Discussion Paper No. 17-039

Productivity and Distribution Effects of Codetermination in an Efficient Bargaining

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ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

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October 2017

Abstract

Codetermination can be regarded as an extreme regulatory intervention of the legislator in the labor market which might affect the efficiency of production and the bargaining power of labor. Based on a model that covers both efficient bargaining and employment bargaining a simple equation is derived that is suited to empirical testing. The empirical test is based on German data and includes years before and after the extension of German codetermination law in 1976. The estimates determine the productivity of labor and relative bargaining power of capital and labor. It turns out that codetermination does not affect productivity, but leads to a significant increase in workers' bargaining power and the distribution of rents.

JEL classification: L22, L23, J52, J53

Keywords: Codetermination, productivity, wage-bill share, bargaining

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Financial support by the Deutsche Forschungsgemeinschaft (SFB 823,"Statistical modelling of nonlinear dynamic processes") is gratefully acknowledged.

I Introduction

Labor markets in all developed countries are characterized by regulation through laws and institutions (Botero et al. 2004). These state interventions include labor law, collective bargaining laws and institutions, and social security regulation such as unemployment benefits. Perotti and Thadden (2006) note that labor market institutions like corporate governance structure are shaped by political decisions and these decisions in turn are influenced by interests of the voters. Once established, corporate governance institutions affect decision making and determine (positively or negatively) rent creation as well as distribution. The topic of this contribution is the impact of a politically mandated change in corporate governance in Germany, namely codetermination, on the productive efficiency of firms and the distribution of rents.

Bargaining between labor and capital is the topic of many articles on labor economics[1]. The bargaining power of labor is determined, among other factors, by the legal framework. In Germany legislation has granted specific rights to labor at plant (Works Constitution Act) and company level (Codetermination Act). Codetermination is realized by the equal representation of worker representatives on supervisory boards[2]. This gives the workforce explicit rights in discourse and decision-making at the highest company level, including the appointment of executives and contract renewal. This article focuses on the effect of codetermination on productivity and the bargaining power of labor.

Over the last few years many articles have been written on codetermination, with quite controversial results[3]. Besides the theoretical papers, some empirical studies have attempted to shed light on the effects of this institution (Svejnar 1982, FitzRoy and Kraft 1993, 2005, Kraft and Ugarkovic 2006, Gorton and Schmid 2004, Fauver and Fuerst 2006). Productivity, profits, stock returns, wages and employment adjustment are among the topics analyzed. However, an explicit bargaining model is not usually applied to estimate the relative

[1] Cf. for a survey Lawson (2011).

[2] Aside of Germany several other European countries have adopted employee representation at board level. These countries are Austria, Croatia, the Czech Republic (however new legislation makes this optional from 2014 onwards), Denmark, Finland, France, Hungary, Luxembourg, the Netherlands, Norway, Slovakia, Slovenia and Sweden http://www.worker-participation.eu/National-Industrial-Relations/Across-Europe/Board-level-Representation2

[3] Addison (2009) provides a very detailed survey on all aspects (theoretical and empirical) of plant and company codetermination. Among the more recent contributions, Allen, Carletti and Marquez (2014) present a theoretical model on the effects of a representation of the interests of stakeholders like employees and suppliers in the firm's decision making process. See also Baranchuk and Dybvig (2009) for a theoretical analysis of the efficiency of diverse corporate boards.

bargaining power of the two parties and to identify the impact of codetermination (as well as other determinants) on the distribution of rents.

The problems stem on the one hand from the theoretical basis and on the other hand from the empirical application. The modeling of bargaining processes is complex if the theoretical model is to be suitable for empirical application. Here a theoretical model is developed to derive a very simple structural equation on the relative bargaining power of labor that is suitable for an empirical test. This test is subsequently carried out using information from 154 stock companies operating in the manufacturing industry in the years 1973 to 1990. It is therefore possible to cover time periods before and after the introduction of (quasi-) parity on the supervisory boards following the extension of Germany's codetermination law in 1976.

Codetermination takes place at the supervisory board level, with this board discussing and deciding on many strategic decisions like market development and medium- to long-term corporate planning like the organization of production or innovation activities. These decisions have relevance on the one hand for the productivity of the firms and on the other hand for the division of the surplus between labor and capital (Kraft 1998, 2001). Therefore the significant extension of codetermination rights in 1976 might well affect the efficiency of the organizations and the bargaining power of labor.

I use an efficient bargaining model that takes account of simultaneous negotiations on wages and employment. A structural equation is derived which is subsequently used for the estimation of bargaining power in codetermined and non-codetermined firms. This structural model can also deal with pure employment bargaining.

The equation explains the wage-bill-to-sales ratio as a simple function of the labor elasticity of output and bargaining power. Hence the productivity of labor is compared with its share in output. Bargaining power is identified as an add-on to the labor elasticity of output.

In the first place a production function is used to estimate the output elasticity of labor. This approach finds no productivity (dis-)advantage of codetermined firms. Subsequently the output elasticity of labor is inserted into a constrained linear regression explaining the wage-bill-to-sales ratio by variables like unionization, unemployment and codetermination to identify bargaining power. The study shows that the extension of codetermination rights has increased the bargaining power of labor by about 2.7-2.9 percent (on top of the base value of bargaining power of 15-20 percent). Hence, the empirical results point to significant effects of

collective bargaining laws or more general regulation of labor (Botero et al. 2004) on the distribution of rents.

