

Discussion Paper No. 03-47

**Works Councils and the Productivity  
Impact of Direct Employee Participation**

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## **Non-technical summary**

Participative establishment practices are praised as suitable and effective means to increase the competitiveness of establishments. In Germany, two approaches to more participation of non-managers at establishment decisions and the work process have to be distinguished. On the one hand, there are changes towards more participation in the work organization that are usually induced by the management such as team-work, a reduction of hierarchies, or autonomous work groups. On the other hand, there are works councils, a long established participation instrument, which is initiated by the employees. The interaction effect between the productivity impact of management-led employee participation and the presence of works councils is a priori unclear. Work councils might facilitate an efficient implementation of participative work forms by using their collective voice function to mediate between the diverging interests of the management and the employees. On the other hand, they might initiate restrictions on the measures taken in order to reduce the additional burden imposed on the employees after the introduction of a more participative work organization.

The empirical evidence concerning the productivity effects of management-led participative measures is mixed. The most important reason for the disturbing divergence in the results seem to be estimation problems. The literature mentions two main sources of estimation biases in this context: selectivity of organizational forms caused by temporary shocks (endogeneity) and unobserved structural differences between establishments (unobserved time invariant heterogeneity). The literature on the empirical productivity effects of works councils is limited in number and inconclusive. Studies on the interaction effects between works councils and the productivity impact of participative work organizations are virtually absent.

Therefore this paper measures the productivity impact of management-led participative establishment practices. On the basis of the IAB establishment panel – a representative German establishment data set comprising establishments from all sectors of the economy – the following result is obtained: the presence of team work and autonomous work groups, and a reduction of hierarchies in 1997, increases the average establishment productivity significantly in the period 1997-2000. The estimation strategy controls unobserved time invariant establishment heterogeneity by using a two-step estimation procedure. First, a standard Cobb-Douglas production

function including the variable input factors labour and capital is estimated by a system GMM panel estimation. From this regression, the establishment specific time-invariant component of the residual (or the fixed effect) is calculated. Second, the fixed effect is explained by establishment characteristics including the presence of works councils, participative work organization, and employee characteristics. These time-invariant characteristics would drop out if they would be included in the first estimation step and therefore the two-step procedure has to be chosen in order to measure their impact on establishment productivity.

In addition, the estimation strategy also controls for endogeneity of participative work forms by instrument variable regressions. Instead of taking the lagged values of the variables, additional external variables are used: those depict expected qualification problems and expected increases in training efforts to identify the decision of the establishment to introduce a participative work organization. After controlling for the endogeneity of the implementation of participative work forms, the measured productivity impact increases considerably. This means that German establishments mainly introduce participation in bad times and that the instrument equation reduces the measurement error of the participation variable.

Finally, it is shown that the productivity effect of management-led participation can only be measured in establishments with work councils. An endogeneous switching regression model estimates the impact of the time invariant establishment and employee characteristics on the fixed effects separately for establishments with and without works councils. The endogeneity of the presence of works councils is taken into account by adding the estimated establishment specific probability to have a works council. This probability is derived from a probit estimation explaining the decisions of the employees to implement a works council.

## **WORKS COUNCILS AND THE PRODUCTIVITY IMPACT OF DIRECT EMPLOYEE PARTICIPATION**

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### **Abstract**

This paper measures the productivity impact of management-led participative establishment practices. On the basis of a representative German establishment data set, the IAB establishment panel, the study finds that the presence of team-work, a reduction of hierarchies and autonomous work groups in 1997 significantly increases average establishment productivity in 1997 – 2000. An endogeneous switching regression model takes the endogeneity of work councils into account and shows that the productivity effect can only be measured in establishments with works councils, i.e. employee induced participation. The estimation strategy controls for unobserved time invariant establishment heterogeneity by using a two-step system GMM panel regression approach. It simultaneously controls for endogeneity of participative work organization by using instrument variable regressions.

Key-words: employee participation, works council, establishment productivity, panel regression

JEL-codes: C23, D24, J50, M12

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## **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). Several empirical papers measure positive productivity effects if Fordistic production methods are replaced by work organizations that increase the involvement of non-managers such as team-work, flat hierarchies or autonomous work groups (Greenan and Mairesse, 2002). In Germany, in addition to these forms of worker participation, works councils are an established and elaborate alternative system of employee participation (Rogers and Streeck, 1995). In contrast to team-work, flatter hierarchies, etc., that are usually introduced by the management, the initiative for the introduction of a works council comes from the employees. Works councils build trustful industrial relations and improve the flow of information between employees and management (Freeman and Lazear, 1995; FitzRoy and Kraft, 2000; Addison, Schnabel and Wagner, 2001), they foster trust and co-operation (Hübler and Jirjahn, 2003) and give employees a far-reaching voice in decisions. Although there is a broad literature on works councils in Germany, there is only very limited and inconclusive empirical evidence for the productivity effects of works councils (Sadowski, Backes-Gellner, and Frick, 1995; Frick and Sadowski, 1995; Addison, Schnabel and Wagner, 2001; Hübler and Jirjahn, 2003).

