Employee Participation and Productivity

Thomas Zwick *

Centre for European Economic Research (ZEW). P.O. Box 10 34 43, D-68034 Mannheim, Germany

Abstract

This paper measures the productivity impact of shop-floor employee involvement. On the basis of a representative German establishment data set, the study finds that the introduction of team-work and autonomous work groups, and a reduction of hierarchies in 1996/97 significantly increased average establishment productivity in 1997 – 2000. The estimation strategy controls for unobserved invariant establishment heterogeneity by using a two-step system GMM panel regression approach. It simultaneously takes account of endogeneity of participative work organization by instrument variable regressions. It is also shown that the productivity effect of shop-floor employee involvement is stronger in establishments with works councils.

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* Tel.: +49-621-1235 283; fax: +49-621-1235 225.
E-mail address: zwick@zew.de (T. Zwick).

1. Introduction

Participative establishment practices are praised as suitable and effective means to increase the competitiveness of firms (Ichniowski, Shaw and Prennushi, 1997; Godard and Delaney, 2000; Black and Lynch, 2001; Wolf and Zwick, 2003). In order to assess their impact on the productivity of German firms, this paper distinguishes between shop-floor employee involvement, such as team-work, flat hierarchies or autonomous work groups, and works councils, which are a well-established instrument of top-level employee participation in Germany (Rogers and Streeck, 1995). In contrast to shop-floor employee involvement that usually is induced by the management, the initiative for the introduction of a works council comes from the employees.

Although there are some studies on the separate productivity impacts of shop-floor participation and works councils, it is completely unclear so far if the presence of a works council in an enterprise hampers the effects of shop-floor participation or improves them. In the theoretical literature, arguments for positive and for negative spill-over effects can be found. Howerver, empirical research on the interaction between shop-floor participation and works councils is virtually absent. The obvious gap in the literature is an important motivation to analyse empirically if shop-floor participation and top-level participation hamper or support each other with respect to establishment productivity.

It is not easy to detect empirically if organizational changes increase firm productivity, because firms may tend to introduce innovations depending on their economic situation. This contribution shows indeed that selectivity of organizational forms caused by temporary shocks (endogeneity) and unobserved structural differences (unobserved time-invariant heterogeneity) have an impact on the estimated productivity effects of participation. In addition, this paper assesses the productivity effects of reorganization that increase the participation of employees with lags up to three years. This is important because the effects of changes in the work organization are smaller during than after their implementation (Kato and Morishima, 2002).

Also the productivity impact of works councils is not easy to capture because it is difficult to establish a unilateral causal link between productivity and the presence of works councils. The introduction of works councils is endogenous, and there are systematic and probably unobserved differences between enterprises with and without works councils (Frick and Sadowski, 1995; Addison, Schnabel and Wagner, 1997; Hübler and Jirjahn, 2002). For that reason, the paper takes account of the endogeneity of works councils in an endogenous switching regression model and measures the productivity impact of shop-floor employee participation separately for establishments with and without works councils.

The remainder of this paper is structured as follows: in the next section, the impact of shop-floor employee participation and works councils on establishment performance is discussed. In section three, the German data set used (the IAB establishment panel)

is presented. Then follows a description of the incidence of reorganizations and their correlation with works councils in Germany. The fifth section presents the empirical estimation strategy and the estimation results. The last section concludes.

2. Background discussion

The main principle behind management-led initiatives in improving shop-floor employee participation is to get lower-level staff more involved in the decision and work process and to grant these employees greater autonomy and control over job tasks and methods of work (Cappelli and Rogovsky, 1994). This increases the necessity of horizontal communication between front-line employees (Ichniowksi, Shaw and Prennushi, 1997). Both intensified communication and autonomy of non-managerial staff are supposed to be improved if the work organization is characterized by (autonomous) teams and flat hierarchies (Appelbaum et al., 2000). But how may increased employee involvement raise firm productivity? First, this strategy takes advantage of the specific knowledge non-managerial employees have about their own work processes and combines the skills and expertise of a group of workers (Levine and Tyson, 1990; Cooke, 1994; Hübler and Jirjahn, 2002). Second, individuals are expected to have a higher identification with their enterprise and the decisions taken so that they feel more committed and consequently do a better job (Huselid, 1995; Fernie and Metcalf, 1995; Ichniowski, Shaw and Prennushi, 1997; Godard and Delaney, 2000). Third, employees participating at decisions can balance production more effectively and as a result eliminate bottle-necks or interruptions of

the production process (Appelbaum et al., 2000). Fourth, reducing hierarchies may make some employees of the middle management redundant, and a higher cost autonomy of groups may diminish waste, inventories and inefficiencies (Appelbaum et al., 2000).

Other observers argue, however, that organizational changes that are supposed to improve shop-floor employee participation may also increase stress and lead to work intensification (Ramsey, Scholarios and Harley, 2000). A change of tasks, responsibilities and work structures renders skills obsolete, increases work pressure and may deteriorate the position of some employees (Greenan and Mairesse, 2002). Some employees might attach little value to participation (Cooke, 1994). Moreover, organizational changes always induce adoption costs before the pay-off can be observed (Milgrom and Roberts, 1992). If, for example, the returns to reorganizations are small or highly uncertain for the employees, and in particular if the organizational change endangers their jobs, employees will hamper these changes (Zwick, 2002b).

Even if only studies covering several sectors are taken, the empirical evidence on the productivity effects of participation is mixed. On the one hand, Arnal, Ok and Torres (2001: 28) reckon that "a review of available studies suggests that there is a positive relationship between new work practices and establishment-level performance". Several studies indicate positive productivity effects of participative human resource practices (Huselid, 1995; Ichniowski, Shaw and Prennushi, 1997; Black and Lynch, 2001; Greenan and Mairesse, 2002; Wolf and Zwick, 2003). On the other hand, there are several studies that did not find any significant effect of participation on

establishment productivity (see the surveys in Godard and Delaney, 2000, or Cappelli and Neumark, 2001).

The success of organizational changes also might depend upon specific internal and external conditions. Some authors argue, for instance, that productivity gains might not occur universally but rely on certain business strategies and production practices and the bundling of human resource practices (Ichniowski et al., 1996; Youndt et al., 1996; OECD, 1999). MacDuffie (1995) and Dunlop and Weil (1996) for example find complementarities between bundles of human resource practices in specific industries such as the US apparel industry or the auto industry. Cooke (1994) stresses that teams contribute more to value added in unionised firms than in non-union firms in the United States. Finally, Addison et al. (2000) establish positive effects of employee involvement on productivity only in non-union plants in Britain.

Also the presence of works councils might influence the productivity effects of management-induced shop-floor employee participation. The German Works Constitution Act (WCA) determines that councils can be elected by the workforce of establishments with five or more employees. However, their creation depends on the initiative of the establishment's employees and therefore councils are by far not present in all eligible establishments. Variation between establishments concerning the implementation of works councils is important because it allows an empirical assessment of the productivity impact of works councils. While works councils have full codetermination rights on payment methods, leave arrangements, overtime work and the use of technical devices designed to monitor employee performance, they

only have consultation rights on changes in equipment and working methods (Müller-Jentsch, 1995; Addison, Schnabel and Wagner, 2001; Hübler and Jirjahn, 2003).[1] This means that unilateral management decisions on the introduction of more participative work forms are also possible in establishments with a works council. We therefore observe both: enterprises with works councils that have teams, autonomous work groups and flat hierarchies and those that do not.