There are not many studies available which actually apply a bargaining framework and confront a structural model with empirical data. Svejnar (1986) develops and estimates a bargaining model which is subsequently applied to U.S. data. Veugelers (1989) empirically determines bargaining power in Belgian industries. Bughin (1996) estimates a bargaining model using Belgian data to simultaneously identify the product market power of firms and union bargaining power. Dobbelaere and Mairesse (2010) estimate a quite general model that allows them to identify product and labor market imperfections, as well as right-to-manage versus efficient bargaining. Hirsch and Schnabel (2014) introduce an alternative approach to identify the bargaining power of unions in Germany by considering the labor share, net wage, average unemployment duration and worker's discount rate.

Bargaining power is estimated by some empirical studies on the basis of less explicit modelling. Using Canadian data, Abowd and Lemieux (1993) show that wages are higher in firms with limited pressure from international competition. Van Reenen (1996) determines the extent of rent sharing due to technological innovation. Abowd and Lemieux (1993) find that 30% of rents go to the employees and van Reenen (1996) estimates an elasticity between wages and quasi rents of 29%. Other relevant studies in this context are Cristofides and Oswald (1991), Blanchflower, Oswald and Sanfrey (1996).

This paper is organized as follows: firstly I describe in section 2 the institutional background of the German Codetermination Act. Section 3 contains a theoretical model that is then used in an empirical application. Section 4 reports the results of our empirical study. Finally, with section 5 I draw conclusions.

2 Institutional Details

German stock companies and large non-traded firms with limited liability (GmbHs) are managed and controlled by a two-tier system: the management board (Vorstand) on the one hand and the supervisory board (Aufsichtsrat) on the other.

In Germany, several laws on codetermination rights for workers at different levels exist[4]. At the establishment level employees are able to ask for the adoption of works councils[5]. At the company level three codetermination laws are relevant:

1951 *"Act on the Co-determination of Employees in the Supervisory & Management Boards of Companies in the Coal, Iron & Steel Industry" (Gesetz über die Mitbestimmung der Arbeitnehmer in den Aufsichtsräten & Vorständen der Unternehmen des Bergbaus und der Eisen und Stahl erzeugenden Industrie (Montan-Mitbestimmungsgesetz))*
• Parity co-determination on supervisory board of companies of the of the coal, iron and steel industries.

1952 *"Works Constitution Act" (Betriebsverfassungsgesetz)*
• One third codetermination on supervisory boards of companies with 500 employees or more

1976 *"Codetermination Act" (Mitbestimmungsgesetz)*
• Extension of the one third codetermination to quasi-parity codetermination on supervisory boards of companies with 2000 employees or more. (The one third codetermination remained relevant for firms employing 500 to 1999 workers.) Note, in the case of conglomerates the total number of employees is counted.

The present study focuses on the extension of the Codetermination law which was introduced in 1952 and significantly extended in 1976 by introducing (quasi-)parity between representatives of labor and capital on the supervisory boards of companies employing 2000 employees or more[6]. The sample of firms with extended codetermination rights is compared with companies which have no or one-third codetermination[7]. The enlargement was legislated by the social-liberal (Social Democratic Party and Free Democratic Party) coalition governing in Germany from 1969 to 1982 led by chancellors Willy Brandt and Helmut Schmidt. Perotti and Thadden (2006, 160) mention this intervention in corporate governance structure as the most pronounced incarnation of the attempt to let labor influence decision making.

The members of the supervisory boards are representatives of capital owners and employees. Since 1977 representatives from labor and capital in such organizations have had an equal

[4] McGaughey (2015) presents a historical view of the development of codetermination in Germany.

[5] Starting with FitzRoy and Kraft (1985, 1987), the effects of works councils have been the subject of a number of studies.

[6] The employment limit is relevant to the company alone or, if it is a conglomerate or the company has subsidiaries, the total number of employees is decisive. Furthermore, only domestic employment matters. It is unclear whether existing empirical studies have taken the complicated rules into account. For quasi-parity codetermination reliable information is available from the Hans-Böckler Stiftung. Unfortunately, for one-third codetermination no such information is obtainable.

[7] The other two regulations on codetermination are disregarded for the following reasons: Within the coal, iron and steel industry only a quite limited number of firms is active and the industry is heavily affected by structural change. As already mentioned, the cases of one third codetermination are unfortunately much more difficult to identify, since no reliable list on the codetermined companies is available.

number of seats on the supervisory boards. Nevertheless, in case of dispute the head of the supervisory board, appointed by the capital owners, has two votes. Therefore the term quasi-parity is used for this kind of codetermination. However, in practice disputes tend to be rare.

The management boards lead companies and decide on all day-to-day business, but they have to report to the supervisory board concerning all important issues. Major decisions must be approved by the supervisory board. What exactly has to be fixed by the supervisory boards is usually determined by a list of approvable operations. This list can be divided into operational reporting and strategic decisions.