It is completely unclear so far, if the presence of a works council in an enterprise hampers the effects of management-led employee participation or improves them. In the theoretical literature, arguments for positive and for negative spill-over effects can be found. On the one hand, works councils may facilitate the introduction of new work practices by assuring the work-force that the negative consequences will be cushioned and controlled. In addition, they may give the management crucial information on the efficient implementation of new work organizations. On the other hand, works councils may restrict the management in the way participatory work places should be introduced in order to protect the work force. Especially necessary reductions in the workforce or changes in the qualificatory mixture of the workforce are mentioned here. A consequence may be that the full productivity effect of management-led participatory work organization is not obtained. To my knowledge, only Frick (2002) and Hübler and Jirjahn (2002) studied the interaction between works councils and participatory work organizations so far. Frick (2002) finds that the higher the number of participatory work

organizations, the less co-operative are work councils. 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 from team-work and groups with own financial responsibilities. Their cross-section analysis encounters causality problems, however. In addition, their endogeneous variable is turn-over divided by the number of employees. Therefore it seems problematic to include sectors such as the public sector, insurances and banks whose turn-over is misleading (Schnabel, 2002). The obvious gap in the literature is an important motivation to analyse empirically if employee-induced participation and management-led 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. The OECD points to this problem as follows: "If firms only began to experiment with new forms of working practices when they faced dire trouble, the existence of practices might be associated with poorer performance, at least over the short-term. On the other hand, if flexible practices were introduced mainly into firms with more highly skilled workforces, there is the danger that higher performance may be attributed to the working practices rather than the higher skills" (OECD, 1999, p. 182). This contribution shows that indeed both factors, 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, the productivity effects of re-organizations that increase the participation of employees are assessed with lags up to three years. This is important, because the literature shows that the effects of work organization measures are clearly 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 endogeneous, 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, this paper takes into account the endogeneity of works councils in an endogeneous switching regression model and it also shows that the production functions differ between establishments with and without works councils.

The remainder of this contribution is structured as follows: in the next section, the theoretical impact of participative work forms and works councils on establishment performance is surveyed. In section three, the German data set (the IAB establishment panel) is presented. Then follows a description of the incidence of re-organizations and their correlation with works councils in Germany. The fifth section presents the empirical estimation strategy and the estimation results. The last section concludes.

## **Background discussion**

The main principle behind management-led initiatives to improve worker participation is to get lower level staff more involved in the decision and work process and to grant them 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 (Ichniowski, Shaw and Prenzushi, 1997). Both, intensified communication and autonomy of non-managerial staff is supposed to be improved if the work organization is characterized by (autonomous) teams and flat hierarchies (Appelbaum et al., 2000). But how may an increased employee involvement raise firm productivity? Firstly, this strategy takes advantage of the specific knowledge non-managerial employees have about their own work processes and combines the skills of a group of workers (Levine and Tyson, 1990; Cooke, 1994; Hübler and Jirjahn, 2002). Therefore higher participation increases the expertise used. Secondly, individuals are expected to have a higher identification with their enterprise and the decisions taken, feel more committed and consequently do a better job (Huselid, 1995; Fernie and Metcalf, 1995; Ichniowski, Shaw and Prenzushi, 1997; Godard and Delaney, 2000). Thirdly, employee participation at decisions can balance production more effectively to eliminate bottle-necks or interruptions of the production process (Appelbaum et al., 2000). Fourthly, 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 employees' participation may also increase stress and responsibility 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). In addition, organizational changes always induce adoption costs that have to be taken on before the pay-off can be observed (Milgrom and Roberts, 1992). If, for example, the returns to re-organizations 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). Finally, it seems plausible that the success of organizational changes depends upon a couple of internal and external conditions. Some authors argue, for instance, that productivity gains of higher participation might not occur universally but rely on certain business strategies and production practices (Ichniowski et al., 1996; Youndt et al., 1996; OECD, 1999). For the United States, Cooke (1994) finds for example that teams contribute more to value added in unionised firms than in non-union firms. Addison et al. (2000) find positive effects of employee involvement on productivity only in non-union plants in Britain.

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” (Huselid, 1995; Ichniowski, Shaw and Prenzushi, 1997; Black and Lynch, 2001; Wolf and Zwick, 2003; Bauer, 2003). On the other hand, there are several studies that did not find any significant effects of participation on establishment productivity (see the surveys in Godard and Delaney, 2000 or Cappelli and Neumark, 2001).

Also the presence of works councils might influence the productivity effects of management-induced participative work organizations. The German Works Constitution Act (WCA) determines that councils can be elected by the work force of establishments with five or more employees. Their creation depends on the initiative of the establishment’s employees, however, 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 co-determination 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).<sup>1</sup> This leaves a role for unilateral management decisions on the introduction of more participative work forms also in establishments with a works council. We may therefore observe both, co-determined enterprises that have more participative work forms and those that do not have them.

The role of works councils in increasing the joint establishment surplus is comparable to that of management-led participative work forms. 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 optimise 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 interactions between management-led participation and works councils regarding establishment productivity are 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 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 worker participation by work organization may be complements because the latter mainly concerns the better usage of information on individual workplaces and teams, whereas questions for 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 into account the workers’ interests and to build trust that the information given by the management is correct. As a result, a serious hearing is given to employees’ ideas and concerns about the design and the processes of participation (Cooke, 1994; Freeman and Lazear, 1995). This increases the workers’ co-operation with the introduction and implementation of more participative work forms (Milgrom and Roberts, 1992; Wolf and Zwick, 2002b; Zwick, 2002b). In addition, flatter hierarchies and team work increase the cohesion among the employees. High

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<sup>1</sup> Just the amendment of the WCA in August 2001 includes co-determination rights of works councils on the organization of team work (Hübler and Jirjahn, 2002).

cohesion is a prerequisite for an effective collective voice, however (Levine, 1990; Kato and Morishima, 2002). Hübler and Jirjahn (2002) and Frick (2002) note that the productivity effects of re-organization measures depend on the level of trust and co-operation between works councils and the management. Cooke (1994) sees the interaction effects between works councils and management-led participation between the two poles positive collective voice effects and negative works council restriction effects.

