.026)
2006	4.096	4.457	0.158	0.158	0.038	0.009	–0.029
			(0.070)	(0.070)	(0.024)	(0.017)	(0.017)
Sum[d]					0.148	0.112	–0.034
No. obs.	5,442	5,442	5,442	5,442	4,535	4,535	4,535

[a] Raw DiD differential is defined as $(\overline{\log N}_t^T - \overline{\log N}_1^T) - (\overline{\log N}_t^C - \overline{\log N}_1^C)$.
[b] Conditional DiD differential for $\log N$ is given by γ_k in Equation (8).
[c] Differential on $\Delta N_{jt}/\bar{N}_{jt}$ is given by γ'_k in Equation (9), which decomposes into hires and separations.
[d] Sum of employment change over 2002 . . . 2006; see Equation (10).

in these data. For standard-time plants, the zero estimate implies that the scale and substitution effects cancel each other out; for overtime plants, both scale and substitution effects mean higher employment.

For overtime plants, the effect is economically significant. An increase of $\bar{H}$ by 1.81 hours (see Figure 4) represents a 4.68% increase (1.81/38.67 = 4.68%), which leads to a 0.113 log-point increase in employment: an elasticity of 0.113/4.68 = 2.4. Alternatively, if we define the DiD as (0.113 + 0.158)/2 = 0.136, then the estimates are slightly bigger. Whilst these treatment effects are large, the 95% confidence interval obviously contains smaller (perhaps more plausible) elasticities. Recall, also, that our estimate includes any effect that comes about from any wage concessions. If we average our estimates across the two types of plant, our results are also consistent with Crepon & Kramarz's (2002) elasticity of 1.2 (a 3% fall in employment that came about because of a cut in hours from 40 to 39 in 1981).

Recall that the definition of whether a plant is standard-time or overtime is fixed at its 2002 value, because we need a balanced panel for estimating DiD effects. When we examine what happens to the subset of plants where overtime status V changes in 2006 by dropping them from our basic model, it turns out that our results are robust to this change.

We noted in Section 2 that some agreements to increase standard hours included employment guarantees for existing workers, meaning that reductions in employment could only be implemented by hiring fewer workers. As our results show that the employment effect of increasing standard hours was zero in standard-time plants and *positive* in overtime plants, this is no longer an issue. Nonetheless, it is interesting to see what happens to hires and separations. The first three panels of Figures 5 plot $\frac{s_{jt}}{N_{jt}}$, $\frac{h_{jt}}{N_{jt}}$ and $\frac{\Delta N_{jt}}{N_{jt}}$ for both treated and control plants. In addition, the rows labelled 'Sum' in Table 2 reports the components of Equation (10), which add up hires, separations (and therefore employment growth) over the sample period. For standard-time plants, the difference in employment growth rates between treated and untreated plants is close to zero, and there is no additional differential effects for either hires or separations.

For overtime plants, the differential in employment growth rates between treated and control plants is 0.148. As one can see from Equation (10), this is approximately the same as the estimate of $\gamma_6 = 0.158$ in the preceding column. The sum of employment growth 0.148 decomposes into 0.112 for hires and −0.034 for separations. Thus, for overtime plants, the increased employment in treated relative to control plants is due to increased hires rather than fewer separations.

7 Conclusion

In this paper we estimate the effect of increasing standard hours in Germany in the early 2000s. Several prominent firms increased their hours in this period, but there were many others. This has been a contentious policy issue in Germany: proponents of increasing working time argue that it is a tool to increase competitiveness, and also protect jobs; others disagree because of worries that firms will substitute hours for jobs. Specifically, we investigate whether there was any significant change in employment for those plants where standard hours increased between 2002 and 2004, relative to a control group of plants which did not increase standard hours. Because this reverses earlier trends in working time, by symmetry our results also inform the 'does worksharing work?' debate.

Overtime plants which increased standard hours increased their employment significantly more than plants which did not change standard hours. The effect is economically significant, with an elasticity of about two-and-a-half. For these overtime plants, there is no evidence whatsoever for positive worksharing effects ($\partial N/\partial \bar{H} < 0$), because employment has *increased* in the treated plants relative to the control plants. For standard-time plants, there is no difference at all between plants which increase standard hours and those which did not ($\partial N/\partial \bar{H} = 0$). These results match the theory exactly, because for overtime plants scale and substitution effects of an increase in standard hours work in the same direction, while for standard-time plants they work in opposite directions. Most likely, a part of the positive scale effect is because of hourly wage concessions, in turn because of keeping weekly income constant.