Operational reporting covers, among other things, information from the supervisory board about market conditions (sales, market share), employment (number of employees, costs, working time, productivity, turnover), production (production volume, inventories, material costs, capacity, innovation policy), finance (debt, equity, leverage, investment), and profitability (cash flow, profits, return on investment, liquidity). Strategic decisions with a medium- to long-term relevance encompass market development (technology, general trends in the main industry, the economy and foreign markets), medium- to long-term corporate planning (strategy, research and development, human resources, production, finance, forecasts concerning sales volume and profits). Employment is therefore directly and indirectly affected by short- and long-term decision making.

Supervisory boards appoint the executives, and decide on contract renewals. A subcommittee of this board also determines the salaries of the top managers and the composition of remuneration in terms of fixed versus short- and long-term parts.

In contrast to most other bargaining institutions, supervisory boards may well have a larger impact (directly or indirectly) on employment than on wages[8]. In Germany wage determination is basically a two-step process. Firstly, wage negotiations between employer associations and unions take place at industry level. Nevertheless, it has been shown that wages differ among firms, as the industry-wide agreement is frequently a substitute for a minimum wage, and wages are fixed at the firm or establishment level in a second round[9]. Codetermination might affect remuneration indirectly, e.g. by exerting resistance against

[8] Cf. Kraft (1998, 2001).

[9] Note that in Germany firms are not forced to adopt collective agreements. In principle, every firm can choose between being a member of an employer association and setting wages through collective agreements or staying out of the employer association and setting wages individually.

wage concessions in cases of economically adverse situations[10]. In addition there are specific situations possible, such as concession bargaining in the case of a severe crisis. Svejnar (1982) presents evidence that the introduction of codetermination has led to a wage increase in the iron and steel industry, but not in the coal mining industry.

3 A Bargaining Model

The utility function is based on risk-neutral agents and is specified as wage differentials between remuneration in the considered firm (called *w*) in relation to wages earned elsewhere (outside option called w_a) multiplied by the number of employees *N*. The monetary value of the outside option is either unemployment benefits or a weighted average of a) employment at a lower wage level and b) unemployment benefits where the weights are determined by the probabilities that the first or the second option applies. This monetary value is called w_a and its value determines the lower boundary for the bargained wage *w*. Hence, the aim of labor is to maximize the function

$$U = N(w - w_a) \tag{2}$$

This is the well-known Stone-Geary utility function with risk-neutral workers and is frequently applied in bargaining models (examples are Blanchflower, Oswald and Sanfy 1996 and Dobbelaere 2004).

The firm simply maximizes profits by means of three production factors: labor *N*, capital *K* and materials *M*. Workers receive the wage *w*, whilst interest rates relevant for the use of capital are denoted by *r* and material costs are called *c*. To keep the model manageable, capital and materials are assumed to be exogenously determined and fixed in the short run. Profits are defined as the difference between sales volume *Pq* and costs for labor *wN*, capital *rK* and materials *cM* .

[10] Gorton and Schmid (2004, 865) argue that employees might use codetermination as an insurance mechanism by resisting wage cuts and dismissals in recessions. In the case of a negative shock, employers might possibly seek to make some workers redundant. Codetermination could be used to resist to such demands or to postpone decisions, with the result that a delay in redundancies is at least likely. As Gorton and Schmid (2004) note, the codetermined firms would then tend to be overstaffed. This should also be reflected in the wage share if codetermined firms are compared with others. Codetermination as an insurance mechanism is also discussed by Perotti and Thadden (2006) as well as by Kim, Maug and Schneider (2015). Guertzgen (2014) presents related empirical evidence and shows that firms with works councils provide more wage insurance than other firms.

(3) $$Pq(K,N,M) - wN - rK - cM$$

Output is determined by a simple Cobb Douglas production function: $q = N^{\alpha}K^{\beta}M^{\gamma}$ with the labor elasticity of output α, capital elasticity of output β, output elasticity of materials γ and firms maximize (as usual) profits. In case of dispute they have to bear the expenditures for capital and material[11]. I consider the realistic case of asymmetric bargaining power, and the bargaining power of the two players is denoted by ϕ and $1-\phi$. The aims of the two parties are combined by the well-known Nash bargaining solution:

(4) $$\Phi = (N(w - w_a))^{\phi}(PN^{\alpha}K^{\beta}M^{\gamma} - wN - rK - cM - (-rK - cM))^{(1-\phi)}$$

In case of efficient bargaining the Nash product is optimized with respect to employment and wages. This leads to the following derivatives:

(5) $$N = \frac{Pq(\phi + \alpha - \phi\alpha)}{w}$$

(6) $$w = \frac{Pq\phi + nw_a + n\phi w_a}{n}$$

Solving these relations yields a simple relation for employment:

(7) $$N = \frac{Pq\alpha}{w_a}$$

Employment is determined by the labor elasticity of output and the alternative wage. Hence in this case employment is at its maximum. A similar expression for the wage leads to:

(8) $$w = \frac{(\phi + \alpha - \phi\alpha)}{\alpha} w_a$$

These two equations can be combined to determine an expression for the wage-bill-to-sales ratio

(9) $$\frac{nw}{Pq} = \phi + \alpha - \phi\alpha$$

In this case the wage-bill-to-sales ratio is a simple function of the output elasticity and bargaining power. Interestingly it is independent of the alternative wage w_a. The ratio of total

[11] This assumption is frequently made in the literature, examples being Bughin (1996), Crepon et al. (1999), Dobbelaere (2004) Abraham et al. (2009).

wage payments to sales is a popular measure for labor's bargaining power and is also applied in empirical studies (e.g. by Gorton and Schmid 2004). This procedure is supported by our simple model, where this ratio is actually determined by bargaining power (and productivity). If the simple textbook model applies and workers have no bargaining power ($\phi = 0$) the wage-bill-to-sales ratio reduces to the output elasticity of labor.