It was already mentioned in the introduction that empirical research on the interaction effects between management-led participation and works councils is virtually absent. Addison, Schnabel and Wagner (1997) mention that works councils are less likely to be observed in firms in which other forms of direct participation are practiced. They argue that the two forms of participation could be an alternative to each other, whereas Müller-Jentsch (1995) stresses that works councils initially rejected new management-led forms of employee involvement. On the basis of the Survey of Employee Direct Participation in Organisational Change (EPOC) data, Arnal, Ok and Torres (2001) find, however, that several management-induced participatory work practices are positively correlated with the incidence of works councils. Frick (2002) argues that more management-led participative work forms are found in establishments with works councils, but that these works councils tend to be less co-operative or even hostile. Several authors analyse the establishment characteristics that promote the beneficial effects of works councils on productivity. Hübler and Jirjahn (2003) stress that positive productivity effects of works councils can only be found in firms additionally covered by collective bargaining agreements. Addison, Schnabel and Wagner (2001) explain that works councils only induce a positive productivity effect in larger establishments with more than 100 employees.<sup>2</sup> Quite the contrary, Smith (1994) finds stronger productivity effects of works councils in smaller establishments. Finally FitzRoy and Kraft (1995) show that works councils reduce productivity if the firm does not implement employee profit sharing. Also for management-led participation, some papers relate the productivity effects to specific industrial relations.

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<sup>2</sup> The authors admit, however that their results may be biased because the presence of works councils is assumed to be exogeneous in their regressions.

## The Data

In order to assess the productivity impact of participative work organizations and their interactions with works councils for the average firm in an economy, we need representative establishment panel data covering 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, 2002b). Data from several sectors are necessary, because the productivity effects of one sector can not 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 participation (Zwick, 2002a).

The establishments asked in the IAB establishment panel enquête are selected from the parent sample of all German establishments that employ at least one employee covered by social security.<sup>3</sup> 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 (Bauer, 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, personnel problems, apprenticeship training, investments, information and communication technology (ICT) usage, innovations, and public subsidies. From time to time, additional topics, such as training and 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 the first year an establishment is observed after 1997) by dividing replacement investments by the sum of the (assumed) average depreciation rate and average growth rate of investments. From the capital

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<sup>3</sup> A detailed description of this data set can be found in Kölling (2000).

stock in the basis year, the capital stock in each following year is calculated by adding deflated expansion investments from the previous period.<sup>4</sup>

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.<sup>5</sup> The variables describing the management-led participative work organizations (the introduction of team-work or autonomous work groups or the reduction of hierarchies) refer to the years 1996 and 1997. After combining this information with additional information from earlier waves that indicate if a re-organization has been introduced already before 1996, the variables show if the management-led participative measures have been ever introduced in the establishment until 1997. The impact of these measures on productivity is estimated in a panel estimation including average productivity of the establishments in the years 1997 – 2000.

## **The incidence of participative work forms in Germany**

The theoretical considerations above indicate that there are many reasons for the supposition that German firms can yield a higher productivity level if they use participative organizational measures 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 workforms until 1997 in our representative sample for Germany for establishments with works councils and for establishments without works councils separately. The most common re-organization measure in 1997 is with 28.7% of the establishments with works councils the delegation of responsibility and decisions to lower levels of hierarchy. Almost 12% of the establishments without works councils introduced this measure. Team-work has been introduced by 19.4% (6.5%), and work groups with independent budget have been introduced by more than 13% (almost 5%) of the establishments. All measures have been introduced clearly more frequently by

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<sup>4</sup> The average depreciation rate is assumed to equal ten percent, while the average growth rate of investments is assumed to equal five percent (compare also Hempell, 2002). Changes in these assumptions did not influence the results from the productivity estimations.

<sup>5</sup> 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 processing and research and development as well as business consulting, other business services, and other personal services.

those establishments with works councils. This result is in line with Arnal, Ok and Torres (2001), Frick (2002) and Hübler and Jirjahn (2002).<sup>6</sup>

*Table 1: Introduction of participative work forms until 1997 (in%)*

	Establishments with works council			Establishments without works council		
	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 budget	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, Waves 1997 and 1998, own calculations.

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. When we only take the group of establishments with works councils that introduce work groups with independent budgets (i.e. set it as 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 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 management-induced participative measure until 1997.

<sup>6</sup> 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.

## **Empirical Analysis of the Productivity Effects of Participation**

The productivity effects of a participative work organization are determined by estimating Cobb-Douglas production functions (see also Black and Lynch, 2001). The dependent variable denotes the economic value added (turn over minus external input costs), and the explanatory variables include capital, the number of employees, participative work forms, works councils as well as other control variables. The strong coherence among the dummy-variables indicating if an establishment introduced participative measures until 1997 (see table 1) is accounted for by aggregating the observed three measures to one independent “participation” variable which equals one if at least one of the measures has been introduced (compare also Hübler and Jirjahn, 2002).<sup>7</sup>

### **Unobserved Heterogeneity**

Cross-section production function estimations may be biased, because some explanatory variables, especially capital and labour, are endogenous (Griliches and Mairesse, 1998). Important reasons for the endogeneity of labour, capital, and other variables in the production function may be that unobserved time invariant factors, such as management quality, industrial relations, or technological change, have an impact on the explanatory variables *and* on the value added. If unobserved characteristics of the establishment, such as management quality or industrial relations, are correlated with both, participation *and* productivity, cross-section estimates are inconsistent. A possibility to correct the estimation bias is to use panel estimation methods that eliminate the unobserved time invariant heterogeneity. 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, can not be identified, however, 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 ever introduced management-led participation until 1997 or not. Therefore, the exact

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<sup>7</sup> The estimations have also been performed on the basis of one independent “participation” factor derived by a main component factor analysis from the three measures (see also Wolf and Zwick, 2002b). All results are qualitatively the same and therefore not reported here.

implementation date is unknown, and there are not yearly data on the incidence of these measures.