The role of works councils in increasing the joint establishment surplus is comparable to that of shop-floor participation. They exert a collective voice (Freeman and Medoff, 1979; FitzRoy and Kraft, 1987; Frick and Sadowski, 1995) and communicate worker preferences and implicit knowledge, which helps to optimize the work routine and to moderate worker demands during rough times (Freeman and Lazear, 1995; Addison, Schnabel and Wagner, 2001; Hübler and Jirjahn, 2002). The interaction between shop-floor employee participation and works councils regarding establishment productivity is less clear, however. On the one hand, works councils may use their bargaining power to negotiate less productive work practices that require less additional effort or endanger less jobs if the management decides to introduce productivity-enhancing work practices (Frick, 2002). It is therefore possible that works councils weaken the full productivity effects of more participative work forms in order to reduce the negative impact on the employees (Hübler and Jirjahn, 2003). In addition, works councils may be inclined to

[1] The amendment of the WCA in August 2001 also includes codetermination rights of works councils on the organization of team-work (Hübler and Jirjahn, 2002). This is after the

make increased participation voluntary, defending the choice of employees not to participate. This would give works councils the opportunity to hold participation activities "hostage" until certain works council demands are met (Cooke, 1994). On the other hand, works councils and shop-floor employee participation may be complements because the latter mainly concerns the better usage of information on individual workplaces and teams, whereas questions that concern the entire establishment can be better arranged by works councils (Hübler and Jirjahn, 2003). Works councils also demand a credible commitment of the management to take account of the interests of the employees. Therefore works councils may induce a serious hearing to employees' ideas and concerns about the design of participation (Cooke, 1994; Freeman and Lazear, 1995). This increases the workers' cooperation in the introduction and implementation of more participative work forms (Milgrom and Roberts, 1992; Wolf and Zwick, 2003; Zwick, 2002b). In addition, flatter hierarchies and team work increase the cohesion among the employees. However, high cohesion is a prerequisite for an effective collective voice (Levine, 1990; Kato and Morishima, 2002). Therefore, either the positive "collective voice effect" or the negative "restriction of management effect" may also determine the impact works councils have on the productivity effect of shop-floor employee participation (Cooke, 1994).

Addison, Schnabel and Wagner (1997) find that works councils are less likely to be observed in firms in which other forms of direct participation are practiced. They

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observation period of this paper, however.

argue that the two forms of participation could be an alternative to each other. Müller-Jentsch (1995) stresses that works councils usually reject new shop-floor employee involvement. Arnal, Ok and Torres (2001) however find that several management-induced participatory work practices are positively correlated with the incidence of works councils. Frick (2002) also argues that more shop-floor employee participation measures are found in establishments with works councils, but that the works councils in these establishments tend to be less co-operative or even hostile. Hübler and Jirjahn (2002) derive a negative interaction effect between works councils and the labour productivity effect from a reduction of hierarchies, while they find a positive interaction effect of team-work and groups with own financial responsibilities. Finally, Kato and Morishima (2002) provide evidence for complementarities between top-level participation such as joint labour-management committees and shop-floor participation in Japan. The empirical evidence on the interaction between works councils and shop-floor participation is therefore mixed and partly contradictory.

3. The Data

In order to assess the productivity impact of shop-floor employee participation and its interactions with works councils for the average firm in an economy, we need representative establishment panel data that covers several sectors (Black and Lynch, 2001). A panel structure is needed because cross-section data on productivity and the introduction of measures do not allow a distinction between cause and effect (OECD,

1999; Wolf and Zwick, 2003). Data from several sectors are necessary because the productivity effects of one sector cannot easily be transferred to those of other sectors (Godard and Delaney, 2000). In order to avoid omitted variable bias, a broad range of establishment and employee characteristics should be included besides information on employee participation (Zwick, 2002a).

Our data base, the IAB establishment panel[2], is collected by personal interviews with the owners or senior managers of smaller establishments and the personnel manager in larger establishments. It is performed by specially trained professional interviewers from a well-known market research institute. As far as possible, the survey is carried out by the same interviewer and interviewee each year. This procedure helps to reduce panel attrition to less than 20% per year. In order to keep the panel representative and to correct for panel mortality, exits and newly-founded units as well as additional establishments are included each year, yielding an unbalanced panel. The additional establishments are stratified with respect to ten categories of establishment size and 16 economic sectors. The establishments are first approached by a letter indicating the goals of the survey. This letter is accompanied by separate letters of recommendation by the president of the Federal Employment Services and the leader of the German employers association. Some weeks after this announcement letter, the establishment is contacted by telephone in order to arrange an individual appointment for the interview. This procedure ensures a response rate

[2] A detailed description of this data set can be found in Kölling (2000).

above 70%, which is high compared with other non-official German establishment panel studies (Kölling, 2000; Addison et al., 2003).

The establishments asked in the enquête are selected from the parent sample of all German establishments that employ at least one employee covered by social security. Thus, self-employed and establishments that employ only people not covered by social security (mineworkers, farmers, artists, journalists, etc.) as well as public employers with solely civil servants do not belong to the original sample. In addition, in order to avoid unnecessary establishment heterogeneity, the agricultural sector and the banking and credit sector are excluded (compare Addison et al., 2003). Only establishments with more than five employees are included because smaller establishments are not eligible for installing a works council.

The establishments covered by the survey are asked every year about the presence of a works council, coverage by collective bargaining, turnover, number of employees, employee qualification structure, personnel problems, apprenticeship training, investment behaviour, innovations, and public subsidies. From time to time, additional topics, such as (changes in the) work organization, are added to the questionnaire.

Capital is constructed using the standard perpetual inventory method (Black and Lynch, 2001; Hempell, 2002). The book value of the capital stock is calculated for 1997 (or for the first year in which an establishment is observed after 1997) by dividing replacement investments by the sum of the (assumed) average depreciation rate and the average growth rate of investments. From the capital stock in the basis

year, the capital stock in each following year is calculated by adding deflated expansion investments from the previous period.[3]

For the purpose of this analysis, only profit oriented establishments and establishments that have not been bought by other establishments or bought other establishments are included.[4] The variables describing the introduction of shop-floor employee participation (team-work, autonomous work groups and the reduction of hierarchies) refer to the years 1996 and 1997. The impacts of these measures on productivity are estimated in a panel estimation including average total factor productivity of the establishments in the years 1997 – 2000.

4. The incidence of participative work forms in Germany

The background discussion above indicates that there are many reasons for the supposition that German establishments can yield a higher productivity level if they use shop-floor employee participation such as team-work, flat hierarchies and work groups with own financial responsibilities. The main diagonals of table 1 provide an overview of the number of establishments that introduced participative work forms in the years 1996 or 1997 in our representative sample for Germany for establishments

[3] The average depreciation rate is assumed to equal 10%, while the average growth rate of investments is assumed to equal 5% (Hempell, 2002). Changes in these assumptions did not influence the results from the productivity estimations.

