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Trust-Based Working Time and Organizational Performance: Evidence from German Establishment-Level Panel Data

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Abstract

This paper empirically examines the impact of trust-based working time on firm performance using panel data from German establishments. Trust-based working time is a human resource management practice that involves a high degree of worker autonomy in terms of scheduling individual working time. From the theoretical viewpoint, trust-based working time may affect worker motivation positively as well as negatively. Therefore, at the establishment level the performance effects of trust-based working time remain an open question. The analysis shows that both establishment productivity and profitability increase with the diffusion of trust-based working time. Referring only to establishments with trust-based working time arrangements, both performance effects are estimated at about 1-2 percent, while in the full sample both performance effects are stronger ranging between about 2.5 and 5 percent.

JEL Classification: J24; J81; M50

Keywords: Trust-based working time, working time flexibility, firm performance

Trust-based working time is not just another flexible working time arrangement. In fact, trust-based working time can be seen as a means of transition to flexible working hours that involves an increase along two dimensions: working time flexibility and employee discretion. To a large extent the allocation of working time is up to the employees concerned. As a consequence, the employer does not need to register and control the employees' working time any longer. Instead, the employer can control whether or not the employee achieves his fixed objectives. Hence, trust-based working time implies a shift from input control (recording working hours) to output control (recording goal achievement). In the end, therefore, the notion of trust-based working time does not necessarily mean that the employer really trusts the employees in terms of not abusing their newly gained working time authority by arbitrarily reducing working effort.

In recent years, trust-based working time has become more popular. For example, according to estimations of the Cologne Institute for Economic Research, 46 % out of 1,319 interviewed companies employ workers facing the conditions of trust-based working time (Institut der deutschen Wirtschaft 2010). Graf et al. (2007) determine a slightly lower value for Swiss firms. Moreover, 14 % of the employees surveyed report that they are free to set their working hours on their own responsibility.

The use of trust-based working time may have positive or negative effects on establishment performance largely depending on how employees respond to this kind of working time flexibility. When a high amount of working time discretion contributes to increase worker motivation or decrease establishment costs, trust-based working time is likely to increase establishment performance. For example, establishments with trust-based working time arrangements may effectively reduce direct administrative costs and unit labor costs by eliminating working time registration or cutting overtime, respectively. If, however, more working time autonomy was associated with increasing counterproductive worker behavior due to inequality issues or self-organized work intensification perceived as necessary to achieve the fixed objectives, establishment performance would rather be expected to decline. All in all, therefore, from a theoretical perspective the impact of trust-based working time on establishment performance is heterogeneous and the net effect is ex ante unclear.

The aim of the present paper is to empirically investigate the impact of trust-based working time on establishment performance. For this purpose, we use panel data from German estab-

lishments (the IAB Establishment Panel). Establishment performance is thereby measured by both establishment productivity and profitability. Our econometric model is based on a Cobb-Douglas production function which is augmented by the share of trust-based working time workers as our main explanatory variable. Our estimation strategy accounts for potential endogeneity biases caused by unobserved establishment characteristics, reverse causality or selectivity, so the parameter estimates can be viewed as causal effects.

Our paper adds to the existing literature in various ways. To the best of our knowledge, the present study is the first that empirically examines the impact of trust-based working time on organizational performance using a large-scale establishment-level data set. Furthermore, since our parameter estimates can be interpreted as causal effects, our results allow the derivation of management implications for the effective use of trust-based working time.

Theoretical Background

First of all, it has to be mentioned that the use of trust-based working time is likely to affect the well-being and wealth of both workers and employer. Thereby, trust-based working time may involve beneficial or unfavorable consequences for both labor market parties. The following discussion summarizes the pros and cons of trust-based working time from the perspective of the workers and the employer.

According to the job characteristics model of Hackman and Oldham (1976; 1980), the employees' work motivation can be improved by job design. Thereby, an appropriate job design takes the following job characteristics into account: skill variety, task identity and significance, worker autonomy and feedback. The job characteristics model predicts that high degrees of these job characteristics are likely to improve working conditions and thus also have a positive impact on work morale and job performance. Since trust-based working time is a human resource management tool that contributes to improve at least two of these job characteristics just mentioned – i.e., worker autonomy and feedback – we can assume a positive influence of trust-based working time on worker motivation and performance.[1]

[1] Applying a model of employee attendance, Dalton and Mesch (1990) argue similarly predicting a negative relationship between flexible working time arrangements and absenteeism through increases in worker autonomy, responsibility and job satisfaction.

Another benefit for the workers may result from the change of the establishment's working time culture which accompanies the implementation of trust-based working time (MacEachen et al. 2008). The transition from working time registration to a management by objectives strategy involves a break with the attendance clock era. This strategy change signals that not the workers' pure attendance time at the firm has to be remunerated but the workers' goal achievement (Böhm et al. 2004). As a result, workers are encouraged to design their working time more efficiently and develop a time management that allows them to balance work, leisure and family. Hence, workers may find trust-based working time beneficial, because working time discretion contributes to improve their work-life balance and may thus increase job satisfaction and motivation (Singe and Croucher 2003; MacEachen et al. 2008). In this sense, trust-based working time may also be viewed as a gift from the employer that allows employees to balance their work and life responsibilities (Perry-Smith and Blum 2000; Rau and Hyland 2002). In exchange to the employer's gift, therefore, workers are assumed to respond by providing a high effort level.

Similar to this reasoning, Pierce and Newstrom (1980) as well as Baltes et al. (1999) argue that employees working under flexible time arrangements can adapt more efficiently to individual circadian rhythms and are thus more able to harmonize competing demands. Since trust-based working time implies that the employer considers individual preferences and circadian rhythms to a large extent, the employees' attitudes and behaviors towards their work may be improved leading to higher work morale.

Although the reasoning so far emphasizes the perspective of the workers responding positively to trust-based working time, it can easily be seen that an increased worker motivation caused by a high degree of working time discretion is also likely to have a positive impact on organizational performance (Böhm et al. 2004). Consequently, trust-based working time may not only be beneficial for the workers concerned but also for the employer via increased establishment performance measures like productivity, profitability or employee retention (Singe and Croucher 2003; Wingen et al. 2004).

Apart from the anticipated positive effects of trust-based working time on establishment performance resulting from positive worker responses there are direct cost effects associated with this measure of working time flexibility. First, trust-based working time implies an elimination of direct administrative costs of working time registration. Second, trust-based working

time contributes to lower unit labor costs by cutting overtime. When working time is no longer recorded, overtime is reduced or even eliminated by construction (Wingen et al. 2004).

As mentioned earlier, trust-based working time may contribute to improve the work-life balance of employees by delegating the decision right of working time discretion. Consequently, employers can use trust-based working time as a tool for recruiting and retaining qualified employees, provided that these employees are interested in scheduling their working time autonomously (Singe and Croucher 2003). In this context, trust-based working time is also in line with broader societal developments such as the change of the traditional image of the family, the increasing labor supply of women and single parents or the change in values and increasing diversity of lifestyles. The consideration of these developments within a single measure of flexible working hours consequently improves the attractiveness of the company for potential employees (Rau and Hyland 2002; Wingen et al. 2004).

Ultimately, the reasoning so far is insistently in line with the hypothesis that trust-based working time is going to enhance organizational performance, e.g., via increased worker motivation or the reduction of establishment costs. On the other hand, however, trust-based working time might also have a negative impact on establishment performance. For example, increased working time discretion may induce an employee to intensify his working effort in order to reach the fixed goals. As a result, separating working time from leisure time becomes more and more difficult. Moreover, replacing input by output control might put additional pressure on the employee who therefore responds by increasing his actual working time and neglecting work-life balance issues. However, instead of being more productive, this self-organized work intensification may crowd out intrinsic worker motivation and even harm the mental and organic health of employees. As a consequence, according to this work intensification hypothesis, establishment performance might also be inhibited, for example, by increased absenteeism or productivity losses (Singe and Croucher 2003; Wingen et al. 2004; Böhm et al. 2004).