In order to obtain information on the productivity impact of rather time invariant establishment characteristics such as a participative work organization and nevertheless control 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 capital and labour. In the second step, the fixed effects are explained by the quasi time invariant establishment and employee characteristics including participation and works councils.

In the first step estimation, 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 the simple within estimator or the simple GMM estimator, which take first differences to eliminate unobserved firm-specific effects or use lagged internal instruments to correct for simultaneity in the first-differenced equations. 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). Therefore, in the GMM-SYS estimator the lagged first-differences are used as instruments for the current input values in levels in addition to the usual lagged levels as instruments for equations in first-differences. It hereby has to be assumed that the internal instruments are correlated with current values but independent of the error term. This 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:

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

where  $Y$  is value added,  $K$  is capital,  $L$  is the number of employees,  $v$  is the unobserved time invariant establishment-specific fixed effect, the parameters  $\alpha$  and  $\beta$  are the regression coefficients to be estimated, and  $\varepsilon_t$  is the normally distributed idiosyncratic error term with expected value zero and variance  $\sigma^2$ . 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.<sup>8</sup> Striking is the low coefficient of capital.<sup>9</sup> If there are measurement errors for the input factors (especially for capital), also the GMM-SYS estimator will be 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  $v$  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 modern technical equipment increase the productivity of the establishment (Addison et al., 2000; Black and Lynch, 2001; Wolf and Zwick, 2002b). In addition, exporters and establishments with works councils and collective bargaining usually exhibit a significantly higher productivity (Hübler and Jirjahn, 2002; Addison et al., 2000; Zwick, 2002b). East German establishments may still have lower productivity while differences between the business sectors are captured by 13 dummy variables. 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). A definition of all variables as well as their average values can be found in Table A1 in the appendix.

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<sup>8</sup> The first step panel regressions were computed by using the two-step estimation procedure in the DPD98 programme developed by Arellano and Bond (1998) running in GAUSS.

<sup>9</sup> 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 here).

Participative measures and most other establishment characteristics 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 (Wolf and Zwick, 2002b; Zwick, 2002b; Kato and Morishima, 2002; Bauer, 2003). In addition, by lagging the participative work forms and the other explanatory variables, the endogeneity of these measures in the productivity regression is mitigated (Caroli and Van Reenen, 1999). The second step regression can therefore be written as:

$$(2) \quad v = \theta P + \delta X + \varepsilon,$$

where  $P$  is the dummy “participation” and  $X$  represents the vector of the other control variables including works councils. The parameters  $\theta$  and  $\delta$  are the regression coefficients to be estimated, and  $\varepsilon$  is the normally distributed error term with expected value zero and variance  $\sigma^2$ . The estimation results are shown in table 2. Participation introduced until 1997 has no impact on average establishment productivity in 1997 – 2000 while the other explanatory variables have the expected signs.

### **Endogeneity of Participation**

The panel regression in the last section can give only a first indication of possible productivity effects of management-led measures that increase the participation of employees, because the endogeneity of a participative work organization is not taken into account. In a next step, it is therefore 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 participative work forms until 1997 differ also with respect to other 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).<sup>10</sup> 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 organization. Seven suitable external instruments can be found: three variables on expected personnel problems concerning skill gaps and organizational changes<sup>11</sup> and four training forms, the incidence of which is expected to increase in the next two years.<sup>12</sup> Each of these variables should be positively correlated with the presence of participative work place practices, because we can expect that establishments with a participative work organization have a higher qualification demand and larger problems with employee turn-over (Black and Lynch, 2001; Wolf and Zwick, 2002b). In addition, the identifying variables are uncorrelated with establishment productivity in the following years and therefore satisfy the statistical requirements.

The instrument equation for the dummy “participative work organization”  $P$  can be described as follows:

$$(3) \quad P = \kappa_1 I_1 + \dots + \kappa_7 I_7 + \eta X + \varepsilon,$$

where  $I_1 - I_7$  are the identifying variables and  $X$  is the vector of control variables from equation (2), while  $\kappa_1 - \kappa_7$  and  $\eta$  are the regression coefficients to be estimated. Equation (3) is estimated simultaneously with the fixed effects equation (2) using a full information treatment effects model. This implies that the endogenous dummy  $P$  that is correlated with the error term in equation (2) is replaced by the instrumented variable estimated in equation (3),  $P$ . This variable is correlated with the original dummy but independent from  $\varepsilon$  in equation (2) and therefore exogenous. All instruments have the expected significantly positive impact on the probability of the establishment to

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<sup>10</sup> Nevertheless the list of external identifying variables used has an impact on the estimated coefficient of the instrumented variable. Therefore, several different identifying variables are used here.