[4] We sort the establishments into the following sectors: mining and basic materials, food, consumer goods, production goods, investment goods, construction, trade, traffic and communication, hotels and restaurants, education, health and social affairs, electronic data

with works councils and for establishments without works councils separately. The most common reorganization measure is – with 28.7% of the establishments with a works council – the delegation of responsibility and decisions to lower levels of hierarchy. Almost 12% of the establishments without works councils introduced this measure. Teamwork has been introduced by 19.4% (6.5%), and work groups with independent budgets have been introduced by more than 13% (almost 5%) of the establishments. All measures have been introduced clearly more frequently by establishments with works councils. This result is in line with Arnal, Ok and Torres (2001), Frick (2002), and Hübler and Jirjahn (2002).[5]

>>>Table 1 about here<<<

The figures in the lower triangle of table 1 describe the incidence of different combinations of the measures. That is, for example 11.8% of the establishments with works councils aimed at improving the participation of their employees by shifting responsibility to lower levels of hierarchy *and* by implementing team-work and self-responsible teams. If we only take the group of establishments with works councils that introduce work groups with independent budgets (i.e. set it at 100%), then more than 60% of these establishments introduce both measures. Team-work and self-responsible teams have been introduced by more than 40% (more than 33%) of those establishments that have work groups with independent budgets. Among the firms

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processing, research and development as well as business consulting, other business services, and other personal services.

that implemented team-work and self-responsible teams, a shift of responsibility to a lower level of hierarchy is also very widespread. These findings indicate that many German establishments introduced more than one shop-floor employee participation measure in 1996/97.

5. Empirical Analysis of the Productivity Effects of Participation

The productivity effects of shop-floor employee participation are determined by estimating Cobb-Douglas production functions (see also Black and Lynch, 2001). The dependent variable denotes the economic value added, i.e. turnover minus costs for purchased materials and services (for example rent, raw materials, insurance premia, travel costs, licence costs, etc.). The explanatory variables include capital, the number of employees, shop floor employee participation, works councils and a broad range of other control variables. The strong clustering among the dummy variables indicating if an establishment introduced participative measures in 1996/97 (see table 1) is accounted for by aggregating the observed three measures to one "participation dummy" which equals one if at least one of the measures has been introduced (Hübler and Jirjahn, 2002). The estimations have also been performed on the basis of one independent "participation factor" derived by a main component factor analysis

[5] One has to take into account, however, that the establishments with and without work councils differ with respect to establishment size and other characteristics. The multivariate analyses in the next section control for that.

from the three measures, see table A2 in the appendix (Huselid and Becker, 1996; cluster 3 in Ichniowski, Shaw and Prennushi, 1997; Wolf and Zwick, 2003; Greenan and Mairesse, 2002). Using this synthetic factor has the advantage that the number of organizational changes introduced is taken into account (establishments with more measures have a higher factor value).

5.1 Unobserved Heterogeneity

Cross-section production function estimations may be biased because some explanatory variables, especially capital and labour, are endogenous (Griliches and Mairesse, 1998). Endogeneity of labour, capital and other variables in the production function may occur because unobserved time-invariant factors, such as management quality, industrial relations, or technological changes, have an impact on the explanatory variables *and* on the value added (Huselid and Becker, 1996). If these unobserved characteristics of the establishment are correlated with both participation *and* productivity, cross-section estimates are inconsistent. The estimation bias can be corrected for by using panel estimation methods that eliminate the unobserved time-invariant heterogeneity (Cappelli and Neumark, 2001). If, for example, deviations from an establishment's mean or first differences are taken, all time-invariant variables, such as the introduction or presence of certain work organizations during a period of time, the industry sector, the existence of works councils as well as other variables in the production function, cannot be identified because they drop out (Ichniowski, Shaw and Prennushi, 1997; Black and Lynch, 2001). This feature proves

to be a crucial hindrance in our case because we only know if an establishment has introduced shop-level employee participation measures in the years 1996 or 1997.

In order to obtain information on the productivity impact of time-invariant establishment characteristics, such as a participative work organization, and nevertheless to control for unobserved time-invariant heterogeneity, the two-step estimation procedure suggested by Black and Lynch (2001) is adopted. The basic idea of the estimation strategy is to calculate the establishment-specific time-invariant component of the residual (or in other words the fixed effect indicating if an establishment's total factor productivity is structurally higher or lower than that of its competitors) from a panel production function estimation containing the variable input factors. In the second step, the fixed effects are explained by the time-invariant establishment and employee characteristics including participation and works councils.

In the first step, the system GMM (GMM-SYS) estimator proposed by Arellano and Bover (1995) is used instead of a simple within estimator or a simple GMM estimator. The GMM-SYS estimator avoids the poor finite sample properties of these estimators, which take first differences to eliminate unobserved firm-specific effects or use lagged internal instruments to correct for simultaneity in the equations in first differences. Both estimators produce implausibly low capital coefficients and returns to scale because measurement errors in the explanatory variables (especially capital) bias the coefficients towards zero. In addition, the lagged levels of capital (or replacement investments) or labour are usually only weakly correlated with the

subsequent first differences of these variables and therefore have a weak explanatory power (Griliches and Mairesse, 1998; Blundell and Bond, 1999). For that reason, in the GMM-SYS estimator the lagged first-differences are used as instruments for the current input values in levels in addition to the lagged levels as instruments for equations in first-differences. It hereby has to be assumed that the internal instruments are correlated with current values of capital, labour and output but independent of the error term. The GMM-SYS estimator avoids inconsistencies incurred by unobserved heterogeneity and simultaneity of the choice of capital, labour and output (Blundell and Bond, 1999; Black and Lynch, 2001; Hempell, 2002). The first step of the panel regression can therefore be written as follows:

$$\ln Y_t = \alpha \ln K_t + \beta \ln L_t + \upsilon + \varepsilon_t \quad \text{with} \quad t = 1997 - 2000, \qquad (1)$$

where Y is value added, K is capital, L is the number of employees, υ is the unobserved time-invariant establishment-specific fixed effect, the parameters α and β are the regression coefficients to be estimated, and ε_t is the normally distributed idiosyncratic error term with expected value zero and variance σ^2. Also year and industry dummies are included to allow for differential industry productivity effects and to control for business cycle effects. The estimation results of equation (1) can be found in table A3 in the appendix.[6] Striking is the low coefficient of capital.[7] If there

[6] The first step panel regressions were computed by using the two-step estimation procedure in the DPD98 programme developed by Arellano and Bond (1998).

are measurement errors for the input factors (especially for capital), also the GMM-SYS estimator is inconsistent and we may observe too low capital intensities in the production function (Griliches and Mairesse, 1998). Another reason might be the relatively small amount of firms observed in at least three consecutive waves. The GMM-SYS estimator depends on the absence of second order serial correlation in the error term (Dearden, Reed and Van Reenen, 2000), while a negative first order correlation is consistent with the model assumptions. Therefore, the serial correlation tests are reported. The Sargan-test indicates that the model is not overidentified.