Trust-based working time may also contribute to worsen the organizational climate and is then likely to affect organizational performance negatively. This statement can be explained by the fact that trust-based working time implies a decoupling of working time and attendance time. Under the regime of trust-based working time employees perform less visible for others than under the regime of working time registration. As a consequence, trust-based working time employees are endangered to be perceived as less productive, less committed or labeled

as free riders. Such a situation can lead to mutual monitoring, social conflicts and dysfunctional activities among co-workers, so in the end organizational climate and thus organizational performance may be harmed substantially (Singe and Croucher 2003; Ngo et al. 2009).[2]

This reasoning is consistent with equity theory (Adams 1965). According to equity theory employees compare their reward-contribution ratio with the corresponding ratio of co-workers. If the reference worker's reward-contribution ratio is perceived to exceed the own ratio, the concerned worker identifies inequality and can thus be expected to take actions in order to reduce perceived inequality. In the present case, trust-based working time employees may be perceived as privileged compared to employees working under the regime of time registration. In order to respond to perceived inequality workers may act counterproductive, for example, by reducing their effort level, so that establishment performance will also be affected negatively.

All in all, therefore, the theoretical discussion with respect to the impact of trust-based working time on firm performance is heterogeneous. Trust-based working time may be associated with positive or negative performance effects, so the net effect remains an open question that calls for an empirical analysis shedding light on this issue. Before turning to the empirical analysis, however, we provide a brief review of the related empirical literature.

Related Literature

Empirical evidence on the performance effects of trust-based working time is scarce. The related empirical research largely refers to flexible working time arrangements other than trust-based working time. Roughly speaking the empirical work which is relevant to our study can be separated into three areas. At first, there are various studies examining the effects of flexible working time at the individual level. Other studies explicitly focus on the impact of flexible working hours on organizational performance. Finally, the third area consists of studies that investigate the effects of trust-based working time on individual and firm performance.

The first stream of related literature addresses the impact of flexible working time on outcomes measured at the worker level. The adaption of flexible working time arrangements af-

[2] Furthermore, such a corporate culture may encourage employees who have the option for trust-based working time not to make use of it since they expect negative consequences for their career opportunities or regarding their perceived commitment.

fects employment and work organization patterns and thus the employees concerned (De Menezes and Kelliher 2011; Beauregard and Henry 2009; Perry-Smith and Blum 2000). Many empirical studies reveal a positive impact of flexible working time arrangements on employee performance (Baltes et al. 1999; Kauffeld et al. 2004), attitudinal and behavioral outcomes like job satisfaction, worker well-being and motivation (McNall et al. 2010; Scandura and Lankau 1997) and wages (Winder 2009; Beblo et al. 2004). The main argument in this context is that flexible working time improves the employees' work-life balance which in turn increases their motivation and productivity. On the other hand, there are studies finding negative effects of flexible working time on worker outcomes like health and well-being (Janssen and Nachreiner 2004) as well as work-life balance (Baltes et al. 1999). An explanation for this finding is that flexible arrangements of work hours are often subject to company control and decision, so these arrangements involve only little worker autonomy. All in all, therefore, the effects of flexible working time on worker performance largely depend on the fact whether or not working time flexibility is accompanied by worker autonomy (Stavrou and Kilaniotis 2010).

The studies of Askenazy and Caroli (2006) as well as Origo and Pagani (2008) investigate the influence of flexible working time on employee outcomes in the context of a series of innovative work practices such as part-time work, employee involvement, job rotation, work autonomy and teamwork. Regarding the impact on working conditions and subjective well-being at work, Askenazy and Caroli (2006) find that flexible working times are associated with more mental strain and greater time pressure which supports the work intensification hypothesis. Similarly, Origo and Pagani (2008) obtain no or negative effects of flexible working hours and other forms of quantitative workplace flexibility on job satisfaction, while they find a positive impact of employee involvement, work autonomy and other forms of qualitative workplace flexibility. This finding suggests a complementary relationship between flexible working hours and worker autonomy.

Another stream of empirical literature considers the influence of flexible working time arrangements on a range of organizational performance measures. In this context, some studies show that firms providing flexible working time arrangements may benefit from reductions in absenteeism and labor turnover (Stavrou and Kilaniotis 2010; Konrad and Mangel 2000; Stavrou 2005). This finding can again be explained with an improved work motivation resulting from the delegation of working time discretion. In line with this reasoning, other studies find

that firms offering flexible working time arrangements are less likely to have problems in terms of recruiting skilled workers (Rau and Hyland 2002; Dalton and Mesch 1990).

In a recent study, Muehler and Steffes (2011) analyze the relationship between various human resource practices and employee retention. Thereby, the human resource practice 'working time flexibility' also includes trust-based working time. The most important result for our purposes is a positive link between flexible working times and employee retention. Consistent with the reasoning pointed out above this result can be explained by increased job satisfaction resulting from improved time discretion. However, since trust-based working time in this study is seen as a part of a coherent system of human resource practices, an isolated effect cannot be identified exactly.

Moreover, there are studies that focus on the impact of flexible working time on direct performance measures like firm productivity (Shepard III et. al. 1996; Konrad and Mangel 2000; Bloom et al. 2011) firm efficiency (Wolf and Beblo 2004; Kerkhofs et. al. 2008; Perry-Smith and Blum 2000) and financial performance (Sands and Harper 2007; Arthur 2003). These studies find quite mixed effects that largely depend on the specific type of flexible working time arrangement as well as the concrete measure of organizational performance. Furthermore, there are differences with respect to the empirical strategy and data availability. For example, Shepard III et al. (1996) find that flexible working time increases firm productivity by about 10 percent. This study, however, is restricted to the pharmaceutical sector and additionally lacks from not accounting for other human resource practices that are possibly correlated with the use of flexible working time. In contrast, the data used in the study of Wolf and Beblo (2004) provide detailed information about other human resource practices that are often implemented together with flexible working hours, so the authors can disentangle diverse effects resulting from flexible working times and other human resource practices. Their main finding is that moderate working time flexibility is positively related to firm efficiency, while stronger working time flexibility seem to have a negative impact. The authors conclude, however, that their results should not be interpreted in terms of causal effects.

Similar to the studies at the individual-level, the empirical studies at the firm-level do also often differ with respect to the conceptualization of flexible working time arrangements. More precisely, working time flexibility is often analyzed in the context of family-friendly workplace practices (Perry-Smith and Blum 2000; McNall et al. 2010; Bloom et al. 2011) or high

performance work systems including practices such as the reduction of hierarchies, employee involvement and autonomy or self-managed work groups. Here, various studies identify significant complementarities between broadly defined flexible workplace practices regarding firm performance (e.g., MacDuffie 1995; Wolf and Zwick 2002; White et al. 2003).

Finally, a third stream of literature relates to studies that explicitly focus on the relationship between trust-based working time and individual or firm performance. As already mentioned, empirical evidence on this topic is really scarce. Furthermore, to a large extent the inference of performance effects is derived from business case studies and interviews of employees and managers in terms of their experiences with trust-based working time. For example, MacEachen et al. (2008) find qualitative evidence for increasing working intensity caused by trust-based working time. Moreover, Wingen et al. (2004) as well as Neubert and Thomas (2005) detect a positive effect of trust-based working time on performance measures like employee satisfaction, productivity, customer orientation or declining absenteeism. In contrast, Böhm et al. (2004) and Haipeter (2001) do not identify a clear trend. On the one hand, positive performance effects can be observed caused by enhanced worker autonomy and a changing corporate working time culture. On the other hand, some evidence is consistent with the work intensification hypothesis. However, due to small sample sizes or the case study character of the analyses these results fail to be representative.

From a methodological perspective the study of Hanglberger (2010) is quite near to our analysis. Using the German Socio-Economic Panel and specifying a fixed effects model, the author estimates the impact of flexible working time arrangements – including trust-based working time – on employee job satisfaction. The most important result from our viewpoint is a positive effect of trust-based working time on employee job satisfaction. However, contrary to our study, Hanglberger (2010) does not account for reverse causality or selectivity. Moreover, his analysis is based on individual-level data, while our study uses establishment-level data.