If we average our elasticities of zero and two-and-a-half across the two types of plant, our estimates are perfectly consistent with the findings of Crepon & Kramarz (2002), whose mid-range estimate converts to an elasticity of 1.2, albeit we analyse plant-level data, they worker-level data.

The key issue in the interpretation of our results is that we identify the employment response from a change in standard hours which is chosen by firms rather than imposed exogenously as a policy, as in, for example, Crepon & Kramarz

(2002). For our estimates to be a measure of the causal impact of standard hours on employment, we require that firms did not respond to a firm-level short-term demand shock within the sample period, but instead responded to long-run permanent changes in demand. The institutional background supports this interpretation because firms renegotiate standard hours only rarely. We also require that the employment trends of treated and control firms would have been the same in the absence of the change in hours. A comparison of pre-treatment trends supports this assumption.

In summary, we come to the same conclusion as most studies of worksharing, discussed in the Introduction. Theory predicts that we should not observe positive worksharing effects in the data, which is what we find. Ours is the only study that analyses employment at the employer level; moreover, it is different because it is the only one that analyses the more recent increases in standard hours.

References

Abowd, J., Corbel, P. & Kramarz, F. (1999), 'The entry and exit of workers and the growth of employment: an analysis of French establishments', *The Review of Economics and Statistics* **81**(2), 170–187.

Andrews, M., Schank, T. & Simmons, R. (2005), 'Does worksharing work? Some evidence from the IAB establishment panel', *Scottish Journal of Political Economy* **52**(2), 141–176.

Andrews, M. & Simmons, R. (2001), 'Friday may never be the same again: some results on worksharing from union-firm bargaining models', *Scottish Journal of Political Economy* **48**(5), 488–516.

Angrist, J. & Pischke, J.-S. (2009), *Mostly Harmless Econometrics*, Princeton University Press.

Bender, S., Haas, A. & Klose, C. (2000), 'The IAB employment subsample 1975–1999', *Schmollers Jahrbuch* **120**(4), 649–662.

Booth, A. (1995), *The Economics of the Trade Union*, Cambridge University Press.

Calmfors, L. & Hoel, M. (1988), 'Work sharing and overtime', *Scandinavian Journal of Economics* **90**(1), 45–62.

Carley, M. (2004), Working time developments 2003. European Industrial Relations observatory (EIRO) `http://www.eurofound.europa.eu/eiro/2004/03/update/tn0403104u.htm`.

Crepon, B. & Kramarz, F. (2002), 'Employed 40 hours or not employed 39: lessons from the 1982 mandatory reduction in the workweek', *Journal of Political Economy* **110**(6), 1355–1389.

Estevão, E. & Sá, F. (2008), 'The 35-hour week in France: straightjacket or welfare improvement?', *Economic Policy* **23**(55), 417–463.

Fischer, G., Janik, F., Müller, D. & Schmucker, A. (2009), 'The IAB Establishment Panel — things users should know', *Schmollers Jahrbuch* **129**(1), 133–148.

Hart, R. (1987), *Working Time and Employment*, Allen and Unwin, chapter 5.

Hunt, J. (1999), 'Has work-sharing worked in Germany?', *Quarterly Journal of Economics* **114**(1), 117–148.

Imbens, G. (2009), Estimation of treatment effects under unconfoundedness: Part 1, *in* G. Imbens & J. Wooldridge, eds, 'New developments in econometrics: lecture notes', CENMAP.

Leslie, D. (1984), 'The productivity of hours in US manufacturing', *Review of Economics and Statistics* **66**(3), 486–490.

Raposo, P. & van Ours, J. (2010), 'How working time reduction affects jobs and wages', *Economics Letters* **106**(1), 61–63.

Schank, T. (2006), 'Have employees in Germany received full wage compensation after a cut in standard hours?', *The Manchester School* **74**(3), 273–293.

Sinn, H.-W. (2003), 'Wieder 42 stunden arbeiten', Frankfurter Allgemeine Zeitung. 23 July, p.11.

Skuterud, M. (2007), 'Identifying the potential of work-sharing as a job-creation strategy', *Journal of Labor Economics* **25**(2), 265–287.