On the basis of these first step regression results, the establishment-specific time-invariant component of the residual υ in the period 1997 – 2000 is calculated. It serves as dependent variable for the second estimation step including the quasi time-invariant establishment and employee characteristics. From the results of the empirical literature it can be expected that a high share of qualified employees and a modern technical equipment increase the productivity of the establishment (Addison et al., 2000; Black and Lynch, 2001; Wolf and Zwick, 2003). In addition, exporters are forced to increase their productivity in order to stand international competition. Establishments with branches frequently can reap scale effects. Also establishments with works councils and collective bargaining usually exhibit a significantly higher productivity because the exchange of private information is valuable, because consultation offers new solutions to production problems, and because

[7] A simple fixed effects estimation in the first step leads to comparable labour and capital coefficients. Therefore, also the second step results are qualitatively the same (not shown

codetermination encourages workers to take a longer-run view of the prospects of the firm (Freeman and Lazear, 1995; Hübler and Jirjahn, 2002; Addison, Schnabel and Wagner, 2001; Zwick, 2002b). Establishments with a high share of female employees usually have a lower productivity because female employees on average prefer activities that allow a larger flexibility between job and family. As a consequence, their activities probably have a lower interdependence with other employees than optimal (Hübler and Jirjahn, 2002). In addition, strict hiring rules and a regular assessment of the performance of the employees increases the quality of the match between employee and job and hereby reduces job turnover and increases productivity (Black and Lynch, 2001). Also four dummy variables for different legal establishment forms are included in order to control for systematic differences between full and limited liable establishments (Harhoff and Stahl, 1998). East German establishments may have lower productivity. Differences between the business sectors are captured by 13 dummy variables. A definition of all variables as well as their average values can be found in table A1 in the appendix.

One basic assumption of this two-step estimation procedure is that the explanatory variables in the second step explaining the establishment fixed effect are indeed quasi-fixed. This means, however, that all those establishments characterized as "participative" (or equipped with modern technical equipment, covered by collective bargaining, etc.) in 1997 keep their characteristics until 2000. One can argue that this

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here).

assumption is acceptable for a period of four years (Cappeli and Neumark, 2001; Black and Lynch, 2001).

Measures that increase shop-floor employee participation may not have an instantaneous effect on establishment productivity, and therefore the productivity impact is lagged by using the 1997 values of the explanatory variables (Zwick, 2002b; Kato and Morishima, 2002; Kato, 2003). In addition, by lagging the measures for employee participation and the other explanatory variables, the endogeneity of these measures in the productivity estimation is mitigated (Caroli and Van Reenen, 1999). The second step regression can therefore be written as:

$$\upsilon = \theta P + \delta' X + \varepsilon, \qquad (2)$$

where P is the participation dummy or the participation factor and X represents the vector of the other control variables including works councils. The parameter θ and vector δ are the regression coefficients to be estimated, and ε is the normally distributed error term with expected value zero and variance σ^2. The estimation results are shown in columns two and three of table 2 and table 3. Participation introduced in 1996 or 1997 has a significantly positive but modest impact on average productivity in 1997 – 2000. The other explanatory variables have the expected signs.

5.2 Endogeneity of Participation

The panel regression in the last section can give only a first indication of possible productivity effects of shop-floor employee participation because the endogeneity of

the decision to introduce a participative work organization is not taken into account. A Durbin-Wu-Hausman test proposed by Davidson and MacKinnon (1993) shows that the participation dummy and the participation factor are indeed endogenous.[8] Consequently, it is necessary to correct for endogeneity of participation here. In a next step, it is explored on the basis of instrument variable regressions if the results presented in the previous estimations are biased, because those establishments that decided to introduce shop-floor employee participation in 1996/1997 differ also with respect to other unobserved characteristics that have an impact on productivity in the years after.

Most data sets do not provide suitable additional variables that meet the requirements for qualifying them as identifying variables in an instrument regression. In the case of panel data, lagged values or differences of the explaining variable in question are often used as instruments. This strategy is problematic, however, because the instruments are often only weakly correlated with the endogenous variables, and explanatory variables are only weakly correlated over time. Therefore, it is preferable to use external instruments that intuitively explain the selection process in the establishment and exhibit the necessary statistical properties (Griliches and Mairesse, 1998). The wave 1997 of the IAB establishment panel contains information on expected training activities and on expected personnel problems, which may serve as identifying regressors for the decision to implement a participative work

[8] The value of the F-test on the significance of the coefficient of the estimated residual of the participation dummy in the production function is: $F(1,2055) = 8.44$, $Prob > F < 0.01$, the corresponding value for the participation factor is: $F(1,2055) = 20.02$, $Prob > F < 0.01$.

organization. Four suitable external instruments are employed: two variables on expected personnel problems concerning skill gaps[9] and two training forms, the incidence of which is expected to increase in the next two years.[10] Each of these variables is positively correlated with the introduction of shop-floor employee participation measures because establishments with a participative work organization have a higher qualification and training demand (Black and Lynch, 2001; Wolf and Zwick, 2003; Zwick, 2004). Valid instruments should depict an exogenous variation between establishments that characterizes the introduction of participative work practices. On the other hand, they should not capture unobserved establishment heterogeneity that might be correlated with productivity (Card, 2000; Wooldrigde, 2002). It therefore should be argued that expected skill shortages and increased training needs are not correlated with management quality, industrial relations or other structural unobserved characteristics of the establishment that influence productivity in the years 1997 – 2000. In other words, the expectations expressed here stem from a temporary phenomenon and they are not signals for underlying structural competitive advantages or disadvantages of the establishment. Statistically, this indeed is the case: the identifying variables are correlated with the introduction

[9] The dummy variable has the value one if the establishment expects problems in finding suitable skilled employees on the labour market and a large demand for training and qualification. It is based on the question "Which personnel problems do you expect in the following two years?".

[10] The two training forms are job rotation and self-induced training. The dummy variable has the value one if the establishment expects that the incidence of these training forms increases during the next two years.

of the participation measures and uncorrelated with average establishment productivity ν.

The instrument equation for the participation factor or the participation dummy *P* can be described as follows:

$$P = \kappa_1 I_1 + ... + \kappa_4 I_4 + \eta' X + u, \qquad (3)$$

where $I_1 - I_4$ are the identifying variables and *X* is the complete vector of control variables from equation (2), while κ_1 - κ_4 and the vector η´ are the regression coefficients to be estimated and *u* is the error term. Equation (3) is estimated simultaneously with the fixed effects equation (2) using a maximum likelihood treatment effects model for the participation dummy and a one-step instrumental variable estimation for the participation factor. This implies that the endogenous dummy or factor *P* that is correlated with the error term in equation (2) is replaced by the instrumented participation factor or dummy estimated in equation (3), $\hat{P}$. This variable is correlated with the original factor or dummy but independent from ε in equation (2) and therefore exogenous.

The participation equations are well defined with a (pseudo) R^2 of 0.16 and 0.21, compare tables A4 and A5 in the appendix. All instruments have the expected individually and jointly significantly[11] positive impact on the probability of the establishment to introduce participation. Also the other controls from vector *X* have

[11] The Wald test has the value $\chi^2_{(4)} = 65.61$, Prob > χ^2 < 0.01 in the participation dummy regression and F(4,2705) = 15.82, Prob > F < 0.01 in the participation factor regression.

the expected impact on the introduction of shop-floor employee participation: establishments with branches and investments in ICT as well as publicly listed establishments introduce participative work forms more frequently. Also establishments that offer training and employ strict hiring rules and assess their employees regularly are more inclined to introduce shop-floor employee participation. Partnerships and larger establishments introduce team work, flat hierarchies and autonomous work groups less frequently, however.