To sum up, the empirical literature on the impact of flexible working hours on individual or firm performance is not unambiguous. There a several reasons for this impression. Most importantly, the spectrum of flexible working time arrangements is quite large containing a series of single practices that are relatively heterogeneous. Trust-based working time is one of these practices. As a result, the performance effects of working time flexibility largely depend

on the specific working time measure. They cannot be generalized or transferred to other measures of working time flexibility (De Menezes and Kelliher 2011; Beauregard and Henry 2009).

Given these mixed and less clear-cut results, the empirical evidence so far is not able to shed light on the impact of trust-based working time on establishment performance. To the best of our knowledge, our study is the first that empirically examines the performance effects of trust-based working time using a large-scale data set at the establishment-level. Moreover, none of the existing studies on the effects of trust-based working time take the potential endogeneity of this kind of working time flexibility into account. As a result, the estimated effects of trust-based working time cannot be interpreted as causal effects, but represent simple correlations instead.[3] At the establishment level, however, the implementation of trust-based working time is likely to be endogenous, since establishments using this measure of working time flexibility can be expected to differ systematically from non-using establishments. For example, successful establishments may be more likely to implement trust-based working time arrangements, so trust-based working time itself may be a function of establishment performance. Therefore, an important objective of our empirical investigation is to control for selectivity biases and unobserved firm characteristics using panel data and applying appropriate estimation methods.[4] In this sense, our paper should add quite substantially to the empirical literature on the performance effects of trust-based working time.

Data, Variables and Descriptive Statistics

In our study, we use the establishment panel data of the Institute for Employment Research (IAB). The IAB Establishment Panel is an annual survey of over 15,000 establishments of all size classes and industries, which makes it being the most extensive establishment-level data set in Germany. The firms are selected from a parent sample of all German establishments that employ at least one employee covered by social security. This parent sample can be considered as complete, because firms have to report about their employees under social security by law. The selection method is stratification with respect to ten categories of establishment size and 16 economic sectors. This is why an establishment's probability of being selected

[3] The study of Hanglberger (2010) is an exception to this statement, because the author at least controls for unobserved (time-constant) individual characteristics.

[4] In fact, the lack of empirical work that allows the derivation of causal performance effects of flexible working time arrangements has recently been criticized by De Menezes and Kelliher (2011), Beauregard and Henry (2009) as well as Stavrou and Kilaniotis (2010).

increases with employment. Hence, the IAB Establishment Panel is approximately proportional to employment and therefore representative for the German economy. A large set of questions are covered periodically, such as employment and wages, sales, investments, international trade, innovations, organizational change, worker representation, as well as vocational and continuing training. Additionally, special topics are covered by the questionnaire every year. For example, the incidence of trust-based working time is covered regularly every two years since 2004, while the diffusion of trust-based working time is solely covered in the panel wave of 2006.[5]

In order to estimate the impact of trust-based working time on organizational performance we use both establishment productivity (measured as total sales) and establishment profitability (measured as total sales minus wage bill) as performance measures. Our key explanatory variable is the diffusion of trust-based working time captured by the number of employees working under the regime of trust-based working time relative to total employment. Finally, we use a set of control variables that are quite common in estimating the performance effects of certain human resource management practices within a production function framework of the Cobb-Douglas type. Note that the vector of control variables also contains various measures of working time arrangements other than trust-based working time. Herewith, we take some of the related literature into account indicating that the implementation of a certain innovative work practice is often accompanied by other human resource practices. Hence, this proceeding enables a more precise estimation of the isolated performance effect of trust-based working time. Table A1 in the appendix provides the definitions and descriptive statistics of the complete set of variables used in this study.

Figures 1 and 2 provide some descriptive information on the incidence of trust-based working time within selected industries and establishment size classes.

[Insert Figure 1 and Figure 2 about here]

The statistics in figures 1 and 2 clearly demonstrate that trust-based working time has been becoming more and more popular irrespective of sector affiliation and firm size. However, banks and insurance companies are especially likely to offer trust-based working time arrangements to their employees. More than 50 % of the firms in this industry apply this in-

[5] For an introduction to the IAB Establishment Panel see Fischer et al. (2009).

strument of working time flexibility followed by establishments of the sectors firm-related services as well as mining and energy, where almost 40 % have implemented a trust-based working time arrangement. Apart from the positive time effect, Figure 2 additionally demonstrates that the incidence of trust-based working time increases with establishment size.

Figure 3 displays the diffusion of trust-based working time depending on establishment size. Thereby, the displayed values represent the share of workers with trust-based working time arrangements in establishments that have already implemented this measure of working time flexibility. Not surprisingly, there is an inverse relationship between the proportion of trust-based working time employees and establishment size. Note, however, that the share of trust-based working time employees appears to remain quite stable at a level of almost 15 % in establishments with more than 100 employees.

[Insert Figure 3 about here]

Econometric Model

In order to estimate the performance effects of trust-based working time, we specify a Cobb-Douglas production function which is augmented by the share of trust-based working time employees relative to total employment, $\%T$, and a set of control variables X. Our basic econometric model, therefore, is

$$\ln P_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \gamma \%T_{it} + \delta' X_{it} + \mu_i + \xi_t + u_{it} \,, \tag{1}$$

where P is our performance measure of establishment i at time t. In total, we apply two performance measures: Y is total sales and serves as a measure for establishment productivity, while $Y - W$ is total sales minus wage bill representing a measure for establishment profitability. Furthermore, K represents capital stock (measured as total investments), L describes the input factor labor (number of employees), and u is an error term with zero mean and finite variance. Finally, ξ_t represents cyclical fluctuations captured by a set of time dummies and μ_i reflects unobserved time-invariant establishment characteristics. The parameter of interest to be estimated is γ.

Our estimation strategy aims at addressing the potential endogeneity of trust-based working time use. Thereby, we treat the establishment's diffusion of trust-based working time as an endogenous explanatory variable in the production function. Ignoring endogeneity issues would probably lead to a biased and inconsistent estimate of γ in equation (1), because establishments are likely to differ systematically in their propensity to adopt trust-based working time based on observed and unobserved factors. For example, an establishment's decision to implement trust-based working time may depend on the skill structure of its workforce as well as performance or business cycle issues. Therefore, our econometric model is a structural model approach that allows for observed and unobserved time-varying establishment characteristics. Specifically, we estimate the following two-equation system:

$$\begin{aligned} \ln P_i &= \beta_1 \ln K_i + \beta_2 \ln L_i + \gamma \%T_i + \delta' X_i + u_i \\ \%T_i &= \theta_1 \ln K_i + \theta_2 \ln L_i + \psi' X_i + \varphi_1 M_i + \varphi_2 \overline{\%T}_{jk} + \eta_i = \pi' Z_i + \eta_i \ . \end{aligned} \tag{2}$$

Here, the first equation in (2) is the structural equation, while the second equation in (2) is the reduced-form (or first-stage) equation. Note that Z includes all explanatory variables specified for the structural equation and additionally contains two exclusion restrictions, M and $\overline{\%T}$, as identifying instrumental variables. The parameters are estimated using the two-stage least squares estimator (2SLS), where the coefficient γ in the structural equation is of particular interest. Since the model in (2) is overidentified with one overidentifying restriction, we can test the validity, i.e., relevance and exogeneity of the applied instruments.

To be valid instruments, the exclusion restrictions must significantly contribute to determine an establishment's share of trust-based working time employees $\%T$ without being correlated with the error term u_i in the structural equation. Here, M is a dummy variable measuring whether or not an establishment applies formalized goal-setting processes according to a management by objectives approach. As explained above, the introduction of trust-based working time implies a change from input control to output control. Consequently, there should be a strong positive relationship between M and $\%T$. Moreover, we apply the group-specific mean of trust-based working time diffusion $\overline{\%T}$ as a technical instrument for an establishment's actual diffusion regarding trust-based working time, i.e., the share of trust-based

working time employees.[6] In our case, a group is determined by establishment size class j and sector affiliation k.[7] $\overline{\%T}_{jk}$ is correlated with $\%T_i$ by construction, but there is no reason to expect that it has an influence on establishment performance in any other way than through its effect on the actual share of trust-based working time employees of this specific establishment, i.e., $\%T_i$. Hence, we use one instrument in substance (M) and one technical instrument ($\overline{\%T}$) to identify the model parameters.