The European Economic Advisory Group (2005), Longer working hours — the beginning of a new trend?, *in* L. Calmfors, G. Corsetti, S. Honkaphoja, J. Kay, W. Leibfritz, G. Saint-Paul, H.-W. Sinn & X. Vives, eds, 'The EEAG report on the European Economy 2005', CESifo.

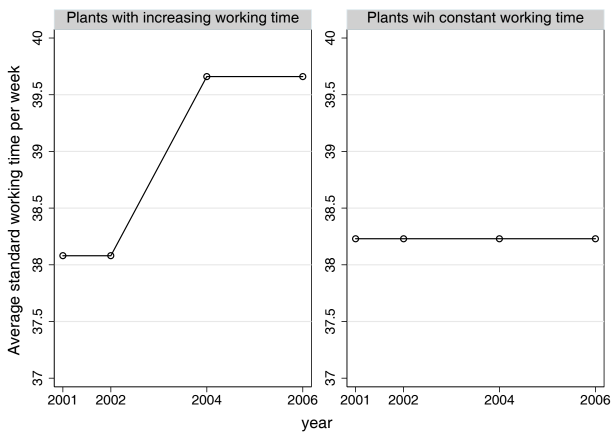
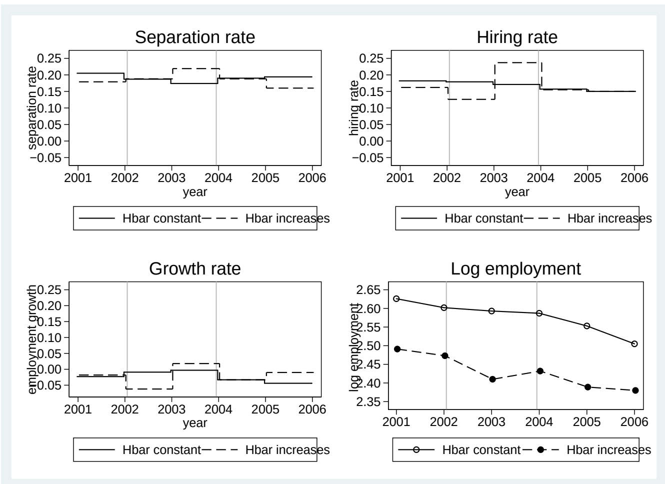


Figure 4: Average standard hours for plants in the treatment and control groups. There are 111 plants in the treatment group which have constant hours between 2001 and 2002 (average = 37.66) and between 2004 and 2006 (average = 39.47), and which increase hours between 2002 and 2004. There are 1,908 plants in the control group which have constant hours between 2001 and 2006 (average = 39.11).



Separation rate
separation rate
0.25
0.20
0.15
0.10
0.05
0.00
−0.05
2001
2002
2003
2004
2005
2006
year
Hbar constant
Hbar increases
Hiring rate
hiring rate
0.25
0.20
0.15
0.10
0.05
0.00
−0.05
year
Hbar constant
Hbar increases
Growth rate
employment growth
year
Hbar constant
Hbar increases
Log employment
log employment
2.65
2.60
2.55
2.50
2.45
2.40
2.35
Hbar constant
Hbar increases

Appendix Matching

To generate a propensity score for each plant in the unmatched data, for each sample separately, using the same covariates as for the DiD regressions in the main text, we run a Logit of whether $\bar{H}$ has increased or not on a vector of plant-level covariates for 2001:

$$\widehat{\Pr}(\Delta\bar{H}_j > 0) = \hat{\Lambda}_j = \Lambda(\mathbf{x}_{j1}\hat{\beta})$$

We then use 'Nearest Neighbour Matching'. For each treated plant we search for a matched plant in the control group by finding the plant with closest propensity score, without replacement, within narrowly defined plant-size classes, and provided that $\Delta\bar{H}^T - \Delta\bar{H}^C \leq 1$ hour.