>>>Table 2 about here<<<

>>>Table 3 about here<<<

Controlling for endogeneity of participation clearly increases the measured productivity impact of the participation dummy and participation factor on average total factor productivity (see columns four and five of table 2 and table 3). This is also found by Wolf and Zwick (2003) and Hübler and Jirjahn (2002). The coefficients of the other explaining variables are more or less unchanged. This result shows that taking account of selection effects can be important for the evaluation of the productivity effects of shop-floor shop floor employee participation even after controlling for unobserved heterogeneity. There are two potential explanations for the increase in the measured productivity impact of participation: On the one hand, especially establishments with a productivity gap might introduce participation methods in order to improve their competitiveness. This is also found by Ichniowski, Shaw and Prennushi (1997) and Nickell, Nicolitsas and Patterson (2001). On the other hand, the instrumental variable regression reduces the measurement error and

hereby the downward bias incurred by it (Griliches and Hausman, 1986). Especially the dummy variable and the factor variable for participation entail a large measurement error because they value the introduction of minor changes equivalently to a sweeping organizational shake-up and the share of employees affected by the changes is also unknown.

The regression indicates that the introduction of at least one of the participation enhancing measures in 1996 or 1997 leads to an increase in average productivity by 26% in 1997 – 2000. Wolf and Zwick (2003) find that the contemporaneous productivity effect of the introduction of these measures is not significant, and therefore the productivity increases obviously only after some years. This is also found for the introduction of organizational and financial participation in Japan (Kato and Morishima, 2002) and for the productivity effects of continuing training in Germany (Zwick, 2002a). Hübler and Jirjahn (2002) estimate the impact of a dummy marking one reorganization from a list of seven reorganization measures on labour productivity.[12] They find a contemporaneous significantly positive productivity impact of more than 155% if they control for the endogeneity of the reorganization measures. They do not take account of unobserved heterogeneity, however. If they analyse the reorganization measures individually, teamwork has a negative significant impact and the introduction of autonomous work groups and flatter hierarchies have no impact on contemporaneous labour productivity, however. The

[12] In addition to the three reorganization measures analysed here, they include insourcing, outsourcing, general reorganization, integration or exclusion of departments.

productivity effects of joint labour-management committees and shop-floor committees in Japan are lower than those measured here. These participation forms are clearly less pervasive than the measures analysed here, however, because they are mainly constrained to employee voice and not concrete participation measures. Black and Lynch (2001) do not find positive labour productivity effects of the proportion of workers meeting regularly in groups or the proportion of workers in self-managed teams. They do not control for the endogeneity of these measures, however, and therefore their estimations are similar to the OLS regression results in column two and three of table 2. Also Cappelli and Neumark (2001) find mainly insignificant effects of employee involvment and self-managed or autonomous teams and their interactions with other work practices on labour productivity. While they estimate a panel fixed effects model, they do not take endogeneity of the measures into account, however.

Also the participation factor has a positive and significant impact on average total factor productivity. This indicates that the productivity impact increases with the number of measures employed because establishments with more employee participation measures have a higher factor value. Ichniowski, Shaw and Prennushi (1997) also find a significantly positive impact of a factor consisting of higher employee involvment in teams (majority of operators involved in teams, operators participate in more than one problem-solving team and formal team practice) and enhanced labour-management communication (information sharing, regular meetings

between line managers and workers) on uptime in the US steel industry (HRM system 3).

5.3 Presence of works councils

The production functions differ between establishments that have a works council and those that do not have one – this is shown by a χ^2 test.[13] Therefore, the productivity effect of shop-floor employee participation has to be estimated separately for establishments with and without works councils and the interaction effects between works councils and shop-floor participation cannot be captured by just adding interaction terms (Frick and Sadowski, 1995). In addition, works councils are endogenous in the production function estimation because it is not the average establishment that has a works council.[14] In other words, there is a correlation between the presence of works councils and the establishment fixed effect that should be corrected for by an instrumental variable approach or a Heckman correction (Clark, 1984). Consequently, an endogenous switching regression model should be estimated instead of an exogenous switching regression model (Hübler and Jirjahn, 2002).

[13] The test statistic for the participation dummy equation is: $\chi^2_{(31)} = 466.90$, Prob > χ^2 <0.01 and for the participation factor equation: $\chi^2_{(31)} = 466.91$, Prob > χ^2 <0.01.

[14] A Durbin-Wu-Hausman Test shows that the works council dummy is endogenous: $F(1,2055) = 11.71$, Prob > F < 0.01.

In the first estimation step, the presence of a works council is estimated. It is assumed that a latent variable W^* indicates the benefits the employees have from the installation of a works council:

$$W^* = \gamma' Z + \varepsilon, \tag{4}$$

where Z is the vector of variables relevant for the benefits of the works council and γ' is the vector of coefficients to be estimated. The employees are motivated to install a works council if $W^* > 0$, and they do not install one if $W^* \leq 0$. The explanatory variables for the presence of works councils Z contain the variables from the production function equation (3), X, and one additional instrumental variable that explains the presence of works councils but has no impact on productivity.

The instrumental variable found is profit/capital sharing in 1998. Again, it should be argued that this variable can explain the presence of works councils while it does not depict unobserved characteristics of the establishments that have a structural impact on productivity. The intuition behind this variable is that works councils have an interest in promoting rent sharing (Freeman and Lazear, 1995; FitzRoy and Kraft, 2000; Hübler and Jirjahn, 2003). Therefore, profit and capital sharing are positively correlated with the presence of works councils. Profit sharing and employee share ownership indeed have a positive and significant impact on the presence of works councils, see table A6 in the appendix. The presence of works councils is very well determined with a (pseudo) R^2 of 0.51. Profit sharing and employee share ownership

do not have an impact on establishment productivity. This is also found for example by Wolf and Zwick (2002).

The impact of the other explanatory variables on the presence of works councils is as follows: Larger establishments, publicly listed establishments and establishments with branches, collective bargaining, strict hiring and assessment rules and capital or profit sharing are more prone to have a works council. Individual establishments, East German establishments and establishment with autonomous work groups or state-of-the-art technical equipment less frequently have a works council. These correlations are also found in the empirical literature for Germany (Addison, Schnabel and Wagner, 1997; Frick and Sadowski, 1995; Jirjahn, 2003).

From the estimation in table A6 explaining the presence of a works council, the density function $\varphi(\gamma'Z)$ and the distribution function $\Phi(\gamma'Z)$ for the existence of a works council can be calculated for each establishment. In order to consistently estimate the establishment-specific fixed effect υ separately for establishments with and without works councils and to take the endogeneity of works councils into account, the normal hazard function (also called inverse Mills' ratio) for the presence of works councils has to be added for both types of establishments (Maddala, 1983; Wolf and Zwick, 2002; Hübler and Jirjahn, 2003):

$$\nu = \gamma\hat{P} + \delta'X + \sigma\left(-\frac{\varphi(\gamma'Z)}{\Phi(\gamma'Z)}\right) + \varepsilon, \quad \text{for} \quad W = 1, \tag{5a}$$

$$\nu = \gamma\hat{P} + \delta'X + \sigma\left(-\frac{\varphi(\gamma'Z)}{1-\Phi(\gamma'Z)}\right) + \varepsilon, \quad \text{for} \quad W = 0. \tag{5b}$$

The coefficient σ measures the covariance between the error term from equation (2) and the selection equation (4). In equations (5), the production functions are calculated for both types of establishments while the instrumented values for participation P are used in order to account for the endogeneity of shop-floor employee participation simultaneously.