<sup>11</sup> The dummy variable has the value one if the establishment expects problems to find suitable skilled employees on the labour market, organizational problems due to maternal leave 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?”.

<sup>12</sup> The four training forms are formal external courses, job rotation, self-induced training and quality circles. The dummy variable has the value one if the establishment expects that the incidence of these training forms increases during the next two years.

introduce participation while also the controls from vector  $X$  have the expected signs: larger establishments and establishments with investments in ICT and a high share of qualified employees introduce participative work forms more frequently while exporting establishments are less prone to implement participation. The estimation results are not shown here.

*Table 2: Productivity Effects of Participation on Average Productivity 1997-2000*

	OLS regression		Treatment effects model	
	Coefficients	z-values	Coefficients	z-values
Participation	0.03	0.82	0.26***	2.38
ICT investment	0.11***	2.72	0.10***	2.65
Training	0.17***	3.80	0.15***	3.34
Share qualified employees	0.49***	6.06	0.49***	6.05
Exporter	0.20***	3.85	0.20***	3.77
State-of-the-art technical equipment	0.16***	4.16	0.16***	4.22
Works council	0.42***	8.54	0.42***	8.50
Collective bargaining	0.13***	3.01	0.13***	3.00
Individual establishment	-0.37***	-6.54	-0.36***	-6.58
Partnership	-0.09	-1.52	-0.09	-1.55
Publicly listed establishment	0.16**	2.16	0.16**	2.15
Establishment size 20-199	0.45***	8.96	0.45***	8.97
Establishment size 200-499	1.07***	14.43	1.05***	14.33
Establishment size 500-999	1.31***	13.36	1.28***	13.09
Establishment size 1000+	1.82***	18.61	1.78***	18.12
East German establishment	-0.35***	-9.01	-0.35***	-8.92
Constant	-1.19***	-8.35	-1.65***	-6.51
	N=2124		N=2124	
	R <sup>2</sup> =0.79			

Notes: Significance levels: \*\*\*<1%, \*\*<5%, all explanatory variables are in values for 1997, except works councils, the value of which is only available for 1998. Also 13 sector dummy variables are included, standard errors are heteroscedasticity robust.

Source: IAB Establishment Panel, waves 1999 and 2000, own calculations.

Controlling endogeneity of participation clearly increases the measured productivity impact of the participation dummy on the average fixed effect (see table 2). This result is also found by Wolf and Zwick (2002b), Hübler and Jirjahn (2002) and Bauer (2003). The coefficients of the other explanatory variables are more or less unchanged. This result shows that taking account of selection effects can be decisive for the evaluation of the productivity effects

of participation even after controlling 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 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; Zwick, 2003). Especially the dummy variable for participation entails a large measurement error, because it values the introduction of minor changes equivalently to a sweeping organizational shake-up.

### 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  $\chi^2$  test.<sup>13</sup> Therefore the productivity effects of management-led participation have to be estimated separately for establishments with and without works councils and the interaction effects between works councils and management-led participation cannot be captured by just adding interaction terms (Frick and Sadowski, 1995). In addition, endogeneity of the presence of works councils has to be taken into account, because it is not the average establishment that has a works council. Therefore an endogeneous switching regression model should be estimated instead of an exogeneous switching regression model (Hübler and Jirjahn, 2002; Wolf and Zwick, 2002a).

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 work council:

$$(4) \quad W^* = \gamma Z + \varepsilon,$$

where  $Z$  is the vector of variables relevant for the benefits of the works council and  $\gamma$  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  $W^* \leq 0$ . According to the literature, the size of the establishment, a participative work organization, incentive wages, strict hiring and assessment rules, dummies for exporters, establishments bound by collective bargaining and establishments with branches, as well as different legal forms should be

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<sup>13</sup> The test statistic is:  $\chi^2_{(27)}$ : 116.24, Prob >  $\chi^2 < 0.01$ .

included in  $Z$  (Addison, Schnabel and Wagner, 1997; Frick and Sadowski, 1995; Jirjahn, 2003). The results from the literature in the estimation of equation (4) are replicated, see table A4 in the appendix: Larger establishments, publicly listed establishments and establishments with collective bargaining, branches, strict hiring and assessment rules and capital or profit sharing are more prone to have a works council. Individual establishments and establishments with autonomous work groups less frequently have a works council. From the variables included in equation (4), strict hiring and assessment rules and profit/capital sharing in 1998 do not have an impact on productivity in 1997-2000 and therefore can be used as identifying variables.

From the estimation in table A4 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  $\nu$  separately for establishments with and without works councils taking 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, 2002a; Hübler and Jirjahn, 2003):

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

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

The coefficient  $\sigma$  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 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 can be only realized by establishments with works councils. This means that works councils obviously favour the proper implementation of participation and the positive collective voice effect of work councils is more important than the negative 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 non-union firms.<sup>14</sup>

This result is not only derived if the endogeneity of works councils is taken into account. In an exogeneous switching regression model without the additional selectivity correction terms, the productivity impact of participation is comparable for establishments with works councils, but higher for establishments without works councils (not shown here). All results presented here are also obtained if the sample is restricted to establishments with at least 20 employees.

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<sup>14</sup> This result may be problematic, because neither the endogeneity of the presence of unions nor of participative workforms is controlled and the production functions are estimated jointly for unionized and non-unionized firms although large differences between both groups of firms are revealed in the descriptive analysis.