Table A.1: Unweighted sample means, pre-treatment (2001). The sample is matched using Nearest Neighbour Matching. The z-statistic for testing equality of means is defined in Equation (11)

	Standard-time plants			Overtime plants		
Variable	$\Delta\bar{H} > 0$	$\Delta\bar{H} = 0$	z	$\Delta\bar{H} > 0$	$\Delta\bar{H} = 0$	z
Employment (N)	23.61	24.55	-0.016	181.72	179.19	0.006
Standard-time ($\bar{H}$)	38.15	38.45	-0.092	37.84	37.92	-0.042
Share of female employees	0.414	0.403	0.025	0.293	0.345	-0.137
Share of part-time employees	0.234	0.204	0.092	0.091	0.160	-0.278
Hiring rate	0.130	0.165	-0.156	0.153	0.127	0.161
Separation rate	0.205	0.180	0.101	0.142	0.137	0.033
Share of vacancies	0.004	0.006	-0.075	0.015	0.003	0.376
Export share in total sales	0.025	0.005	0.173	0.173	0.070	0.333
Very good or good profitability	0.294	0.255	0.061	0.406	0.313	0.134
No collective agreement	0.451	0.471	-0.027	0.438	0.313	0.178
Sector-level bargaining agreem't	0.471	0.510	-0.054	0.500	0.531	-0.043
Firm-level bargaining agreement	0.078	0.020	0.191	0.063	0.156	-0.208
Works council	0.157	0.039	0.280	0.406	0.531	-0.173
Plant located eastern Germany	0.333	0.275	0.089	0.156	0.125	0.062
Regional unemployment rate	0.116	0.108	0.005	0.086	0.092	-0.095
Number of observations	51	51		32	32	

Post-matching, there are 51 standard-time plants and 32 overtime plants. Very few differences in sample means reported in Table A.1 are insignificantly different from zero, $z > 0.25$, and none have $z > 0.4$. Table A.2 is the same as Table 2 in the main text, but on these matched samples. The estimates are similar, but with higher standard errors. This means that there is little gain to matching, but a significant disadvantage in that the sample is smaller.

Table A.2: Difference-in-difference estimates for the matched sample, standard-time and overtime plants separately.

	Raw differential			Conditional differential			
	$\overline{\log N_t^C}$	$\overline{\log N_t^T}$	DiD[a]	$\log N$[b]	$\frac{\Delta N_{jt}}{\bar{N}_{jt}}$[c]	$\frac{h_{jt}}{\bar{N}_{jt}}$	$\frac{s_{jt}}{\bar{N}_{jt}}$
(a) 102 matched standard-time plants (51 treated)							
2001	2.396	2.447					
2002	2.382	2.410	–0.024	–0.024	–0.026	0.022	0.048
			(0.038)	(0.038)	(0.038)	(0.037)	(0.035)
2003	2.368	2.333	–0.086	–0.086	–0.063	–0.026	0.038
			(0.044)	(0.044)	(0.041)	(0.034)	(0.037)
2004	2.332	2.357	–0.026	–0.026	0.051	0.109	0.058
			(0.069)	(0.070)	(0.057)	(0.045)	(0.042)
2005	2.331	2.309	–0.073	–0.073	–0.034	0.029	0.063
			(0.086)	(0.087)	(0.058)	(0.036)	(0.047)
2006	2.297	2.304	–0.045	–0.044	0.009	0.089	0.010
			(0.109)	(0.111)	(0.060)	(0.041)	(0.050)
Sum[d]					–0.063	0.223	0.197
No. obs.	612	612	612	510	510	510	510
(b) 64 matched overtime plants (32 treated)							
2001	4.277	4.291					
2002	4.261	4.283	0.008	0.008	–0.001	0.043	0.044
			(0.052)	(0.053)	(0.051)	(0.034)	(0.031)
2003	4.250	4.294	0.029	0.029	0.011	0.025	0.015
			(0.063)	(0.064)	(0.035)	(0.024)	(0.028)
2004	4.253	4.336	0.069	0.069	0.028	0.041	0.013
			(0.070)	(0.072)	(0.042)	(0.034)	(0.028)
2005	4.203	4.331	0.113	0.113	0.035	0.070	0.036
			(0.089)	(0.091)	(0.045)	(0.030)	(0.032)
2006	4.128	4.354	0.211	0.211	0.080	0.035	–0.045
			(0.111)	(0.113)	(0.048)	(0.027)	(0.046)
Sum[d]					0.153	0.214	0.063
No. obs.	384	384	384	320	320	320	320

[a] Raw DiD differential is defined as $(\overline{\log N_t^T} - \overline{\log N_1^T}) - (\overline{\log N_t^C} - \overline{\log N_1^C})$.
[b] Conditional DiD differential for $\log N$ is given by γ_k in Equation (8).
[c] Differential on $\Delta N_{jt}/\bar{N}_{jt}$ is given by γ_k' in Equation (9), which decomposes into hires and separations.
[d] Sum of employment change over 2002 … 2006; see Equation (10).