The separate estimation of the production function for establishments with and without works councils produces an interesting result: the positive productivity effect of employee-induced participation is higher in establishments with a works council, see table 4. The participation dummy equation shows that shop-floor participation increases average total factor productivity by 19% in these establishments.[15] This means that works councils obviously support the proper implementation of shop-floor employee participation, and the positive collective voice effect of works councils is more important than the negative management restriction effect. A comparable result is derived by Hübler and Jirjahn (2002) for team-work and autonomous work groups (while the productivity impact of the reduction of hierarchies is negatively influenced by works councils in their study). Cooke (1994) also finds on the basis of US data that the productivity effects of participation are larger in unionized firms than in non-unionized firms. He argues that unionized firms provide a better environment for tapping the benefits of employee participation than

[15] However, the increase is only significant at the 10% level.

non-union firms.[16] However note that the participation factor does not have a significant impact on productivity, see table 5.

>>>Table 4 about here<<<

>>>Table 5 about here<<<

6. Conclusions

This contribution shows that the introduction of shop-floor employee participation in 1996 or 1997 significantly increased average total factor productivity of establishments in Germany by 28% in 1997 – 2000. Team-work, autonomous work groups and the reduction of hierarchies provide establishments with an additional productivity advantage. A second regression using a synthetic participation factor that takes into account which (bundle of) measures has been implemented by each establishment indicates that the productivity impact increases with the number of measures introduced.

In this paper, selectivity in the introduction of shop-floor employee participation is controlled for by using four external instruments for participative work organizations. The instrumental variables indicate if the establishment expects skill shortages and an increase in continuing training demand. Expected skill shortages and expected higher

[16] His result may be biased, however, because neither the endogeneity of the presence of unions nor of participative workforms is controlled for. The production functions are

demands for continuing training are positively correlated with the introduction of shop-floor participation but they are not correlated with average productivity in the following years. A comparison between the simple OLS production function estimation and the instrumental variable regressions shows that especially establishments with productivity gaps introduce shop-floor employee participation and that the instrumental variable regressions reduce measurement errors when estimating participation in the OLS production function. Time-invariant unobserved heterogeneity of the establishments is controlled for by using a two-step procedure proposed by Black and Lynch (2001). In the first estimation step, the establishment fixed effect (or total factor productivity) is estimated using a system GMM panel production function that contains the variable production inputs. In the second estimation step, the average fixed effects are explained by a large vector of quasi-fixed establishment and employee characteristics including the participation dummy or the participation factor.

In an endogenous switching regression model, it is demonstrated that works councils have a positive impact on the productivity effects of shop-floor participation. Establishments with a works council, i.e. top-level participation, can derive a higher productivity effect from shop-floor employee participation. The endogeneity of the introduction of works councils again is taken into account by using an instrumental

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estimated jointly for unionized and non-unionized firms although large differences between both groups of firms are revealed in the descriptive analysis.

variable approach with one external instrument, the presence of profit sharing and employee share ownership.

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Appendix

>>>Table A1 – Table A6 here<<<

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Tables

Table 1
Introduction of participative work forms in 1996 or 1997 (in %)

		Establishments with a works council			Establishments without a works council		
	Shop-floor employee participation measures	1	2	3	1	2	3
1	Shift responsibility to lower level of hierarchy	28.7 (100)			11.7 (100)		
2	Team-work and self-responsible teams	11.8 (60.8)	19.4 (100)		4.1 (62,5)	6.4 (100)	
3	Work groups with independent budgets	7.7 (58.7)	5.3 (40.6)	13.2 (100)	2.5 (53.4)	1.6 (33.5)	4.7 (100)

Notes: The figures present the percentage of establishments applying a certain measure (based on the whole population). The figures in brackets describe the percentage of establishments that use a certain combination of measures (based on the number of establishments in the corresponding category).

Source: IAB Establishment Panel, wave 1998, own calculations.

Table 2
Productivity effects of participation on average productivity 1997-2000, participation dummy

	OLS regression		Treatment effects model	
	coefficients	z-values	coefficients	z-values
Participation dummy	0.09**	2.25	0.28***	2.88
Strict hiring rules	0.19***	3.76	0.18***	3.72
Assessments	0.15***	3.39	0.15***	3.24
Branches	0.20***	3.81	0.20***	3.75
Share female employees	-0.48***	-4.61	-0.48***	-4.62
ICT investment	0.14***	3.39	0.14***	3.30
Training	0.24***	5.29	0.23***	4.87
Share qualified employees	0.32***	3.74	0.32***	3.79
Exporter	0.32***	5.65	0.31***	5.56
State-of-the-art technical equipment	0.18***	4.42	0.18***	4.46
Works council	0.61***	11.21	0.61***	11.19
Collective bargaining	0.20***	4.23	0.20***	4.26
Individual establishment	-0.51***	-8.88	-0.50***	-8.92
Partnership	-0.08	-1.24	-0.08	-1.28
Publicly listed establishment	0.40***	4.31	0.39***	4.26
Establishment size 20-49	-0.12**	-2.39	-0.12**	-2.30
Establishment size 50-99	0.08	1.25	0.09	1.37
Establishment size 100-249	0.02	0.30	0.02	0.35
Establishment size 250-499	0.27***	3.97	0.28***	4.09
Establishment size 500+	0.31***	4.03	0.31***	4.01
East German establishment	-0.40***	-9.62	-0.40***	-9.53
Constant	-0.76***	-4.91	-0.87***	-5.32
13 sector dummies	yes		yes	
	N=2085		N=2085	
	R^2=0.49			

Notes: Significance Levels: ***<1%, **<5%, the values of all explanatory variables are for 1997, except works councils, the value of which is only available for 1998. Standard errors are heteroscedasticity robust.

Source: IAB Establishment Panel, Waves 1997 - 2000, own calculations.

Table 3
Productivity effects of participation on average productivity 1997-2000, participation factor

	OLS regression		Instrument variables regression	
	coefficients	z-values	coefficients	z-values
Participation factor	0.05***	3.63	0.16**	2.28
Strict hiring rules	0.17***	3.45	0.09	1.31
Assessments	0.14***	3.12	0.08	1.44
Branches	0.20***	3.79	0.18***	3.28
Share female employees	-0.48***	-4.59	-0.47***	-4.39
ICT investment	0.13***	3.15	0.07	1.30
Training	0.24***	5.19	0.20***	4.01
Share qualified employees	0.33***	3.82	0.34***	3.95
Exporter	0.31***	5.60	0.30***	5.13
State-of-the-art technical equipment	0.18***	4.34	0.16***	3.74
Works council	0.61***	11.19	0.61***	10.91
Collective bargaining	0.19***	4.19	0.19***	4.00
Individual establishment	-0.50***	-8.82	-0.48***	-8.10
Partnership	-0.08	-1.20	-0.06	-0.96
Publicly listed establishment	0.38***	4.20	0.33**	3.38
Establishment size 20-49	-0.12**	-2.32	-0.11**	2.16
Establishment size 50-99	0.09	1.45	0.12*	1.80
Establishment size 100-249	0.04	0.55	0.10	1.27
Establishment size 250-499	0.29***	4.19	0.34***	4.25
Establishment size 500+	0.32***	4.13	0.35***	4.20
East German establishment	-0.40***	-9.62	-0.40***	-9.43
Constant	-0.74***	-4.77	-0.73***	-3.87
13 sector dummies	yes		yes	
	N=2085		N=2085	
	R^2=0.49		R^2=0.47	

Notes: Significance Levels: ***<1%, **<5%, the values of all explanatory variables are for 1997, except works councils, the value of which is only available for 1998. Standard errors are heteroscedasticity robust.