Table 3: *Productivity Effects of Participation in 1997 on Average Productivity 1997-2000*

	Works council not present (Endogeneous switching regression model, IV estimates)		Works council present (Endogeneous switching regression model, IV estimates)	
	Coefficients	z-values	Coefficients	z-values
Participation	0.14	0.58	0.29*	1.88
ICT investment	0.04	0.76	0.16***	2.45
Training	0.10*	1.87	0.15*	1.85
Share qualified employees	0.42***	4.15	0.37***	2.86
Exporter	0.20***	2.73	0.06	0.74
State-of-the-art technical equipment	0.13**	2.53	0.16***	2.74
Collective bargaining	0.04	0.83	-0.03	-0.28
Individual establishment	-0.23***	-3.97	0.07	0.27
Partnership	-0.08	-1.10	-0.07*	-0.82
Publicly listed establishment	-0.02	-0.14	0.10	1.17
Establishment size 20-199	0.26***	4.60	0.00	0.02
Establishment size 200-499	0.15	0.79	0.40*	1.85
Establishment size 500-999	0.09	0.27	0.61***	2.68
Establishment size 1000+	0.34	0.95	1.11***	4.87
East German establishment	-0.25***	-4.92	-0.37***	-5.85
Constant	-1.88***	-5.52	-0.33	-0.69
- $\varphi/\Phi$			0.54***	5.59
$\varphi/(1-\Phi)$	0.75***	7.82		
	N=1219		N=864	

Notes: Significance levels: \*\*\*<1%, \*\*<5%, all values are for 1997, except works councils, the value of which is only available for 1998. Also 16 sector dummy variables added, standard errors are heterosedasticity robust.

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

## Conclusions

This contribution shows that the presence of management-led participative work organizations in 1997 increases the average productivity of establishments in Germany in the period 1997 – 2000 by more than 25%. The introduction of team-work, autonomous work groups and the reduction of hierarchies therefore provides establishments with an additional productivity advantage. In this paper, selectivity is controlled by using external instruments

for participative work organizations. A comparison between the simple OLS production function estimation and the treatment effect model shows that especially establishments with productivity gaps introduce participative work forms and that instrumental variables reduce measurement errors in the OLS production function. Time invariant unobserved heterogeneity of the establishments is controlled by using a two-step procedure proposed by Black and Lynch (2001). In the first step, the establishment fixed effect is estimated in a system GMM panel production function containing the variable production inputs capital and labour. In the second step, the average fixed effects are explained by a large vector of quasi fixed establishment and employee characteristics including the participation variable. Finally, in an endogeneous switching regression model, it is demonstrated that works councils have a positive impact on the productivity effects of participation. In fact, only establishments with works councils, i.e. employee-induced participation, can derive positive productivity effects from management-led participation.

Problematic is the rough measure of management-led participation in this paper. It is neither known how many employees are covered by these measures, nor is it known if some establishments abolished some measures again after 1997 or introduced other personnel measures after 1997. One basic assumption of the two-step estimation procedure used is that the explanatory variables in the second step explaining the establishment fixed effect are quasi-fixed, indeed. 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 participative work organization and the other establishment and employees characteristics until 2000. One can argue, however, that for a period of four years, this assumption is acceptable (Black and Lynch, 2001).

## Appendix

*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
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
Reduction of hierarchies	0.17				Establishment reduced hierarchies until 1997, yes=1, no=0
Teamwork	0.10				Establishment introduced teamwork until 1997, yes=1, no=0
Autonomous work groups	0.07				Establishment introduced autonomous work groups, yes=1, no=0
Incentive wages	0.04				Establishment offers incentive wages, yes=1, no=0
Strict hiring rules	0.09				Establishment has strict hiring rules, yes=1, no=0
Assessment system	0.09				Establishment has an assessment system for employees, yes=1, no=0
Participation	0.27				Establishment introduced participative work form until 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
Expected skill shortage	0.24				Establishment expects skill shortages in next 2 years, yes=1, no=0

*Table A1 (continued)*

Expected organizational problems due to maternal leave	0.11	Establishment expects organizational problems due to maternal leave 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 internal formal courses	0.27	Establishment expects increase in internal formal courses 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 self-induced training	0.12	Establishment expects increase in self-induced training 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<sup>a</sup> 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

Notes: <sup>a</sup> The factors have been rotated by promax.

Source: IAB establishment panel, wave 1999, own calculations.

*Table A3: System GMM production function 1997-2000, endogeneous 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: Significance level: \*\*\*<1%. The standard errors are heteroscedasticity corrected.

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

*Table A4: Probit regression, endogeneous variable: works council*

Variables	Coefficient	z-Value
Establishment size 20-49	0.58***	6.31
Establishment size 50-99	1.27***	12.87
Establishment size 100-249	1.99***	19.10
Establishment size 250-499	2.18***	16.46
Establishment size 500+	2.48***	16.36
Establishment with branches	0.27***	3.87
Reduction of hierarchies	-0.04	-0.58
Teamwork	0.08	0.99
Autonomous work groups	-0.26***	-3.22
Incentive wages	0.20**	2.29
Strict hiring rules	0.27***	4.15
Assessment system	0.16**	2.55
Exporter	0.08	1.06
Collective bargaining	0.85***	12.53
Individual establishment	-0.67***	-5.78
Partnership	-0.01	-0.17
Publicly listed establishment	0.48***	2.88
East German establishment	-0.21***	-3.26
Constant	-2.10***	-8.09
Number of observations = 3933 Pseudo R <sup>2</sup> = 0.51		

Notes: Significance levels: \*\*\*<1%, \*\*<5%. All variables take the values of year 1997 (except works councils the values of which are only available for 1998), also 13 sector dummy variables are added, standard errors are heteroscedasticity robust.