As already discussed above, the question arises whether a model based on efficient bargaining is really adequate for analyzing codetermination, as wages are rarely an explicit issue for supervisory boards[12]. Interestingly it is rather simple to include pure employment bargaining. Rearranging the optimality condition for employment bargaining (5), leads exactly to equation (9). Hence, with respect to equation (9), it doesn't matter whether wages and employment are determined in negotiations simultaneously or whether employment only is negotiated.

The relevance of equation (9) for efficient as well as employment bargaining is clearly advantageous, as other determinants of the outcome of bargaining are not based on employment bargaining only. Note, however pure, wage negotiations are not covered by this model.

Imperfect competition

Monopolistic Competition

Until now prices are exogenously determined and not a function of the output produced by the firm in question. This is true for competitive markets but in many situations imperfect competition is more realistic. A simple way to consider such a situation is by including monopolistic competition[13]. Demand for output *q* is determined in the following way:

$$D = P^{\eta} Y, \eta < -1 \tag{10}$$

With Y being a general demand factor and η stands for the price elasticity of demand. Inverting this relation leads to an equation for price:

$$P = D^{\varepsilon} Y^{-\varepsilon}, -1 < \varepsilon = \eta^{-1} < 0 \tag{11}$$

Inventory holding is disregarded here and therefore $D = q$

[12] A discussed above, in particular during recessions wages might be an implicit issue.

[13] Many papers use a monopolistic competitive framework. Very well-known examples are Dixit and Stiglitz (1977) as well as Blanchard and Kyotaki (1987)

Combining these relations together with the production function implies

(12) $$q = (N^{\alpha} K^{\beta} \mathrm{M}^{\gamma})^{(1+\varepsilon)} Y^{-\varepsilon}$$

The bargaining function is now

(13) $$\Phi = (N(w - w_a))^{\phi} ((N^{\alpha} K^{\beta} \mathrm{M}^{\gamma})^{(1+\varepsilon)} Y^{-\varepsilon} - wN - rK - cM - (-rK - cM))^{(1-\phi)}$$

Optimization leads to somewhat more complicated expressions which, however, are interpreted very similarly to the relations determined earlier:

(14) $$w = \frac{\phi + \alpha(1 + \varepsilon - \phi - \phi\varepsilon)}{\alpha(1+\varepsilon)} w_a$$

(15) $$N = \frac{(1+\varepsilon) P q \alpha}{w_a}$$

Employment again depends on the alternative wage, output elasticity and sales. It comes as no surprise that due to $\varepsilon < 0$ employment is lower than in the case of perfect competition.

The expressions for wage and employment can be used to explain the wage-bill-to-sales ratio

(16) $$\frac{wN}{Pq} = \phi + \alpha(1+\varepsilon) - \phi\alpha(1+\varepsilon)$$

During the estimation process to be explained below, the output elasticity of labor and the expression for demand elasticity are always simultaneously determined.

Cournot Oligopoly

As it is well known, in a Cournot model the marginal revenue function depends on output:

(17) $$Pq_i = P(Q) q_i \text{; with}$$

$$Q = \sum_{i=1}^{n} q_i \text{ and}$$

$$\frac{\partial (Pq_i)}{\partial q_i} = P \frac{\partial Q}{\partial q_i} + \frac{\partial P}{\partial Q} \frac{\partial Q}{\partial q_i} q_i$$

The derivative of sales with respect to employment is now

(18) $$\frac{\partial Pq_i}{\partial N} = P \frac{\partial Q}{\partial q_i} \frac{\partial q_i}{\partial N} + \frac{\partial P}{\partial Q} \frac{\partial Q}{\partial q_i} \frac{\partial q_i}{\partial N} q_i$$

If the typical Cournot assumption $\frac{\partial Q}{\partial q_i} = 1$ is applied the expression from above reduces to

(19) $$\frac{\partial (Pq_i)}{\partial N} = (P + \frac{\partial P}{\partial q_i} q_i) \frac{\partial q_i}{\partial N}$$

Straightforward rearrangements lead to

(20) $$\frac{\partial (Pq_i)}{\partial N} = P(1 + \frac{s_i}{\eta}) \frac{\partial q_i}{\partial N} .$$

The term s_i stands for the individual market share and η represents the demand elasticity. Taking into account the Cobb-Douglas production function from above leads to the following relation

(21) $$\frac{\partial (Pq_i)}{\partial N} = P(1 + \frac{s_i}{\eta}) \alpha \frac{q_i}{N}$$

Just to simplify notation, I introduce $a = (1 + \frac{s_i}{\eta})$. When the logarithmic Cobb-Douglas production function is estimated, not α is identified but

(22) $$\frac{\partial \ln(Pq_i)}{\partial \ln N} = a\alpha$$

If this is taken up in the bargaining model the following relation for the wage-bill-to-sales ratio emerges:

(23) $$\frac{wN}{Pq} = \phi + a\alpha - \phi a\alpha$$

The upshot of the consideration of these two simple models of imperfect competition is that in principle the bargaining model is not affected. The estimated production elasticities are determined somewhat differently, but this has no effect on the analysis of the distribution process.