Source: IAB Establishment Panel, Waves 1997 - 2000, own calculations.

Table 4
Productivity effects of participation on average productivity 1997-2000, participation dummy

	Works council not present (Endogenous switching regression model, treatment effect estimates)		Works council present (Endogenous switching regression model, treatment effect estimates)	
	coefficients	z-values	coefficients	z-values
Participation dummy	0.06	0.18	0.19*	1.81
Strict hiring rules	-0.11	-1.62	0.04	0.60
Assessments	0.04	0.72	0.04	0.66
Branches	-0.02	-0.27	0.10	1.58
Share female employees	-0.39***	-3.13	-0.38**	-2.21
ICT investment	0.02	0.46	0.17***	2.53
Training	0.08	1.53	0.12	1.51
Share qualified employees	0.37***	3.65	0.24*	1.79
Exporter	0.21***	2.83	0.07	0.90
State-of-the-art technical equipment	0.14***	2.82	0.21***	3.71
Collective bargaining	0.05	0.94	-0.05	-0.48
Individual establishment	-0.23***	-3.94	-0.02	-0.07
Partnership	-0.08	-0.98	-0.02	-0.19
Publicly listed establishment	0.13	0.76	0.11	1.29
Establishment size 20-49	0.21***	3.81	-0.59***	-4.71
Establishment size 50-99	0.50***	5.72	-0.62***	-6.26
Establishment size 100-249	0.37**	2.40	-0.66***	-7.61
Establishment size 250-499	0.30	1.47	-0.34***	-4.62
Establishment size 500+	0.28	1.55	-0.30***	-3.97
East German establishment	-0.25***	-4.86	-0.37***	-5.61
Constant	-1.19***	-3.61	1.82***	5.70
$-\varphi/\Phi$			0.76***	6.48
$\varphi/(1-\Phi)$	0.65***	5.74		
13 sector dummies	yes		yes	
	N=1219		N=864	

Notes: Significance Levels: ***<1%, **<5%, all values are for 1997, except works council, the value of which is only available for 1998. Standard errors are heteroscedasticity robust.
Source: IAB Establishment Panel, waves 1997 - 2001, own calculations.

Table 5
Productivity effects of participation on average productivity 1997-2000, participation factor

	Works council not present (Endogenous switching regression model, IV estimates)		Works council present (Endogenous switching regression model, IV estimates)	
	Coefficients	z-values	Coefficients	z-values
Participation factor	0.03	0.28	0.11	1.49
Strict hiring rules	-0.12	-1.27	-0.03	-0.36
Assessments	0.04	0.48	-0.01	-0.09
Branches	-0.02	-0.24	0.09	1.39
Share female employees	-0.39***	-3.07	-0.38**	-2.14
ICT investment	0.02	0.23	0.13*	1.77
Training	0.08	1.39	0.11	1.29
Share qualified employees	0.38***	3.45	0.21	1.49
Exporter	0.20**	2.55	0.10	1.15
State-of-the-art technical equipment	0.14***	2.68	0.20***	3.25
Collective bargaining	0.05	0.88	-0.04	-0.34
Individual establishment	-0.23***	-3.82	-0.04	-0.15
Partnership	-0.07	-0.95	-0.01	-0.07
Publicly listed establishment	0.13	0.75	0.09	0.97
Establishment size 20-49	0.21***	3.49	-0.55***	-4.10
Establishment size 50-99	0.50***	5.27	-0.53***	-4.18
Establishment size 100-249	0.37**	2.36	-0.56***	-4.76
Establishment size 250-499	0.31	1.50	-0.28***	-2.96
Establishment size 500+	0.27	1.55	-0.18***	-2.77
East German establishment	-0.25***	-4.26	-0.35***	-4.96
Constant	-1.16***	-3.57	0.62	1.24
- φ/Φ			0.73***	6.11
$\varphi/(1-\Phi)$	0.65***	5.60		
13 sector dummies	yes		Yes	
	$R^2 = 0.38$		$R^2 = 0.42$	
	N=1219		N=864	

Notes: Significance Levels: ***<1%, **<5%, *<10%, all values are for 1997, except works council, the value of which is only available for 1998. Standard errors are heteroscedasticity robust.

Source: IAB Establishment Panel, waves 1997 - 2001, own calculations.

Table A1
Descriptive statistics of variables used

Variables	1997	1998	1999	2000	Comments
Value added	12.90	12.85	12.99	13.07	Turnover minus inputs, in DM, logs
Capital	12.44	12.45	12.38	12.44	Constructed by perpetual inventory method, in DM, in logs
Number of employees	1.95	1.95	1.97	1.96	Number of employees, in logs
Branches	0.27				Establishment has at least one branch
Share female employees	0.35				Share of female employees on all employees
Share qualified employees	0.66				Share of employees with professional degree on all employees
Exporter	0.17				Establishment exports, yes=1, no=0
State-of-the-art technical equipment	0.68				Technical state of equipment is modern or state-of-the-art, yes=1, no=0
Participation	0.27				Establishment introduced participative work form in 1996 or 1997, yes=1, no=0
Works council		0.29			Establishment has works council, yes=1, no=0
Collective bargaining	0.74				Establishment is subject to or orients itself on sector- or establishment-specific collective wages, yes=1, no=0
Individual establishment	0.14				Establishment is an individual firm, yes=1, no=0
Partnership	0.08				Establishment is a partnership, yes=1, no=0
Publicly listed establishment	0.05				Establishment is publicly listed, yes=1, no=0
Limited (reference)	0.63				Establishment is a public limited company, yes=1, no=0
Profit sharing and employee share ownership	0.14				Establishment grants profit sharing and/or employee share ownership, yes=1, no=0
Strict hiring rules	0.31				Establishment has strict hiring rules, yes=1, no=0
Assessment	0.32				Establishment regularly assesses the performance of the employees, yes=1, no=0
Expected skill shortage	0.24				Establishment expects skill shortages in next 2 years, yes=1, no=0
Expected large demand for training and qualification	0.15				Establishment expects large demand for training and qualification in next 2 years, yes=1, no=0
Expected increase in job rotation	0.09				Establishment expects increase in job rotation in next 2 years, yes=1, no=0
Expected increase in quality circles	0.12				Establishment expects increase in quality circles in next 2 years, yes=1, no=0

Note: Averages derived from cross-section samples and weighted.
Source: IAB establishment panel, waves 1997 – 2001, own calculations.

Table A2
Rotated component matrix of factor analysis

Factor	Variables	Factor loadings
Participative work organization	Shift responsibilities	0.82
	Team-work	0.80
	Independent work groups	0.73

Note: The factors have been rotated by promax.
Source: IAB establishment panel, wave 1999, own calculations.