The instrumental variables approach displayed in equation (2) explicitly accounts for potential endogeneity issues like selectivity and reverse causality. However, some studies apply estimation strategies that additionally control for time-constant unobserved heterogeneity in the production function. Since our key explanatory variable $\%T$, i.e., the share of trust-based working time employees, is only available in the panel wave of 2006, we cannot account for unobserved establishment heterogeneity estimating a conventional fixed effects model. However, an appropriate solution in this case has been proposed by Black and Lynch (2001).[8] Applying their two-step estimation strategy allows us to control for unobserved heterogeneity in a situation, where the core explanatory variable is only available in one panel wave.

According to the first step of the Black and Lynch approach, we estimate a standard Cobb-Douglas production function using the within estimator. This Cobb-Douglas function is augmented by year and sector dummies to control for cyclical shocks and sectoral developments. Hence, the first-stage estimation equation can be written as

$$\ln P_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \alpha' S_t + \lambda' I_{it} + \mu_i + u_{it} \,, \tag{3}$$

where the vector S contains the year dummies and I denotes sector affiliation. From the estimates of equation (3) we calculate the establishment-specific, time-invariant component of the residual, i.e.,

$$\hat{\mu}_i = \overline{\ln P_i} - \hat{\beta}_1 \overline{\ln K_i} - \hat{\beta}_2 \overline{\ln L_i} - \hat{\alpha}' \overline{S} - \hat{\lambda}' \overline{I}_i \,, \tag{4}$$

[6] In a similar way group-specific means have also been used as technical instruments, for example, in Woessmann and West (2006) and Mueller (2009). Thereby, Woessmann and West (2006) are interested in estimating the effects of class-size on student performance, while Mueller (2009) focuses on the productivity effects of works councils in Germany.

[7] All in all, we defined six establishment size classes and eight economic sectors.

[8] The Black and Lynch estimation approach has previously been applied, for example, in Zwick (2004; 2005).

where the bars over the respective variables represent average values over time. The establishment fixed effect $\hat{\mu}_i$ measures whether individual performance structurally exceeds or falls below the performance of other establishments. In the second step, $\hat{\mu}_i$ is regressed on the trust-based working time variable $\%T$ and a set of (quasi-fixed) control variables X:

$$\hat{\mu}_i = \gamma \%T_i + \delta' X_i + \varepsilon_i \,, \tag{5}$$

where ε_i is an i.i.d. random variable. The coefficient γ is of particular interest, because its estimate represents the impact of the internal diffusion of trust-based working time on the fixed effect of an establishment's performance. The parameters in equation (5) are estimated by conventional ordinary least squares.

In order to simultaneously account for both selectivity and unobserved establishment heterogeneity in the production function, we combine the Black and Lynch approach with our structural model approach in equation (2) and yield

$$\begin{aligned} \hat{\mu}_i &= \gamma \%T_i + \delta' X_i + u_i \\ \%T_i &= \psi' X_i + \varphi_1 M_i + \varphi_2 \overline{\%T}_{jk} + \eta_i \,. \end{aligned} \tag{6}$$

In the end, the estimate of γ is the causal effect of trust-based working time diffusion on establishment performance.

Empirical Results

Table 1 displays the performance effects of trust-based working time (parameter γ) applying different estimation techniques.[9] The cross-section OLS estimates for equation (1) thereby serve as a reference for the estimates resulting from 2SLS as well as 2SLS in combination with the Black and Lynch approach (equations (2) or (6), respectively). Table 1 displays the

[9] In our analysis we exclude non-profit establishments and the public sector. Furthermore, we exclude establishments of the banking and insurance sector because our dependent variables are based on total sales. However, since the corresponding measure for banks and insurance companies is based on total assets instead of total sales, we decided not to consider these companies in our analysis.

estimates for the full sample and a restricted sample including only the establishments with trust-based working time arrangements.[10]

[Insert Table 1 about here]

The OLS estimates reveal an economically quite modest, albeit highly significant performance effect of trust-based working time diffusion with a magnitude of 0.3 percent. Thus, a one percent increase in the share of trust-based working time employees would be associated with a 0.3 percent increase in establishment performance. This holds for both performance measures, i.e., productivity and profitability, and is irrespective of whether we use the full or the restricted sample. However, the OLS estimates are likely to be biased and inconsistent as the OLS approach does not account for the potential endogenous nature of the trust-based working time variable.

The potential endogeneity of trust-based working time diffusion is explicitly addressed using 2SLS and its combination with the Black and Lynch approach.[11] First of all, the necessity to account for an endogenous diffusion of trust-based working time within establishments is strongly indicated by Wooldridge's robust score test (Wooldridge 1995) that – with one exception – rejects the null hypothesis of $\%T$ to be exogenous. Looking at the parameter estimates, we can see a considerable increase of the coefficient for the share of trust-based working time employees relative to the OLS estimates. More precisely, the performance effect rises to about five to six percent in the full sample, at which the profitability effect is even slightly higher than the productivity effect. In the restricted sample, however, which includes only the establishments offering trust-based working time arrangements to their employees, we obtain a performance effect of about one or two percent.[12] These estimates point to quite large performance differences between establishments with and without trust-based working

[10] The OLS estimates of the input factors *K* and *L* as well as the control variables can be found in Table A2 in the appendix. The first-stage estimates resulting from the 2SLS approach are displayed in Table A3 in the appendix. The first-stage estimates according to the Black and Lynch approach are displayed in Table A4 in the appendix. All remaining estimates are available from the authors upon request.

[11] Note that the moderate sample size reduction from 7,999 (855) to 7,693 (823) displayed in Table 1 is caused by the use of the exclusion restrictions.

[12] These performance effects are substantially smaller than the performance effect obtained in the study of Shepard III et al. (1996) who found that flexible working time increases firm productivity by about 10 percent. Although the authors of this study also apply an instrumental variables estimation strategy, one should be careful in terms of comparing the results. As mentioned in the related literature section, the study of Shepard III et al. (1996) is restricted to the pharmaceutical sector, while our analysis covers all sectors apart from banks and insurance companies as well as the public and non-profit sector. Moreover, Shepard III et al. (1996) consider the productivity effects of working time flexibility in general and do not explicitly focus on trust-based working time.

time arrangements. More precisely, the performance differences in the two samples suggest that high performance establishments are more likely to implement trust-based working time than weak performing establishments.[13]

The informative value of the 2SLS estimates largely depends on the validity of the considered exclusion restrictions. Looking first at the parameter estimates of the exclusion restrictions displayed in Table A3 in the appendix, we can see that both instruments are highly significant and thus relevant. Moreover, they exhibit the expected positive sign. The relevance of the instrumental variables is confirmed by the diagnostic F test displayed in Table 1. This F test checks for joint significance of the chosen exclusion restrictions in the reduced-form equation. The F statistic is always highly significant and even conforms to the often claimed rule of thumb, i.e., $F > 10$. Finally, the exclusion restrictions can be considered as exogenous. This result is provided by Wooldridge's robust score test of overidentifying restrictions (Wooldridge 1995) which is – leaving aside one exception – insignificant at the 5 % level. Hence, the diagnostic tests support the validity of the exclusion restrictions and thus the informative value of the (combined) 2SLS estimates. All in all, therefore, our empirical results are consistent with the work motivation hypothesis emphasizing the benefits of trust-based working time for both workers and establishments.

