Essays on Wage Formation and Globalization

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Andreas Hauptmann
Nürnberg, November 2015

Chapter 1
Introduction

This thesis studies wage formation processes in the context of a globalizing economy and different institutional settings. Wage formation is highly relevant for employees, firms, policy makers and scientists alike, and therefore constitutes an important area for economic research. Globalization and other changes in the economic environment, such as technological progress and the deregulation of product markets, have also affected the conditions for wage formation. For instance, there are widespread concerns that globalization and international economic integration results in wage losses and increases inequality. Globalization may increase aggregate output, but also affect the distribution of income between firms and workers and different groups in the labor market unequally. Collective labor representation can mitigate or aggravate the effects for employers and employees. Moreover, increasing international and national competition together with technological progress can affect unionization and the coverage of collective wage contracts.

Against this background, this thesis addresses three main questions: First, how does collective bargaining coverage evolve in modern economies if firms are free to opt for alternative modes of wage-setting? Second, how does the increasing international exposure of firms affect wages in the context of different institutional settings? Third, how do wages and competitiveness affect the export participation of firms?

The immanent complexity of the subject does not allow for a unified answer, although all these topics are closely related. Consequently, each chapter of this thesis contains an independent analysis addressing different aspects, using a variety of economic and econometric methods.

The starting point for the analysis is presented in Chapter 2 by studying endogenous selection into wage regimes based on differences in cost structures. The choice between different wage regimes is essential to understand how wages are determined in modern economies and how different modes of wage-setting evolve over time in an environment with technological progress and increasing product market competition. The analysis is motivated by two seemingly contradicting observations: On the one hand, it is widely believed that firms oppose unions because they reduce profits. On the other hand, in most European countries, collective bargaining is at the discretion of the employer. The aim of the chapter is therefore to contribute to a better understanding of why firms might prefer collective bargaining over other modes of wage setting. The analysis is carried out in a theoretical general equilibrium framework with endogenous selection of wage regimes, where firms are free to choose to bargain with a local union or to refrain from it. Selection is driven by differences in the cost structure between wage regimes. It is shown that cost differences are sufficient to explain incomplete collective bargaining coverage rates as an equilibrium outcome. Furthermore, the results show that the decrease in collective bargaining coverage rates can be attributed to technological progress and product market deregulation.

Chapter 3 investigates wage formation in international firms subject to collective agreements. The growing inequality over the last decades in many Western countries has been attributed to technological change, institutional reforms and globalization. Previous research has shown that the rise in wage inequality can be attributed to higher wages at exporting firms, the so called exporter wage premium. In this context, recent theoretical contributions have emphasized that more trade exposure can influence the wage structure by reducing the exporter wage premium in firms subject to collective bargaining (e.g. Egger and Etzel, 2012). We test this hypothesis by employing German linked employer–employee data. One important challenge is to separate the effects from differences in the workforce structure and rent-sharing. We construct a measure of plant-level profitability that is free from compositional effects. We find that rent-sharing is less distinct in more export-intensive firms or more open industries. This chapter is joint work together with Gabriel Felbermayr (Ifo Institute Munich) and Hans-Jörg Schmerer (IAB Nuremberg) and has been published in the *Scandinavian Journal of Economics*.[1]

Chapter 4 addresses another aspect of wage formation in exporting firms. Again, the point of departure is the exporter wage premium, referring to the empirical observation that exporting firms pay systematically higher wages. It is also well documented that this wage premium decreases substantially once worker and firm characteristics are accounted for. However, the identification is based on the within variation of the data and might yield imprecise estimates if the variation over time is low. Recent contributions provide theoretical explanations for the exporter wage premium: Egger, Egger, and Kreickemeier (2011) base their rent-sharing mechanism on a fair-wage framework. Fair-wage considerations are, among other things, related to the firm's "ability to pay". Chapter 4 contributes to this literature by providing new empirical evidence for the fair-wage framework based on the system of industrial relations in Germany. The collectively agreed wage constitutes a legally binding wage floor. But firms are always allowed to pay more if they want to. The empirical analysis is based on the IAB establishment panel and employs different estimators addressing potential endogeneity and the truncation of the dependent variable from below. The results show that a firm's export intensity is systematically related to payments above collectively

1 See Felbermayr, Hauptmann, and Schmerer (2014). Previous versions of the paper have been circulated as Felbermayr, Hauptmann, and Schmerer (2012a) and Felbermayr, Hauptmann, and Schmerer (2012b).

agreed wage floor and therefore support the fair-wage hypothesis. The chapter is co-authored by Hans-Jörg Schmerer (IAB Nuremberg) and has been published in *Economics Letters*.[2]