Source: IAB establishment panel, wave 1999, own calculations.

## References

- Addison, J.T., Schnabel, C., and Wagner, J., On the Determinants of Mandatory Works Councils in Germany, *Industrial Relations*, Vol. 36, pp. 419-445, 1997.
- Addison, J.T., Schnabel, C., and Wagner, J. “Works Councils in Germany: Their Effects on Firm Performance, *Oxford Economic Papers*, Vol. 53, pp. 659-694, 2001.
- Addison, J.T., Siebert, W.S., Wagner, J., and Wie, X., Worker Participation and Firm Performance: Evidence from Germany and Britain, *British Journal of Industrial Relations* Vol 38, pp. 7-48, 2000.
- Appelbaum, E., Bailey, T., Berg, P. and Kalleberg, A., *Manufacturing Advantage – Why High-Performance Work Systems Pay off*, Ithaca: ILR Press, 2000.
- Arellano, M. and Bond, S., Dynamic Panel Data Estimation Using DPD98 for GAUSS: A Guide for Users, Mimeo, 1998.
- Arellano, M. and Bover, O., Another Look at the Instrumental Variable Estimation of Error-Components Models, in: *Journal of Econometrics*, Vol. 68, pp. 29-51, 1995.
- Arnal, E., Ok,W. and Torres, R., Knowledge, Work Organisation and Economic Growth, OECD Occasional Paper, Paris, 2001.
- Bauer, T., Flexible Workplace Practices and Labor Productivity, IZA Discussion Paper 700, 2003.
- Black, S. and Lynch, L., How to Compete: The Impact of Workplace Practices and Information, Technology on Productivity, *Review of Economics and Statistics* Vol. 83, pp. 434-445, 2001.
- Blundell, R. and Bond, S., GMM Estimation with Persistent Panel Data: An Application to Production Function, Institute for Fiscal Studies Working Paper 4/99, London, 1999.
- Cappelli, P. and Neumark, D., Do ‘High-Performance’ Work Practices Improve Establishment-Level Outcomes? *Industrial and Labor Relations Review* Vol. 54, pp. 737-775, 2001.
- Cappelli, P. and Rogovsky, N., New Work Systems and Skill Requirements, *International Labour Review*, Vol. 2, pp. 205-220, 1994.

- Caroli, E. and Van Reenen, J., Skill Biased Organizational Change? Evidence from a Panel of British and French Establishments, CEPREMAP Discussion Paper 9917, Paris, 1999.
- Cooke, W., Employee Participation Programs, Group-Based Incentives, and Company Performance. A Union-Nonunion Comparison, *Industrial and Labor Relations Review*, Vol. 47, pp. 594-609, 1994.
- Dearden, L., Reed, H., and Van Reenen, J., Who Gains When Workers Train? Training and Corporate Productivity in a Panel of British Industries, IFS Working Paper 00/01, London, 2000.
- Fernie, S. and Metcalfe, D., Participation, Contingent Pay, Representation and Workplace Performance: Evidence from Great Britain, *British Journal of Industrial Relations* Vol. 33, pp. 379-415, 1995.
- FitzRoy, F. R. and Kraft, K., Efficiency and Internal Organization: Works Councils in West German Firms, *Economica*, Vol. 54, pp. 493-504, 1987.
- Fitzroy, F. R. and Kraft, K., Forms of Profit Sharing and Firm Performance, in: *Journal of Economic Behavior and Organization*, Vol. 26, pp. 145-160, 1995.
- FitzRoy, F. R. and Kraft, K., Co-Determination, Efficiency and Productivity, Working Paper, University of Essen, 2000.
- Freeman, R.B., and Lazear, E.P., An Economic Analysis of Works Councils, in: Rogers, J. and Streeck, W. (eds.), *Works Councils – Consultation, Representation and Cooperation in Industrial Relations*, Chicago: University of Chicago Press, pp. 27-52, 1995.
- Freeman, R.B. and Medoff, J.L. The Two Faces of Unionism, *The Public Interest*, Vol. 57, pp. 69-93, 1979.
- Frick, B., “High Performance Work Practices” und betriebliche Mitbestimmung: Komplementär oder substitutiv? Empirische Befunde für den deutschen Maschinenbau, *Industrielle Beziehungen*, Vol. 9, pp. 79-102, 2002
- Frick, B. and Sadowski, D., Works Councils, Unions and Firm Performance: The Impact of Workers’ Participation in Germany, in: Buttler, F., Franz, W., Schettkat, R., and Soskice, D., (eds.), *Institutional Frameworks and Labor Market Performance: Comparative Views on the U.S. and German Economies*, London: Routledge, pp. 46-81, 1995.