Sensitivity Analysis

In this section we run additional regressions that are intended to check the robustness of our estimation results presented previously. Thereby, we examine whether our results are affected by the application of an imputation technique that aims at addressing a potential missing value problem with regard to our key explanatory variable $\%T$. The missing value problem may result from the fact that information about the share of employees with trust-based working time arrangements is only requested from those establishments that use trust-based working time just in some areas or departments. Unfortunately, the corresponding information from establishments applying trust-based working time for the entire establishment is not requested. As a consequence, a substantial number of establishments that definitely use trust-

[13] This interpretation is confirmed by the results of a complementing regression analysis, where we estimate the performance effects of trust-based working time diffusion applying an endogenous switching regression model. Here, we find that in both performance equations the respective coefficients for inverse Mill's ratio are negative and highly significant which suggests that high performing establishments are systematically more likely to apply trust-based working time than their lower performing counterparts.

based working time arrangements is excluded from providing information on the internal diffusion of trust-based working time. This scenario may even cause a sample selection bias.

We respond to this problem by predicting the missing shares of trust-based working time employees from the information provided by establishments using trust-based working time just in some areas of the establishment. Thereby, we assume that establishments with a company-wide application of trust-based working time are more likely to employ a higher fraction of trust-based working time employees than establishments with a quite selective use of this practice. Our further proceeding can then be described in three steps. At first, we group the establishments with respect to establishment size class j and sector affiliation k. In the second step, we calculate the 75 percent and the 90 percent quantil of our variable of interest, i.e., $\%T$ for each of the groups using the available information from the establishments with a selective use of trust-based working time. Finally, we replace the missing values for the establishments with a company-wide trust-based working time use by imputing the respective quantiles obtained for every group. All in all, therefore, this imputation strategy is a convenient procedure to address the described missing value problem adequately.[14]

The application of the imputation technique just introduced allows us to increase the number of observations for our main explanatory variable $\%T$ by 735 establishments from 7,999 to 8,734 (all establishments) or from 855 to 1,590 (establishments with trust-based working time arrangements), respectively. However, the use of the two exclusion restrictions M and $\overline{\%T}$ required for the 2SLS estimations again slightly reduces effective sample size to 8,386 (all establishments) or 1,516 (establishments with trust-based working time arrangements), respectively.

With regard to the estimation strategy we proceed analogously to our approach in the previous section and estimate the equation system

$$\begin{aligned} \hat{\mu}_i &= \gamma \%T_i^q + \delta' X_i + u_i \\ \%T_i &= \psi' X_i + \varphi_1 M_i + \varphi_2 \overline{\%T}_{jk}^q + \eta_i \ , \end{aligned} \tag{7}$$

[14] We decided to apply this imputation technique as potential alternatives using predictions from regression or interpolation methods exhibit some limitations. See Cameron and Trivedi (2010, p. 47). The present scenario, for example, requires an imputation technique accounting for the fact that we observe missing values just for those establishments which are especially likely to employ large fractions of trust-based working time workers.

where q describes the respective quantil, i.e., $q = 75, 90$. Table 2 displays the resulting 2SLS estimates of γ for our modified main explanatory variables $\%T^{75}$ and $\%T^{90}$.[15]

[Insert Table 2 about here]

The second-stage estimates for $\%T^{75}$ and $\%T^{90}$ largely confirm the results discussed in the previous section. After controlling for an endogenous diffusion of trust-based working time within a structural model approach both the productivity and the profitability effect are positive and highly significant. Interestingly, in those specifications applying the full sample the profitability effect slightly exceeds the productivity effect, which indicates a small negative wage bill effect of trust-based working time diffusion.[16]

Comparing the point estimates for $\%T^{75}$ and $\%T^{90}$ with the corresponding estimate for $\%T$ in the previous section, we find slightly smaller values for $\%T^{75}$ and $\%T^{90}$ than for $\%T$. This outcome might be interpreted as an indication for diminishing marginal returns. Both $\%T^{75}$ and $\%T^{90}$ represent variables, where the missing values for those establishments with a company-wide use of trust-based working time arrangements are replaced by the group-specific 75 or 90 percent quantil. Hence, this imputation procedure is associated with an increasing average share of trust-based working time employees relative to the shares measured by $\%T$. According to our findings, relatively moderate proportions of trust-based working time employees are associated with slightly higher performance effects than higher employment shares generated by the imputation technique. However, we abstain from interpreting this finding in terms of a non-linear (concave) performance effect for two reasons. First, the results of this section are substantially based on imputed values added to actual observations. Second, we observe that the performance effects of $\%T^{90}$ slightly exceed those obtained for $\%T^{75}$. This finding, however, is not consistent with a concave performance effect of trust-based working time diffusion.

[15] The first-stage estimates and the second-stage estimates of the covariates are available from the authors upon request.

[16] However, additional 2SLS wage bill estimations do not support this statement. The wage effect of trust-based working time diffusion turns out to be very small and mostly insignificant.

The diagnostic tests conducted to check the endogeneity problem as well as the validity of the considered exclusion restrictions provide comparable results to those obtained in the previous section. Note, however, that in the sample including only the trust-based working time establishments the estimated productivity effects might suffer from an endogeneity problem concerning the exclusion restrictions. Here, the robust score test of overidentifying restrictions rejects the null hypothesis of exogenous instruments at the 5 percent level, so the corresponding point estimates should be interpreted cautiously. As an alternative, however, we consider the 2SLS estimates resulting from equation (2), where $\%T$ is replaced by $\%T^{75}$ or $\%T^{90}$ and $\overline{\%T}$ is replaced by $\overline{\%T}^{75}$ or $\overline{\%T}^{90}$, respectively. In the end, the resulting point estimates are very similar to those displayed in Table 2. This holds for both magnitude (0.009 and 0.007) and significance. However, the robust score test of overidentifying restrictions does no longer reject the null hypothesis of exogenous instruments ($\chi^2 = 2.193$, $p = 0.138$ and $\chi^2 = 2.457$, $p = 0.117$), which indicates the validity of our instruments in this case. All in all, therefore, the results of our sensitivity analysis support the estimates in the previous section. Hence, we conclude that our findings are insistently in line with the work motivation hypothesis emphasizing the beneficial consequences of trust-based working time for the workers concerned and thus the respective establishments.

Conclusion

In this paper we empirically examine the impact of trust-based working time on firm performance using German establishment-level panel data. The implementation of trust-based working time is associated with a high degree of worker autonomy with regard to scheduling individual working time. Theoretically, workers may respond positively as well as negatively to their newly gained time flexibility depending on whether trust-based working time increases or declines individual worker motivation.

Based on an augmented Cobb Douglas production function we find that both establishment productivity and profitability increase with the diffusion of trust-based working time to a similar extent. Thereby, the estimated performance effects range between about 2.5 and 5 percent, when we consider all establishments in the sample. However, when we restrict our analysis to establishments offering trust-based working time arrangements at all, both performance effects reduce to about 1-2 percent. This performance difference in the two samples

suggests that high performance establishments are more likely to implement trust-based working time than weak performing establishments. All in all, therefore, our results insistently confirm the work motivation hypothesis assuming positive consequences of trust-based working time for the well-being and wealth of workers and establishments.

Our estimation strategy accounts for the potential endogeneity of trust-based working time diffusion by explicitly addressing unobserved establishment characteristics, reverse causality and selectivity. For this purpose, we combine the 2SLS method with a two-step estimation approach suggested by Black and Lynch (2001). As a consequence, therefore, the parameter estimates can be viewed as causal effects. Moreover, we apply an imputation strategy to overcome a potential missing value problem arising from the construction of the respective questions about trust-based working time issues in the questionnaire. The results of the regressions applying the imputation technique strongly support our previous estimates with respect to the performance effects of trust-based working time diffusion, so we conclude that our results are robust.

The results of our study provide some important management implications for establishments reflecting upon the introduction or extension of trust-based working time arrangements. Most importantly, trust-based working time appears to be a valuable human resource practice, so employers can be encouraged to adopt or even intensify trust-based working time arrangements.

The remaining implications follow from the first-stage estimations of our instrumental variables approach which are displayed in Table A3 in the appendix. First, there is a complementary relationship between trust-based working time and some other practices of working time flexibility. Hence, trust-based working time can be integrated to a system of flexible working time practices that includes changes in the working time of part-time workers, the introduction of working time corridors or shifted working times.