Chapter 5 addresses the link between wages and globalization from another perspective. German exports soared in the recent past, and this has been accompanied by a heated public debate. Adversaries object, that years of wage moderation increased international competitiveness and have allowed Germany to grow at the expense of its trading partners in the Eurozone. But beyond the debate on current account imbalances, an additional question arises, which has not received much attention in the literature. What are the determinants of a firm's export participation? Chapter 5 studies this question empirically. It constructs plant- and industry-competitiveness measures to investigate their influence on export participation. The findings indicate that a higher plant-level competitiveness, measured by lower unit labor costs, is positively associated with export participation. The analysis is carried out for different estimators and margins of export participation. There is no evidence that industry-level competitiveness affects export participation. Furthermore, low-wage firms are less likely to export, which is in line with the literature on the export wage premium. The chapter is joint work together with Daniel Etzel (University Bayreuth) and Hans-Jörg Schmerer (IAB Nuremberg) and has been published in *Economic Systems*.[3]

Finally, Chapter 6 briefly concludes the main findings of the thesis.

2 See Hauptmann and Schmerer (2013).

3 See Etzel, Hauptmann, and Schmerer (2013).

Chapter 2

Endogenous wage regime selection: A general equilibrium model

2.1 Introduction

It is commonly assumed that firms oppose unions because they reduce profits due to rent seeking behavior. Many economists see unions as monopolistic organizations that raise wages above the competitive level and create inefficiencies in resource allocations (Clark, 1984; Friedman, 2007).[1] Others emphasize, beyond their role in wage-setting, beneficial aspects, such as the reduction of exits of employees, the raise in investments in firm-specific training (Freeman, 1976; Freeman and Medoff, 1984) and also welfare (Donado and Wälde, 2012).

This chapter takes a different perspective on collective wage bargaining and unions. Union density has declined in many developed countries in the recent past. Nevertheless, collective bargaining is still an important, sometimes the dominating, mode of wage-setting. At the same time collective bargaining recognition is at the discretion of the employer, especially in many European countries. Why are collective agreements still so important today? What determines the collective bargaining coverage rate and why is it changing over time?

From an economic perspective there are two main explanations why firms would agree to collective wage bargaining.[2] First, firms face a tradeoff between higher union wages and foregone revenues during strikes. Generally, the larger the impact of labor conflicts, the more likely the firm will agree to bargain with the union. Second, wage contracts are complex and may cover also more than wages. By dealing with one single entity, employers can realize gains form standardization and centralization. This transaction cost advantage has received almost no attention in the theoretical literature so far.

Against this background, this chapter analyses the role of transaction costs in the context of incomplete collective bargaining coverage and endogenous wage regime selection. The theoretical model draws on standard models of monopolistic competition and right-to-manage wage bargaining. Selection into regimes is driven by differences in cost structures associated with a particular wage regime. Firms are homogeneous after entering the market. Then, they decide whether to join one of two wage regimes. Wages are either bargained between the firm and a local (firm-level) union or they pay the market clearing wage rate in the non-unionized wage regime. When deciding about a wage regime, firms face an additional tradeoff: One wage regime is characterized by low fixed costs

1 Inefficient collective bargaining outcomes are consistent with models of monopoly unions (Dunlop, 1944), right-to-manage bargaining (Nickell and Andrews, 1983), and insider-outsider theories (Lindbeck and Snower, 1987). Other theories suggest that efficiency can be restored once wages and employment are bargained together (McDonald and Solow, 1981; Booth, 1995).

2 There are furthermore potential other historical, political, and regional motives, which are beyond the scope of this chapter.

and high variable regime costs, whereas the opposite holds for the other regime.[3] The wage regime decision is not irrevocable. At every instant firms can enter or exit the market or switch the regime. The findings of this chapter indicate that the decrease in collective bargaining coverage rates over the last decades is consistent, for instance, with technological progress. It is also consistent with product market deregulation, emphasizing the interactions between labor and goods markets. Furthermore, allowing firms to decide over collective bargaining recognitions places a restriction on union actions. This gives rise to cooperation rather confrontation, which is a central feature of German systems of industrial relations.

The model presented in this chapter is related to several strands of literature. The first strand of literature consists of the few contributions which address incomplete union coverage and the choice between different wage bargaining regimes in one way or another. The model presented in Lazear (1983) complements the analysis carried out in this chapter by addressing the tradeoff between lower wages in the non-unionized regime and the cost of labor conflicts. Similar to the approach presented here, the decision problem considers cost differences. In Lazear (1983), competitive firms face a national union. If unionized, the firm pays a wage rate set by the union and hires workers conditioned on the union wage rate. If firms are not unionized, they pay the lower labor market clearing wage. Because the wage is higher in the unionized regime, other things equal, firms oppose unionization. However, fighting off a union and defending against a higher wage rate is costly to the firm and these costs are unequally distributed between firms. Therefore, firms with lower costs (or higher defense skills) will not be unionized up to a threshold level where paying the higher wage becomes cheaper compared to fighting. One of the main findings in Lazear (1983) is that a higher product demand elasticity decreases the likelihood of unionization, similar to the results presented here. However, in contrast to the present chapter, Lazear (1983) employs a framework with perfect competition instead of monopolistically competitive firms and assumes that a national union takes the effects of wages on employment and other aggregates into account.