Table A3
System GMM production function 1997-2000, endogenous variable: value added

	Coefficients	z-values
Capital	0.01	1.14
Labour	0.54***	9.26
Constant	12.88***	73.77
3 time and 13 industry dummies	Yes	
Number of observations	3465	
Number of establishments	973	
Wald-test of joint significance	91.24	p = 0.00
Wald-test of time and industry dummies	152.01	p = 0.00
Sargan-test	30.47	p = 0.11
Test for first order serial correlation	-5.96	p = 0.00
Test for second order serial correlation	0.33	p = 0.75

Note: The standard errors are heteroscedasticity corrected.
Source: IAB Establishment Panel, Waves 1997 - 2001, own calculations.

Table A4
Probit regression: endogenous variable: participation dummy

	All establishments		Establishments without a works council		Establishments with a works council	
	Coeffi-cients	z-values	Coeffi-cients	z-values	Coeffi-cients	z-values
Expected skill shortage	0.25***	4.05	0.36***	4.23	0.09	0.98
Expected large demand for training and qualification	0.35***	4.54	0.22*	1.71	0.45***	4.33
Expected increase in job rotation	0.28***	3.18	0.41***	3.22	0.18	1.54
Expected increase in self-induced training	0.15*	1.70	-0.23	-1.27	0.26**	2.36
Strict hiring rules	0.48***	7.63	0.48***	4.94	0.44***	4.99
Assessments	0.24***	3.93	0.18**	2.05	0.25***	2.87
Branches	0.20***	2.91	0.18*	1.72	0.11	1.24
Share female employees	-0.11	-0.84	-0.20	-1.25	0.04	0.20
ICT investment	0.49***	8.46	0.45***	6.03	0.50***	5.20
Training	0.19**	2.91	0.20**	2.58	0.12	0.91
Share qualified employees	-0.07	-0.68	-0.21	-1.44	0.28	1.59
Exporter	0.13*	1.70	0.21*	1.80	0.01	0.05
State-of-the-art technical equipment	0.05	0.88	0.03	0.31	0.06	0.65
Works council	-0.07	-0.93	-	-	-	-
Collective bargaining	-0.01	-0.12	0.02	0.26	-0.02	-0.13
Individual establishment	-0.14	-1.62	-0.10	-1.10	0.27	0.78
Partnership	-0.19**	-2.12	-0.22*	-1.87	-0.20	-1.37
Publicly listed establishment	0.23**	1.97	0.35	1.21	0.06	0.47
Establishment size 20-49	0.09	1.32	0.19**	2.33	-0.14	-0.92
Establishment size 50-99	0.04	0.42	0.40*	3.31	-0.40***	-2.90
Establishment size 100-249	-0.27***	-3.05	-0.10	-0.59	-0.50***	-4.36
Establishment size 250-499	-0.08	-0.70	-0.20	-0.69	-0.22***	-1.76
Establishment size 500+	-0.03	-0.12	-0.03	-0.07	-0.12*	-1.65
East German establishment	0.09	1.51	0.29***	3.56	-0.16*	-1.67
Constant	-0.99*	-1.76	-0.75*	-1.95	-1.84	-2.59
13 sector dummies	yes		yes		Yes	
Pseudo R^2	0.16		0.13		0.19	
	N=2085		N=1219		N=863	

Notes: Significance levels: ***<1%, **<5%, *<10%. All variables take the values of the year 1997, standard errors are heteroscedasticity robust.

Source: IAB establishment panel, waves 1997 and 1998, own calculations.

Table A5
OLS regression, endogenous variable: participation factor

	All establishments		Establishments without a works council		Establishments with a works council	
	Coeffi-cients	z-values	Coeffi-cients	z-values	Coeffi-cients	z-values
Expected skill shortage	0.19***	2.63	0.30***	3.30	0.00	0.00
Expected large demand for training and qualification	0.25***	2.60	0.01	0.08	0.39***	2.88
Expected increase in job rotation	0.49***	4.58	0.52***	3.22	0.41***	2.83
Expected increase in self-induced training	0.36***	3.27	0.02	0.11	0.46	3.22
Strict hiring rules	0.64***	8.16	0.54***	4.85	0.58***	4.72
Assessments	0.42***	5.60	0.38***	3.82	0.37***	3.13
Branches	0.12	1.44	0.02	0.16	0.06	0.52
Share female employees	-0.07	-0.46	-0.07	-0.36	0.01	0.05
ICT investment	0.46***	6.61	0.46***	5.63	0.34***	2.64
Training	0.16**	2.07	0.17**	1.97	0.08	0.45
Share qualified employees	-0.14	-1.04	-0.30*	-1.85	0.28	1.16
Exporter	0.08	0.83	0.23*	1.78	-0.23	-1.51
State-of-the-art technical equipment	0.13*	1.85	0.10	1.08	0.13	1.11
Works council	0.00	0.05	-	-	-	-
Collective bargaining	0.04	0.45	0.09	1.00	-0.10	-0.53
Individual establishment	-0.15	-1.52	-0.09	-0.88	0.27	0.48
Partnership	-0.14	-1.23	-0.14	-1.08	-0.10	-0.51
Publicly listed establishment	0.40***	2.62	-0.03	-0.07	0.18	0.98
Establishment size 20-49	-0.01	-0.15	0.19**	1.97	-0.33	-1.40
Establishment size 50-99	-0.23**	-2.21	0.28*	1.91	-0.76***	-4.12
Establishment size 100-249	-0.53***	-4.89	-0.06	-0.26	-0.87***	-5.61
Establishment size 250-499	-0.33***	-2.53	-0.03	-0.09	-0.54***	-3.19
Establishment size 500+	-0.15**	-2.11	-0.03	-0.07	-0.33**	-2.13
East German establishment	0.06	0.79	0.23***	2.63	-0.19	-1.51
Constant	-0.42	-1.61	0.21	0.42	-0.62	-0.80
13 sector dummies	yes		yes		Yes	
Adj. R^2	0.21		0.12		0.27	
	N=2085		N=1219		N=863	

Notes: Significance levels: ***<1%, **<5%, *<10%. All variables take the values of the year 1997, standard errors are heteroscedasticity robust.

Source: IAB establishment panel, waves 1997 and 1998, own calculations.

Table A6
Probit regression, endogenous variable: works council

Variables	Coefficient	z-value
Profit sharing and employee share ownership	0.18**	2.17
Establishment has branches	0.27***	3.84
Share female employees	0.13	0.97
Investment in ICT	0.07	1.24
State-of-the-art technical equipment	-0.19***	3.02
Strict hiring rules	0.28***	4.15
Job assessments	0.16**	2.48
Shift responsibilities	-0.03	-0.46
Autonomous work groups	-0.25***	-3.21
Team-work	0.09	1.18
Continuing training	0.17***	2.88
Share of qualified employees	0.66***	5.52
Exporter	0.06	0.81
Collective bargaining	0.85***	12.35
Individual establishment	-0.64***	-5.53
Partnership	-0.01	-0.06
Limited company	0.48***	2.91
Establishment size 20-49	0.57***	6.17
Establishment size 50-99	1.26***	12.61
Establishment size 100-249	1.96***	18.65
Establishment size 250-499	2.14***	15.88
Establishment size 500+	2.41***	15.85
East German establishment	-0.22***	-3.44
Constant	-2.02***	-7.55
13 sector dummies	yes	
Number of observations = 3925	Pseudo $R^2 = 0.51$	

Notes: Significance levels: ***<1%, **<5%. All variables take the values of the year 1997, standard errors are heteroscedasticity robust.

Source: IAB establishment panel, waves 1997 and 1998, own calculations.