Second, there is a strong correlation between the diffusion of trust-based working time and a skilled workforce. This suggests that trust-based working time is especially productive in firms employing relatively high shares of skilled workers. In other words, firms with a high share of low-skilled workers should be careful regarding the implementation of trust-based

working time. Perhaps these firms are better off when they maintain the traditional regime of working time registration.

Finally, firms facing worker representations, i.e., unions and works councils, are encouraged to look for a constructive dialogue with these institutions as according to our first-stage estimations unions and works councils obviously tend to oppose the introduction or diffusion of trust-based working time. A possible explanation for this finding is that worker representatives believe in the work intensification hypothesis discussed above. Although our results in the present study do not support the work intensification hypothesis, additional empirical work has to be done to draw more precise conclusions in this respect. For example, examining the impact of trust-based working time on workers' health would contribute substantially to discriminate between the work intensification and work motivation hypothesis.

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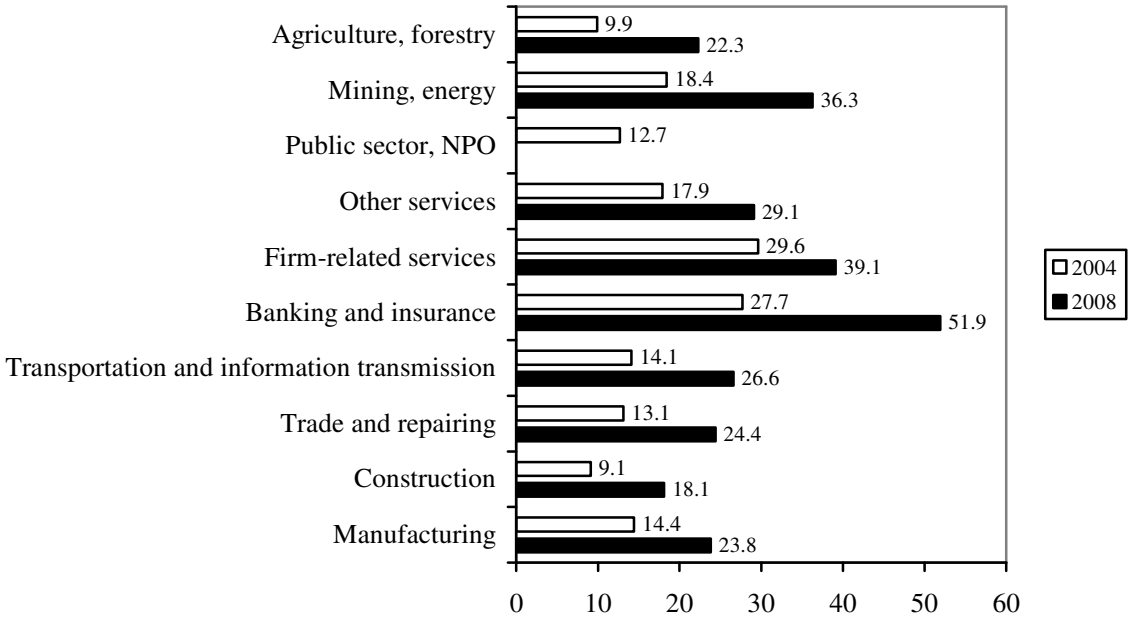
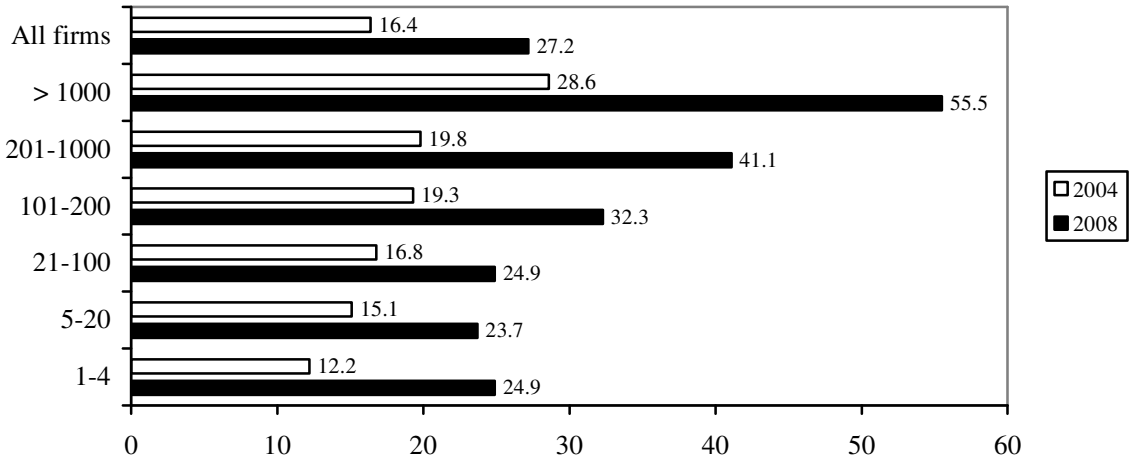
Figure 1. Incidence of Trust-Based Working Time by Sector Affiliation



Note: The displayed values are percentages. The calculations are restricted to establishments that do not provide item non-responses for the subsequent regression analysis. Due to data protection the share of establishments in the public sector / non-profit organizations must not be displayed for 2008. Sample size in 2004 (2008) is 10,741 (9,252).

Source: IAB Establishment Panel 2004 and 2008, own calculations.

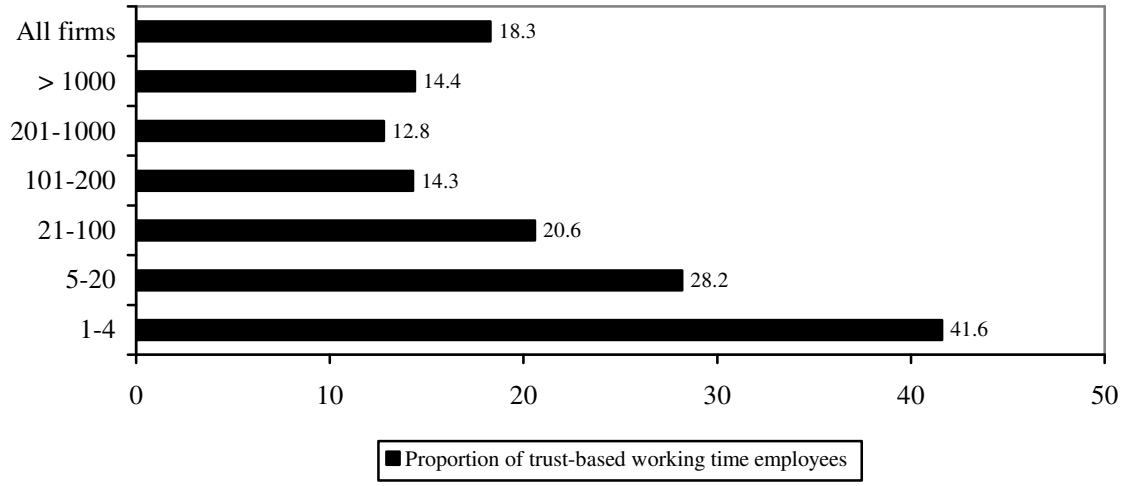
Figure 2. Incidence of Trust-Based Working Time by Establishment Size (Number of Employees)



Note: The displayed values are percentages. The calculations are restricted to establishments that do not provide item non-responses for the subsequent regression analysis. Sample size in 2004 (2008) is 10,741 (9,252).

Source: IAB Establishment Panel 2004 and 2008, own calculations.

Figure 3. Diffusion of Trust-Based Working Time by Establishment Size



Note: The displayed values are percentages. The calculations are restricted to establishments that do not provide item non-responses for the subsequent regression analysis. Sample size is 855.

Source: IAB Establishment Panel 2006, own calculations.