Taschereau-Dumouchel (2014) presents a model tailored towards the US system of industrial relations. It addresses the bargaining regime decision from the worker perspective and analyses its impact on the firms' labor demand decisions. The labor market is characterized by search frictions, generating rents

3 During the description of the model and the subsequent analysis, we do not specify whether the unionized regime is the one with e.g. higher or lower fixed costs. The reason for this approach is that we do not want the conclusion to be buried in the assumptions. In fact we can show that an equilibrium exists in both scenarios, emphasizing that differences in cost structures are sufficient to generate simultaneous wage regimes with endogenous selection.

for firms and job seekers once a worker has found a vacant position. Workers of different productivity vote about being collectively represented. If the majority favors unionization, wages are bargained collectively. Otherwise bargaining takes place individually between each worker and the firm.

Workers with a high productivity have a lower preference for union representation because the wage structure is more compressed. Firms oppose being unionized as it reduces their profits. It is shown that this distorts the hiring decision of the firms and that the distortion is even larger compared to a situation where being unionized is compulsory. Furthermore, it is emphasized that even if union density in the US is relatively low, the threat of being unionized can have a large economic impact.

Some of the more recent literature on incomplete unionization focuses on the impact of skill-biased technological change on unionization and income inequality. If collective bargaining compresses the wage structure – a stylized fact found in many studies[4] – then skill-biased technological change raises the non-union wage opportunities of high-skilled relative to low-skilled workers and therefore reduces the preferences of high-skilled workers for collective representation (Acemoglu, Aghion, and Violante, 2001). Dinlersoz and Greenwood (2012) address this issue by using a dynamic general equilibrium model of costly unionization with high- and low-skilled workers.[5] They find that skill-biased technological change can explain the decline of unionism and a rise in income inequality. This result is confirmed by Acikgöz and Kaymak (2014) building on a small firm search and matching model.

Another strand of literature treats the selection of wage bargaining regimes as given, but investigates incomplete unionization.[6] Delacroix (2006) uses the large firm search and matching model with incomplete union coverage and different levels of coordination. He finds that unemployment increases with collective bargaining coverage and decreases with the degree of centralization or coordination. A similar theoretical approach is employed by Ebell and Haefke (2006). They study the effect of product market regulations on labor market outcomes and find that the decline of collective bargaining coverage rates in the

4 The effect of unionization on the wage structure has been reported numerous times. Among others, see Freeman and Medoff (1984), Card (1996), and Card and DiNardo (2002) for the US and Dustmann, Ludsteck, and Schönberg (2009) for Germany.

5 Their analysis is based on the partial equilibrium of MacDonald and Robinson (1992), where a national union sets the wage rate of its members, their membership dues, and the number of firms covered. Since unionization is a costly endeavor, they find that incomplete union coverage arises from different fixed and variable costs components. Another, early contribution of costly unionization and incomplete coverage is presented in Kuhn (1988). He finds that unionized firms are likely larger and more productive.

6 Some of these contributions describe the conditions in which the agents would not want to switch their wage regime. But this can be considered as a different description of an endogenous selection equilibrium.

US and the UK can be linked to the product market reforms of the 1980s. Jimeno and Thomas (2013) compare the labor market outcomes between firm-level and sector-level bargaining based on a small firm search and matching model. They find that unemployment is lower if firm-level bargaining is applied. Boeri and Burda (2009) show that firms as well as the median voter prefer collective over individual bargaining if a firing tax on a considerable fraction of workers is introduced.

Finally, the approach presented in this chapter is also related to other approaches of endogenous wage regime selection. For instance, Michelacci and Suarez (2006) investigate an environment, where firms can choose whether to post or bargain wages in a directed search model.[7] If wages are posted, firms can increase the probability of filling a vacancy by offering higher wages. However, this also raises the probability that workers with a lower productivity apply. If wages are bargained, wage rates can be adjusted to the productivity of workers, but this reduces the probability of filling the vacancy. Michelacci and Suarez (2006) show that a simultaneous wage regime equilibrium exists if search inefficiencies and the dispersion of worker skills are at a medium level. Furthermore, some authors investigate the endogenous choice of the bargaining level, motivated by the seminal work of Calmfors and Driffill (1988) which finds that fully (de)centralized wage setting systems are superior over intermediate levels of wage bargaining (Ramaswamy and Rowthorn, 1993; Freeman and Gibbons, 1995; Petrakis and Vlassis, 2004).