4 Empirical analysis

4.1 Data

The empirical model is based on a difference-in-differences approach. The extended codetermination law became effective in 1976 but the firms were granted a transition period until 1978 to install supervisory boards with a new allocation of the seats. The empirical test is based on data from stock companies from 1973 to 1990. The advantage of this particular data source is the coverage of periods before and after the major extension of the codetermination laws in 1976.

This test is based on an unbalanced panel of 154 firms from the manufacturing sector which are observed for four periods before (1973 to 1976) and 11 years (1980 to 1990) after the introduction of the extended codetermination law[14]. The years 1977 to 1979 are omitted because of the aforementioned transition periods for installing the newly introduced supervisory boards. Furthermore, adjustment problems might contaminate the "true" effects of codetermination. This leads to a total of 1787 observations[15].

4.2 Estimation of a Production Function

The empirical test is implemented in two steps. In the first place a simple Cobb-Douglas production function is estimated. The estimation is based on the use of capital, labor and material costs as explanatory variables. The dependent variable is sales volume. Sales, capital and materials are divided by the relevant industry-specific producer price index. The coefficients of the production factors stand for the output elasticities if perfect competition applies, or additionally reflect effects of product differentiation by including $1+\varepsilon$ or oligopoly markups by the additional factor $a = (1+\frac{s_i}{\eta})$.

[14] The origin of the data is the German Finance Data Base (Deutsche Finanzdatenbank/ Jahresabschlussdatenbank), which was extended with Hoppenstedt's Handbook of German Corporations (Handbuch der Deutschen Aktiengesellschaften) as well as the annual statements of accounts.

[15] In Germany the number of stock companies is generally smaller than for example in the U.S. Furthermore, only companies from the manufacturing sector are considered, whilst firms from the steel and iron producing industry are excluded, since they are subject to the specific and somewhat stronger codetermination law in the coal, iron and steel industry (as stated above). Some observations are lost because of lags (three periods) needed during the GMM estimation procedure. See below.

Dynamic system-GMM panel model

The estimation of the production function is based on a system GMM model. Due to the limited number of observations it is not possible to estimate a separate value of α for every individual firm. However, some finer partitioning can still be realized: Labor is differentiated according to employment in non-codetermined firms, employment in codetermination firms in periods before the enlargement became effective (1973 until 1976) and employment in codetermined firms after the enlargement became effective from 1980 onwards. Three different (broadly defined) industries are also distinguished to take account of specific technological conditions. These industries are: production of consumer goods, production of industrial goods and investment and production of durable goods. Clearly, the intention is to take account of possible productivity differences which should be reflected in the share of output that goes to labor.

The GMM model addresses time-invariant unobserved heterogeneity like management quality, which may bias the results if this unobserved heterogeneity is correlated with other variables. Furthermore, there might also be feed-back effects present, such as demand shocks which affect output and input factor simultaneously. To cope with time-invariant fixed effects and possible endogeneity problems a system-GMM model is used. The system GMM estimator combines time differencing of the variables with instrumenting endogenous variables by lagged levels and differences of these covariates. Necessary conditions for the validity of this approach are an absence of second order autocorrelation in the differenced errors (Arellano-Bond test) and the validity of the overidentification moment conditions in the presence of robust standard errors (Hansen J test). The model is dynamic and includes the lagged dependent variable. The two-step estimator is used, the standard errors are clustered and the Windmeijer (2005) finite sample correction of the standard errors is applied.

Endogenous variables are the production factors labor, capital and material. Because of the weak instrument problem not all possible lags are used, but just the lags from *t-2* and *t-3*. Nevertheless, as always the use of lagged values as instruments leads to a loss of observations. Time dummies are also included. Table 1 presents the result of the system GMM estimations.

Table 1: Dynamic System GMM production function with log of Sales as Dependent Variable

Independent variables	Consumer goods	Industrial goods	Investment and durable goods
lnSales(t-1)	.196*** (0.039)	.196*** (0.038)	0.196*** (0.038)
Ln (Labor) (codetermination. = 0)	0.164*** (0.048)	0.154*** (0.042)	0.186*** (0.034)
Ln (Labor) (codetermination before 1976)	0.167*** (0.048)	0.149*** (0.039)	0.182*** (0.033)
Ln (Labor) (codetermination =after 1976)	0.155*** (0.045)	0.149*** (0.037)	0.181*** (0.033)
Ln (Material costs)	0.526*** (0.051)	0.493*** (0.049)	0.535*** (0.047)
Ln (Capital)	0.092** (0.044)	0.144*** (0.046)	0.080** (0.05)
Constant	1.347*** (0.158)	1.347*** (0.158)	1.347*** (0.158)
No of obs.		1787	

Number of instruments 353
Arellano-Bond test on AR(2) in first differences p=.757
Hansen J Test on overidentifying restrictions p=.836

Notes: **(*) indicates statistical significance at the 5%(1%) level. All results are two-step system GMM estimates. Time dummies are included but not reported. Parentheses contain clustered standard errors which are based on the finite sample correction proposed by Windmeijer (2005). Clustering takes place at firm level.