Table 1. Performance Effects of Trust-Based Working Time Diffusion

Estimation strategy	OLS		2SLS		2SLS combined with Black & Lynch approach	
	All establishments	Trust-based working time establishments	All establishments	Trust-based working time establishments	All establishments	Trust-based working time establishments
Model specification	(1)	(1)	(2)	(2)	(6)	(6)
Dependent variable: ln *Y*						
%T	0.003*** (0.007)	0.003** (0.037)	0.056*** (0.001)	0.013** (0.033)	0.050*** (0.001)	0.021*** (0.002)
Score test (endogeneity)			26.977*** (0.000)	3.647* (0.056)	24.358*** (0.000)	7.119*** (0.007)
F test (instrument relevance)			11.284*** (0.000)	29.425*** (0.000)	11.284*** (0.000)	18.531*** (0.000)
Score test (overidentification)			3.155* (0.075)	2.154 (0.142)	2.432 (0.118)	4.128** (0.042)
Number of observations	7,999	855	7,693	823	7.693	823
Dependent variable: ln (*Y*−*W*)						
%T	0.003** (0.035)	0.003* (0.070)	0.067*** (0.001)	0.015* (0.077)	0.062*** (0.001)	0.022*** (0.010)
Score test (endogeneity)			31.425*** (0.000)	2.242 (0.134)	29.569*** (0.000)	5.093** (0.024)
F test (instrument relevance)			11.284*** (0.000)	29425*** (0.000)	11.284*** (0.000)	18.531*** (0.000)
Score test (overidentification)			0.449 (0.502)	0.457 (0.498)	0.414 (0.519)	1.965 (0.161)
Number of observations	7,999	855	7,693	823	7,693	823

Note: The values in parentheses represent *p*-values calculated on the basis of robust standard errors. The specifications additionally contain a set of covariates controlling for input factors capital and labor, the structure of the workforce, technological innovations, international trade, worker representation, working time flexibility, regional and sectoral affiliation as well as other establishment characteristics. For more precise information see the estimates of the covariates displayed in Table A2 in the appendix.
*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Source: IAB Establishment Panel, waves 2000 – 2008, own calculations.

Table 2. Performance Effects of Trust-Based Working Time (Specification Using Imputed Values)

Estimation strategy	2SLS combined with Black & Lynch approach			
Dependent variable	ln Y		ln ($Y-W$)	
	All establishments	Trust-based working time establishments	All establishments	Trust-based working time establishments
Model specification	(7)	(7)	(7)	(7)
$\%T^{75}$	0.027***	0.012***	0.044***	0.013***
	(0.000)	(0.001)	(0.000)	(0.003)
Score test (endogeneity)	26.775***	7.299***	44.098***	5.672**
	(0.000)	(0.006)	(0.000)	(0.017)
F test (instrument relevance)	36.541***	76.711***	36.541***	76.711***
	(0.000)	(0.000)	(0.000)	(0.000)
Score test (overidentification)	3.045*	4.239**	0.025	1.351
	(0.081)	(0.039)	(0.872)	(0.245)
Number of observations	8,386	1,516	8,386	1,516
$\%T^{90}$	0.036***	0.009**	0.053***	0.009*
	(0.000)	(0.017)	(0.000)	(0.059)
Score test (endogeneity)	44.193***	4.379**	54.039***	2.635
	(0.000)	(0.036)	(0.000)	(0.104)
F test (instrument relevance)	23.044***	46.510***	23.044***	46.510***
	(0.000)	(0.000)	(0.000)	(0.000)
Score test (overidentification)	0.195	4.917**	0.557	1.766
	(0.658)	(0.026)	(0.455)	(0.183)
Number of observations	8,386	1,516	8,386	1,516

Note: The values in parentheses represent p-values calculated on the basis of robust standard errors. The specifications additionally contain the same set of covariates described in the note to Table 1.
*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Source: IAB Establishment Panel, waves 2000 – 2008, own calculations.

Appendix

Table A1. Definition and Descriptive Statistics of the Variables

Variable	Definition	*N*	Mean	Standard deviation	Min – Max
ln *Y*	Natural logarithm of an establishment's productivity (total sales)	8,757	14.40	2.19	8.72 – 23.11
ln (*Y*–*W*)	Natural logarithm of an establishment's profitability (total sales minus wage bill)	8,757	14.04	2.29	5.29 – 23.06
%T	Share of trust-based working time employees (%): all establishments / trust-based working time establishments	7,999 / 855	1.94 / 18.16	8.47 / 19.44	0 – 97 / 1 – 97
$\%T^{75}$	Share of trust-based working time employees (%) including the group-specific 75 % quantiles: all establishments / trust-based working time establishments	8,734 / 1,590	5.06 / 27.84	13.89 / 20.66	0 – 97 / 1 – 97
$\%T^{90}$	Share of trust-based working time employees (%) including the group-specific 90 % quantiles: all establishments / trust-based working time establishments	8,734 / 1,590	6.70 / 36.80	18.24 / 26.82	0 – 97 / 1 – 97
ln *K*	Natural logarithm of an establishment's total investments	8,757	7.46	5.78	0 – 19.67
ln *L*	Natural logarithm of an establishment's number of employees	8,757	3.05	1.70	0 – 9.71
Skilled workers	Share of skilled and high skilled workers based on total employment (%)	8,757	65.61	26.56	0 – 100
Fixed-term workers	Share of fixed-term workers based on total employment (%)	8,757	4.43	11.28	0 – 100
Part-time workers	Share of part-time workers based on total employment (%)	8,757	20.84	24.64	0 – 100
Apprentices	Share of apprentices based on total employment (%)	8,757	5.06	8.87	0 – 90.47
Female workers	Share of female employees based on total employment (%)	8,757	38.14	29.54	0 – 100
Technical status	Dummy variable calculated from an ordinal variable *TS* ranging between 1 (technologies in use are out-of-date) and 5 (technologies in use are state-of-the-art); 1 if $TS \geq 4$, 0 otherwise	8,757	0.66	0.47	0 – 1
Expansion investments	Share of an establishment's expansion investments based on total investments (%)	8,757	19.72	33.58	0 – 100
Exports	Export share on the basis of total sales (%)	8,757	7.65	18.87	0 – 100
Collective wage bargaining	Dummy variable indicating whether or not establishments commit to collective wage bargaining at industry or firm level	8,757	0.43	0.49	0 – 1
Works council	Dummy variable indicating whether or not an establishment has a works council	8,757	0.24	0.43	0 – 1
Extra pay	Dummy variable indicating whether or not an establishment pays wages above the collective wage bargaining level	8,757	0.20	0.40	0 – 1

Establishment age	Dummy variable indicating whether or not an establishment has been founded before 1990	8,757	0.52	0.49	0 – 1
Private company	Dummy variable indicating whether or not an establishment is managed under the legal form of a one-man business or a business partnership	8,757	0.37	0.48	0 – 1
Foreign ownership	Dummy variable indicating whether or not an establishment has a non-domestic owner	8,757	0.06	0.23	0 – 1
Independent company	Dummy variable indicating whether or not an establishment is autarkic	8,757	0.80	0.39	0 – 1
West German establishment	Dummy variable indicating whether or not an establishment is located in West Germany	8,757	0.60	0.48	0 – 1
Working time account	Dummy variable indicating whether or not an establishment offers the opportunity to use a working time account to their employees	8,757	0.41	0.49	0 – 1
Working at weekends	Dummy variable indicating whether or not employees have to work regularly or partially at weekends	8,757	0.79	0.40	0 – 1
Changes in the working time of part-time workers	Dummy variable indicating whether or not an establishment implements changes in the working time of part-time workers	8,757	0.24	0.43	0 – 1
Working time corridors	Dummy variable indicating whether or not an establishment offers the opportunity to use working time corridors for their employees	8,757	0.10	0.30	0 – 1
Employment securing working time reduction	Dummy variable indicating whether or not an establishment implements working time reduction in order to save jobs	8,757	0.04	0.20	0 – 1
Shifted working times	Dummy variable indicating whether or not an establishment offers the opportunity to shift individual working time for their employees	8,757	0.45	0.49	0 – 1
M	Dummy variable indicating whether or not an establishment applies formalized goal-setting processes	8,406	0.22	0.41	0 – 1
$\overline{\%T}$	Group-specific mean of the share of trust-based working time employees (%): all establishments / trust-based working time establishments	8,757 / 1,599	1.93 / 23.43	1.54 / 11.26	0 – 28.75 / 3 – 57.5
$\overline{\%T}^{75}$	Group-specific mean of the share of trust-based working time employees (%) including the group-specific 75 % quantiles: all establishments / trust-based working time establishments	8,757 / 1,599	5.06 / 27.81	3.38 / 15.60	0 – 28.75 / 3 – 65.57
$\overline{\%T}^{90}$	Group-specific mean of the share of trust-based working time employees (%) including the group-specific 90 % quantiles: all establishments / trust-based working time establishments	8,757 / 1,599	6.68 / 36.78	4.42 / 19.82	0 – 28.75 / 3 – 73

Note: *N* is number of observations. In order to save space the information for regional, sector and time dummies are not displayed.