- Godard, J. and Delaney, J., Reflections on the “High Performance” Paradigm’s Implications for Industrial Relations as a Field, *Industrial and Labor Relations Review* Vol. 53, pp. 482 – 502, 2000.
- Greenan, N. and Mairesse, J., How do New Organizational Practices Change the Work of Blue Collars, Technicians and Supervisors? Results from Matched Employer-Employee Survey for French Manufacturing, mimeo, INSEE-CREST, Paris, 2002.
- Griliches, Z. and Hausman, J., Errors in Variables in Panel Data, *Journal of Econometrics*, Vol. 31, pp. 93-118, 1986.
- Griliches, Z., and Mairesse, J., Production Functions: The Search for Identification, in Strøm, S. (ed.), *Econometrics and Economic Theory in the 20<sup>th</sup> Century*, Cambridge: Cambridge University Press, pp. 169-203, 1998.
- Harhoff, D., and Stahl, K., Legal Form, Growth and Exit of West German Firms – Empirical Results for Manufacturing, Construction, Trade and Service Industries, *Journal of Industrial Economics* Vol. 46, pp. 453-489, 1998.
- Hempell, T., What’s Spurious , What’s Real? Measuring the Productivity Impacts of ICT at the Firm-Level, ZEW Discussion Paper 02-42, Mannheim, 2002.
- Hübler, O. and Jirjahn, U., Arbeitsproduktivität, Reorganisationsmaßnahmen und Betriebsräte, in: Bellmann, L. and Kölling, A. (eds.): *Betrieblicher Wandel und Fachkräftebedarf, Beiträge zur Arbeitsmarkt- und Berufsforschung* 257, Nürnberg, pp. 1-45, 2002.
- Hübler, O. and Jirjahn, U., Works Councils and Collective Bargaining in Germany: The Impact on Productivity and Wages, *Scottish Journal of Political Economy*, 2003 forthcoming
- Huselid, M.A., The Impact of Human Resource Management Practices on Turnover, Productivity, and Corporate Financial Performance, *Academy of Management Journal*, Vol. 38, pp. 635-672, 1995.
- Ichniowski, C., Kochan, T.A., Levine, D., Olson, C., and Strauss, G., What Works at Work: Overview and Assessment, *Industrial Relations*, Vol. 35, pp. 356-374, 1996.
- Ichniowski, C., Shaw, K., and Prennushi, G., The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines, *American Economic Review* Vol. 87, pp. 293-313, 1997.

- Jirjahn, U., Executive Incentives, Works Councils and Firm Performance, *Schmollers Jahrbuch*, Vol. 123, 2003, forthcoming.
- Kato, T., and Morishima, M., The Productivity Effects of Participatory Employment Practices: Evidence from New Japanese Panel Data, *Industrial Relations* Vol. 41, pp. 487-520, 2002.
- Kölling, A., The IAB Establishment Panel, *Schmollers Jahrbuch*, Vol. 120, pp. 291-300, 2000.
- Levine, D., and Tyson, L., Participation, Productivity, and the Firm's Environment, in: *Paying for Productivity*, in: Blinder, A. (ed.), pp. 183-236, 1990.
- Maddala, G., *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge: Cambridge University Press, 1983.
- Milgrom, P. and Roberts, J., *Economics, Organization, and Management*, Englewood Cliffs: Prentice-Hall, 1992.
- Müller-Jentsch, W., Germany: From Collective Choice to Co-Management, in: Rogers, J. and Streeck, W. (eds.) *Works Councils: Consultations, Representation, and Cooperation in Industrial Relations*, Chicago: University of Chicago Press, 1995.
- Nickell, S., Nicolitsas, D., and Patterson, M., Does Doing Badly Encourage Management Innovation?, *Oxford Bulletin of Economics and Statistics*, Vol. 63, pp. 5-28, 2001.
- OECD, *New Enterprise Work Practices and Their Labour Market Implications*, in: *OECD Employment Outlook*, pp. 177-221, 1999.
- Ramsey, H., Scholarios, D., and Harley, B., Employees and High Performance Work Systems: Testing Inside the Black Box, *British Journal of Industrial Relations*, Vol. 38, pp. 501-531, 2000.
- Rogers, J., and Streeck, W., Works Councils - Consultation, Representation and Cooperation, *Industrial Relations*, Vol. 35, pp. 423-455, 1995.
- Schnabel, C., Korreferat zu Hübler, Jirjahn: Arbeitsproduktivität, Reorganisationsmaßnahmen und Betriebsräte, in: Bellmann, L. and Kölling, A. (eds.), *Betrieblicher Wandel und Fachkräftebedarf, Beiträge zur Arbeitsmarkt- und Berufsforschung 257*, Nürnberg, pp. 47-49, 2002.
- Smith, S.C., Employee Participation Rights, Training, and Efficiency: Hypotheses and Preliminary Evidence from Germany, George Washington University, Technical Paper, 1994.

- Wolf, E. and Zwick, T., Produktivitätswirkung von Mitarbeiterbeteiligung: Der Einfluß von unbeobachteter Heterogenität, *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung*, Vol. 35, pp. 123-132, 2002a.
- Wolf, E. and Zwick, T., Reassessing the Impact of High Performance Workplaces, ZEW Discussion Paper 02-07, Mannheim, 2002b.
- Wolf, E. and Zwick, T., Welche Personalmaßnahmen entfalten eine Produktivitätswirkung?, *Zeitschrift für Betriebswirtschaft*, Vol. 73, EH4/2003, pp. 43-62, 2003.
- Youndt, M. A., Snell, S.A., Dean J.W., and Lepak, D.P., Human Resource Management, Manufacturing Strategy, and Firm Performance, *Academy of Management Journal*, Vol. 39, pp. 836-866, 1996.
- Zwick, T., Continuous Training and Firm Productivity in Germany, ZEW Discussion Paper 02-50, Mannheim, 2002a.
- Zwick, T., Employee Resistance Against Innovations, *International Journal of Manpower*, Vol. 23, pp. 542-552, 2002b.
- Zwick, T., The Impact of ICT Investment on Establishment Productivity, *National Institute Economic Review*, Vol. 184, pp. 99-110, 2003.