No significant differences between the coefficients of the output elasticities of labor are estimated. Returns to scale are tested by Wald tests applied to a model with the restriction that the coefficient of *lnSales(t-1)* is zero. Results of this restricted model are presented in Table A1 in the appendix. Constant returns are never rejected.

4.3 Determinants of Bargaining Power

Equations (9), (16) and (23) are relations between output elasticity of labor, bargaining power ϕ and the wage bill to sales ratio. Bargaining power in turn is empirically identified by some economic variables. In particular the following relation is used

(24) $$\phi = \gamma_0 + \gamma_1 CODAL + \gamma_2 CODEFF + \beta_i Z_i + \tau_t T_t$$

In the next step the coefficients of the variables lnemployment (the different values of α respectively $\alpha(1+\varepsilon)$) are used in a constrained least square estimation (see below). The main interest is clearly the determination of possible bargaining effects exerted by the extension of codetermination rights. As usual in difference-in-differences models of this kind the most important variable enters the equation twice: the variable *CODAL* has unit value for codetermined firms for all years, whereas *CODEFF* has unit value if extended codetermination is effectively at work. This means the firms are codetermined and the time periods considered are the years from 1980 onwards. Hence the marginal effect of *CODEFF* (γ_2) is the relevant parameter. Z_i stands for a number of covariates to be explained below and the T_t variables represent time dummies.

Time dummies are also included within the bargaining equation. Furthermore 21 two-digit industry dummy variables I_j are added, but outside of the bargaining equation[16]. The industry dummies identify the coefficients δ_j. The equation now looks like this:

(25) $$\left(\frac{wN}{Pq}\right)_i = (\gamma_0 + \gamma_1 CODAL_i + \gamma_2 CODEFF_i + \beta_i Z_i + \tau_t T_t) + \alpha$$
$$-(\gamma_0 + \gamma_1 CODAL_i + \gamma_2 CODEFF_i + \beta_i Z_i + \tau_t T_t)\alpha + \delta_j I_j$$

This equation can be further simplified and an error term is added as well, leading to

[16] Including them in the bargaining equation implies a somewhat different assumption concerning the determination of bargaining power, but this does not alter the results.

$$(26)\quad \left(\frac{wN}{Pq}\right)_i = \alpha + \gamma_0(1-\alpha) + \gamma_1(1-\alpha)CODAL_i + \gamma_2(1-\alpha)CODEFF_i + \beta_i(1-\alpha)Z_i + \tau_t(1-\alpha)T_t + \delta_j I_j + \varepsilon_i$$

with $\varepsilon_i \sim N\left(0, \sigma^2\right)$

The explanatory variables are multiplied by $(1-\alpha)$ and α is the output elasticity of labor, which is estimated by the production function reported in the last section. As stated before, the output elasticity α is not a constant, but assumes 9 different values. The coefficient of *CODEFF* tells us to what extent bargaining power has increased (or decreased or has not been affected) by the extension of the codetermination law.

Several control variables are added. Standard variables in bargaining models are unemployment and union density. Unemployment is available at the level of the German Federal States or “Bundesländer" (10 Bundesländer before the reunification). Unionization can be computed in the following way: in Germany several industry unions exist. Information is available on the number of union members, the industries for which they are responsible (these are usually more than just one industry), and the number of employees in the relevant industries. On the basis of this information the share of unionized employees is computed. This is the gross rate of unionization and an upper estimate of unionization, since some members of the unions are unemployed or retired.

Union density is frequently regarded as a factor correlated with bargaining power and in the given context this is relevant in two ways. Firstly, bargaining power will most likely have an impact on the base level of wages, which (as explained earlier) is determined by negotiations taking place at industry level. Secondly, high unionization probably reflects the attitude of the workforce in general towards the representation of workers’ rights in bargaining processes. This in turn may be a good indicator of what workers expect from their representatives on the supervisory boards. These are frequently members of the works councils, who are elected every four years by the employees.

The use of accounting firm data offers only limited access to useful covariates of potential interest. Nevertheless, some interesting information can be obtained from other sources. Obviously working time is not constant over time and between firms, and hours in turn will affect the wage bill. The denominator also depends on hours worked as labor input clearly affects output. With quasi-fixed employment and the fact that overtime is partially unpaid, the

effect of overtime on output might be stronger than that on the wage bill. Data on overtime hours per employee is published at industry level and this is used to represent the general state of demand in an industry.

The skill levels of employees will in all likelihood influence wages directly due to productivity effects (remember firm-specific coefficients cannot be estimated) and may possibly also affect bargaining power. As a proxy variable I use the innovation intensity of a firm by computing the number of patents per employee multiplied by the factor 100. Innovative firms usually employ more highly skilled workers and pay higher wages.