Source: IAB Establishment Panel, wave 2006, own calculations.

Table A2. OLS Estimates of the Input Factors and Control Variables

Dependent variable	ln Y		ln ($Y-W$)	
Model specification	(1)		(1)	
ln K	0.021***	(0.000)	0.029***	(0.000)
ln L	0.935***	(0.000)	0.896***	(0.000)
Skilled workers (%)	0.004***	(0.000)	0.004***	(0.000)
Fixed-term workers (%)	-0.002***	(0.001)	-0.004***	(0.000)
Part-time workers (%)	-0.007***	(0.000)	-0.007***	(0.000)
Apprentices (%)	-0.003***	(0.001)	-0.001	(0.258)
Female workers (%)	-0.001***	(0.000)	-0.001**	(0.029)
Technical status	0.126***	(0.000)	0.144***	(0.000)
Expansion investments (%)	-0.000	(0.833)	-0.000	(0.375)
Exports (%)	0.005***	(0.000)	0.006***	(0.000)
Collective wage bargaining	-0.000	(0.984)	-0.026	(0.345)
Works council	0.296***	(0.000)	0.384***	(0.000)
Extra pay	0.066***	(0.006)	0.078**	(0.014)
Establishment age	-0.053***	(0.004)	-0.082***	(0.001)
Private company	-0.335***	(0.000)	-0.301***	(0.000)
Foreign ownership	0.243***	(0.000)	0.324***	(0.000)
Independent company	-0.138***	(0.000)	-0.154***	(0.000)
Establishment located in West Germany	0.226***	(0.000)	0.239***	(0.000)
Working time account	-0.003	(0.842)	-0.033	(0.184)
Working at weekends	-0.028	(0.208)	-0.033	(0.260)
Changes in the working time of part-time workers	-0.027	(0.175)	-0.029	(0.277)
Working time corridors	0.088***	(0.003)	0.094**	(0.018)
Shifted working time	0.009	(0.600)	0.026	(0.262)
Employment securing working time reduction	-0.052	(0.135)	-0.079	(0.106)
Sector dummies	yes		yes	
Constant	11.198***	(0.000)	10.916***	(0.000)

Note: The values in parentheses represent *p*-values calculated on the basis of robust standard errors. The estimates refer to the first column of Table 1.
*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Source: IAB Establishment Panel, wave 2006, own calculations.

Table A3. First-Stage Estimates of the Instrumental Variables Approach

Explanatory variable to be instrumented	$\%T$		$\%T^{75}$		$\%T^{90}$	
Model specification	(2)		(2)		(2)	
ln *K*	0.065***	(0.002)	0.058*	(0.077)	0.047	(0.280)
ln *L*	-0.482***	(0.004)	-1.155***	(0.000)	-1.352***	(0.000)
Skilled workers (%)	0.008**	(0.016)	0.030***	(0.000)	0.041***	(0.000)
Fixed-term workers (%)	-0.003	(0.572)	0.016	(0.180)	0.030*	(0.090)
Part-time workers (%)	-0.001	(0.827)	0.008	(0.300)	0.010	(0.346)
Apprentices (%)	0.001	(0.855)	0.006	(0.704)	0.008	(0.684)
Female workers (%)	-0.007*	(0.062)	-0.010	(0.131)	-0.013	(0.149)
Technical status	-0.066	(0.733)	0.083	(0.784)	0.129	(0.745)
Expansion investments (%)	-0.002	(0.384)	0.004	(0.351)	0.008	(0.159)
Exports (%)	0.005	(0.433)	0.016*	(0.087)	0.024**	(0.048)
Collective wage bargaining	-0.596**	(0.011)	-1.375***	(0.000)	-2.177***	(0.000)
Works council	-0.880**	(0.015)	-1.196***	(0.007)	-1.533***	(0.008)
Extra pay	0.315	(0.321)	0.305	(0.445)	0.264	(0.604)
Establishment age	-0.017	(0.933)	0.573*	(0.091)	0.788*	(0.082)
Private company	-0.585**	(0.016)	-1.678***	(0.000)	-2.043***	(0.000)
Foreign ownership	1.627***	(0.008)	2.245***	(0.001)	2.647***	(0.003)
Independent company	-0.355	(0.298)	-0.520	(0.218)	-0.670	(0.233)
Establishment located in West Germany	1.230***	(0.000)	2.980***	(0.000)	4.133***	(0.000)
Working time account	0.555**	(0.031)	-0.005	(0.987)	-0.705	(0.138)
Working at weekends	0.296	(0.217)	0.611	(0.146)	0.518	(0.357)
Changes in the working time of part-time workers	0.657**	(0.029)	1.389***	(0.001)	1.652***	(0.002)
Working time corridors	2.130***	(0.000)	3.739***	(0.000)	4.788***	(0.000)
Employment securing working time reduction	-0.318	(0.498)	0.438	(0.523)	0.988	(0.291)
Shifted working times	0.416*	(0.065)	1.710***	(0.000)	2.380***	(0.000)
Sector dummies	yes		yes		yes	
Constant	-0.203	(0.735)	-1.267	(0.265)	-1.214	(0.407)
M	1.026***	(0.001)	1.484***	(0.000)	1.830***	(0.001)
$\overline{\%T}_{jk}$; $\overline{\%T}^{75}_{jk}$; $\overline{\%T}^{90}_{jk}$	0.848***	(0.001)	0.918***	(0.000)	0.815***	(0.000)

Note: The values in parentheses represent *p*-values calculated on the basis of robust standard errors. The group-specific mean variable $\overline{\%T}_{jk}$ is applied in the original sample, while $\overline{\%T}^{75}_{jk}$ and $\overline{\%T}^{90}_{jk}$ are used in the samples extended by the respective imputed group-specific quantiles. The estimates refer to the full sample.
*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Source: IAB Establishment Panel, wave 2006, own calculations.

Table A4. First-Stage Estimates of the Black and Lynch Approach

Dependent variable	ln Y		ln ($Y-W$)	
Model specification	(3)		(3)	
Estimation strategy	Within estimator		Within estimator	
ln K	0.006***	(0.000)	0.006***	(0.000)
ln L	0.522***	(0.000)	0.555***	(0.000)
Year 2001	0.006	(0.101)	0.005	(0.420)
Year 2002	0.021***	(0.000)	0.028***	(0.000)
Year 2003	0.021***	(0.000)	0.035***	(0.000)
Year 2004	0.021***	(0.000)	0.031***	(0.000)
Year 2005	0.029***	(0.000)	0.055***	(0.000)
Year 2006	0.036***	(0.000)	0.048***	(0.000)
Year 2007	0.077***	(0.000)	0.104***	(0.000)
Year 2008	0.095***	(0.000)	0.126***	(0.000)
Sector dummies	Yes		yes	
Constant	12.770***	(0.000)	12.291***	(0.000)
R^2 (overall)	0.836		0.752	
Number of establishments	25,800		25,800	
Number of observations	84,692		84,692	

Note: The values in parentheses represent *p*-values calculated on the basis of cluster-robust standard errors. The reference group for the time dummies is Year 2000.
***Statistically significant at the .01 level.

Source: IAB Establishment Panel, waves 2000 – 2008, own calculations.