Some empirical evidence exists that firms in concentrated industries employ more highly qualified workers and this in turn will positively affect the wage bill[17]. Another argument points in the opposite direction: Monopoly power reduces the labor share in output as prices rise due to a higher mark-up on costs, but wages do not (if concentration is not associated with higher unionism)[18]. This argument is also valid in this context if my estimated output elasticities of labor are not disaggregated enough to take account of different market structures. Given that I only consider three broadly defined industries this might well be the case. Hence the two lines of reasoning lead to opposite hypotheses on the coefficient of concentration. The degree of imperfect competition is measured at the two-digit industry level by the six firm concentration ratio. International competitive pressure is considered by the import ratio, specified as the monetary value of imported goods divided by the total value of all sales in an industry.

Following Koenker and Hallock (2001) I adjust continuous variables by subtracting from the observed value its respective mean value. In addition to centering the continuous variables all industry dummies are included but with the restriction that the sum of all coefficients totals zero, and therefore $\sum_1^k \delta_i = 0$ (with k industries)[19]. This approach has the advantage that the constant term, in this case called centercept, can be interpreted as the mean bargaining power of non-codetermined firms with average values for overtime hours, innovation intensity

[17] Cf. Belman and Heywood (1990), who consider the interaction between concentration, innovation and qualification.

[18] Cf. e.g. Conyon (1994).

[19] Suits (1984) proposed an indirect way to compute the average effect. Kennedy (1986) extended this approach, while Greene and Seaks (1991) discuss the restricted least squares model, which is applied here.

concentration, union density and unemployment in the absence of codetermination[20]. It does not, in contrast to the classical intercept, express an out-of-sample prediction. The coefficients of the industry dummies inform about deviations from the average level (but are not reported in the tables).

Estimation is by means of constrained linear regression. The constraints are inclusion of the different values of α with a "coefficient" of one and that the sum of the coefficients of the industry dummies adds up to one. I use bootstrapping with cluster adjustment and 200 replications, as the empirical model is basically a two-stage procedure and works in the second stage with an estimated coefficient.

The results are presented in Table 2. All specifications include time dummies and 21 two-digit industry dummies. Column (1) is the preferred specification. It might be argued that, if wages are high in general, a feedback effect from the wage bill to unemployment causes an endogeneity problem. Therefore in one specification (presented in column 2) this variable is simply excluded. This omission does not alter the main results. The variables overtime hours, concentration and patent might determine the rent to a larger extent than bargaining power. As the dependent variable is a ratio with sales volume in the denominator, this is probably of limited relevance. Nevertheless, an equation with no covariates except unemployment and unionization is estimated as well (presented in column 3) with largely unchanged coefficients of the remaining variables. Column (4) shows the result of the bargaining equation if the output elasticity of labor is estimated by the application of the restricted GMM model, which excludes the lagged dependent variable (GMM results presented in Appendix Table A1).

The results point to a significant effect of the extension of the codetermination rights on the wage-bill-to-sales ratio. As the productivity effect is included via the output elasticities, the results suggest a redistribution effect beyond productivity. Hence, according to the outcome of the applied model, the extension of the codetermination law has had an impact on bargaining power.

[20] Please note that the centercept identifies $\gamma_0(1-\alpha)$ and not γ_0 as the use of $(1-\alpha)$ as a variable in connection with the noconstant option led to technical problems because of the additionally inserted value of α.

Table 2: Constrained linear regression on bargaining power (column 1-3 α based on dynamic system GMM, column 4 α based on restricted system GMM)

Dep. Var	(1) Share of labor costs	(2) Share of labor costs	(3) Share of labor costs	(4) Share of labor costs
α (constrained)	1	1	1	1
Constant	0.136***	0.159***	0.121***	0.138***
	(0.013)	(0.012)	(0.012)	(0.013)
CODAL	-0.011	-0.098	-0.009	-0.003
	(0.008)	(0.008)	(0.008)	(0.008)
CODEFF	0.022***	0.023***	0.023***	0.021**
	(0.009)	(0.009)	(0.009)	(0.009)
Overtime hours	-0.038***	-0.037***		-0.039***
	(.007)	(0.007)		(0.007)
Patents per employee*100	0.016***	0.015***		0.016***
	(0.004	(0.004)		(0.004)
Concentration	0.006***	0.006***		0.006***
	(0.002)	(0.002)		(0.001)
Unemployment	-0.006***		-0.005***	-0.006***
	(0.001)		(0.001)	(0.001)
Unionization	0.097*	0.100**	0.089*	0.104**
	(0.05)	(0.051)	(0.050)	(0.051)
Import Ratios	-0.032	-0.031		-0.018
	(0.036)	(0.036)		(0.035)
Industry dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
No. of obs.	1787			

Notes: **(*) indicates statistical significance at the 5% (1 %) level. Parentheses contain bootstrapped and clustered standard errors. Clustering takes place at firm level. The "coefficient" of α is constrained to 1 (see equation 26).

The coefficients of CODEFF have values between 0.021 and 0.023. As outlined by equation (26) these coefficients are $\gamma_2(1-\alpha)$ and based on this relation the "true" impact of codetermination γ_2 can be computed. These estimates point to a gain in bargaining power of about 2.73 to 2.94 percent. This increase can be set in relation to bargaining power without enlargement of codetermination. The centercepts (constant terms) stand for average levels of $\gamma_0(1-\alpha)$ in the absence of codetermination. These coefficients vary between 0.136 and 0.159. Computation of averages of γ_0 leads to values between 15.34 and 20.19 %. Taking the ratio between γ_2 and γ_0 gives us information about the relative increase in bargaining power in relation to the "base level". In comparison to the bargaining power in firms without codetermination, enlargement of codetermination increases bargaining power by about 14.54-18.77 %. This conclusion also can be drawn with regard to the sample of codetermined firms before the enlargement of the codetermination rights has taken place, as the coefficient of CODAL is insignificant. In all cases the bargaining power of labor is far from an equal power distribution.

This result is consistent with the estimations of Gorton and Schmid (2004), who explain logarithmic value of the ratio of employees to sales and the log ratio of the wage bill to sales by codetermination (and covariates). However, one difference to their study is the consideration of productivity effects. The empirical results of my study are also in accordance with the study of Petry (2015), who shows that the enlargement of codetermination led to a decline in shareholder wealth. Related evidence on the effect of labor unions as shareholders in the U.S. is presented by Agrawal (2012) and by Ahern and Dittmar (2012) on the impact of the imposition of a 40% quota of female members of the boards of directors of publicly listed firms in Norway. In contrast, Ginglinger, Megginson and Waxin (2011) find no significant impact of the presence of directors elected by employees on firm value or profitability.

The included control variables attract coefficients with the expected sign and are mostly significant. Innovative firms have a higher wage-bill-to-sales ratio, which is presumably explained by the employment of highly skilled and better paid employees. Employees of firms active in highly concentrated industries receive a larger share of sales, which supports the hypotheses that in concentrated industries employees are more highly qualified. Unsurprisingly, unemployment reduces the labor share, while union density increases it. Average overtime at industry level decreases the wage-bill-to-sales ratio as apparently output

reacts stronger to changes in hours than wages. In the case of the share of imports no significant impact is estimated.

5 Conclusion

I use a simple model to determine the effect of the extension of codetermination rights on productivity and subsequently on bargaining power. In the first place a production function is estimated by application of a dynamic system GMM model, and this model does not point to productivity disadvantages of codetermined firms. Bargaining power is identified by comparing the wage-bill-to-sales ratio with the labor elasticity of output, which is identified by the GMM estimations of the production function. In the absence of bargaining power both variables are expected to have the same magnitude. Variables extending the share of sales that goes to labor are used to model bargaining power. Some standard control variables to determine bargaining power of labor like unemployment and unionization are also included. The most important variable is the enlargement of the codetermination rights, the effect of which is determined within a difference-in-differences framework.

According to the results of estimation of the bargaining equation, the extension of the Codetermination Act in 1976 increased bargaining power by 2.7-2.9 % (on top of the otherwise relevant level of 15-20 %). Summarizing, the increased codetermination rights neither harmed nor improved efficiency, but led to increased bargaining power of labor and affected the distribution of rents. This is an example of how political decisions shape corporate governance institutions and these in turn affect rent sharing.

Clearly the model is based on restrictive assumptions. On the other hand, it leads to a quite simple equation, which can be applied to an empirical test. Most likely the relation used to identify bargaining power is of relevance above the question of codetermination.

In future work I intend to apply more general specifications. One extension might be a less restrictive production function. Another idea is to employ a utility function, which allows for risk aversion on the part of the employees. Moreover at the moment I ignore the second main pillar of German industrial relations, the works councils. Works councils are active at the plant level, and it is quite likely that works council affect efficiency of production and the bargaining power of labor. In contrast to codetermination at the company level, medium-sized

firms with less than 2000 employees frequently have works councils[21] and it would be useful to compare their effects with that of codetermination.

[21] Works councils are not mandatory but the workforce must be allowed the option of establishing one. The relation between works councils and performance and rent sharing is discussed by Jirjahn and Kraft (2007) among others.

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Appendix

Table A1: Restricted System GMM production function with log of Sales as Dependent Variable (without lagged dependent variable)

Independent variables	Consumer goods	Industrial goods	Investment and durable goods
Ln (Labor) (codetermination. = 0)	0.174*** (0.045)	0.188*** (0.032)	0.263*** (0.024)
Ln (Labor) (codetermination before 1976)	0.165*** (0.046)	0.179*** (0.030)	0.254*** (0.025)
Ln (Labor) (codetermination =after 1976)	0.170*** (0.040)	0.176*** (0.028)	0.246*** (0.024)
Ln (Material costs)	0.641*** (0.047)	0.576*** (0.033)	0.644*** (0.047)
Ln (Capital)	0.151*** (0.040)	0.223*** (0.031)	0.105** (0.041)
Constant	1.616*** (.130)	1.616*** (.130)	1.616*** (.130)
No of obs.		1787	
Number of instruments 279			
Arellano-Bond test on AR(2) in first differences p=.246			
Hansen J Test on overidentifying restrictions p=.519			

Notes: *** indicates statistical significance at the 1% level. All results are two-step system GMM estimates. Time dummies are included but not reported. Parentheses contain clustered standard errors which are based on the finite sample correction proposed by Windmeijer (2005). Clustering takes place at firm level.