Thus, the approach presented here is most similar to contributions in the literature which study the endogenous choice between different wage bargaining regimes in a general equilibrium framework considering different cost structures. This allows to analyze the links between wage-setting, labor demand and competition on product markets.

The main contribution of this chapter is to offer an explanation for the empirically relevant and significant share of collective agreements in many European countries, where at the same time the recognition of the agreement is at the discretion of the employer. The approach presented herein is based on transaction cost motives, emphasizing the effect of different modes of wage formation on the cost structure of the firms. The findings in this chapter can further help to explain the decline in collective agreement coverage rates in recent years, stressing the importance of goods and labor market interactions as an additional channel.

7 For a similar approach see Masui (2011).

Moreover, as outlined above, the choice of firms between different bargaining regimes restricts union actions and industrial conflicts. This may explain why German firms adjusted wages rather than employment in the course of the economic shock triggered by the financial crisis in 2008 and 2009.[8]

The reminder is structured as follows: Section 2.2 outlines the evolution of collective agreement coverage in Germany between 1996–2011 and sketches the institutional background. Section 2.3 outlines the modeling framework. Section 2.4 solves the model in partial equilibrium. This is done sequentially. Starting from a parsimonious definition, the model is extended step by step. The solution and comparative statics for selected parameters are investigated at each step. Section 2.5 shows the general equilibrium solution of the model and discusses the conditions for its existence. Section 2.6 discusses the model's implications and puts them into perspective. Section 2.7 concludes.

2.2 Collective bargaining regimes in Germany

Although decreasing since several years, collective agreements are still widely applied in the German system of industrial relations. In 2011, 32 percent of all establishments and about 60 percent of all workers have been covered by collective agreements of some sort. The predominant form are industry- or regional-level contracts (*Flaechentarifvertrag*), where unions bargain about wages and other employment conditions with an employers' association. If a firm does not want to join an employers' association it may also bargain with the union directly about firm-level contracts (*Firmentarifvertrag*). Either way, the agreed wage constitutes a legally binding wage-floor.[9]

There are several important differences in the German system of industrial relations compared to other countries. First, union recognition is a choice made by the employer (Dustmann, Ludsteck, and Schönberg, 2009). This is, for instance, in contrast to the US, where firms are legally obliged to bargain with a union once workers decided for union representation by majority vote (DiNardo and Lee, 2004). These differences to the US do not imply that trade unions have no influence on collective agreement recognition. It rather emphasizes the importance of different systems of industrial relations. Second, collective agreements are often applied to all employees, whether they are union members or not. Otherwise, it would

8 See Dustmann, Fitzenberger, Schönberg, and Spitz-Oener (2014), who argue that the governance structure of German industrial relations is the key factor for understanding why German firms adjusted at the internal rather than at the external margin to the economic shock in 2008 and 2009.

9 A third form of worker representation in Germany are plant-level agreements between the employer and their work council *(Betriebsvereinbarung)* and it is important to mention that these councils are not allowed to negotiate about issues that are normally covered by collective agreements, such as wages.

give non-unionized workers additional incentives to become union members (Gürtzgen, 2009b).

Therefore union coverage is larger than union density in Germany, where union density is defined as the share of workers with union membership relative to all employees. For a detailed review of the German industrial relations system see Keller and Kirsch (2010).

Data of the IAB establishment panel are used to describe the evolution of collective bargaining coverage rates. The IAB establishment panel is a yearly conducted survey, which covers by now about 16,000 plants per year. Furthermore, it is the primary data source on collective bargaining coverage rates in Germany. Sampling is based on all plants with at least one employee subject to social security contributions. The data set contains detailed information on e.g. employment, revenues, investment and also covers information on whether a plant recognizes a single- or multi-employer collective agreement. For the figures presented below, all observations have been weighted by their inverse sampling probability. The survey is conducted in East and West Germany since 1996. More detailed information on the IAB establishment panel can be found in Fischer, Janik, Müller, and Schmucker (2009) and Kölling (2000).

Figure 2.1 shows the evolution of the share of firms which are either subject to a local (single-employer) agreement or a centralized (multi-employer) agreement. The share of firms covered by centralized wage agreements decreases from 45 percent in 1996 to roughly 30 percent in 2011. This decrease has not been compensated by local agreements which remain at 3 percent between 1999 and 2011. Therefore, the share of plants not subject to any form of collective agreement increases from 44 percent in 1996 to 68 percent in 2011. It has been documented that this recent decline in coverage rates is rather explained by changes in firm behavior than changes in firm composition (Addison, Teixeira, Bryson, and Pahnke, 2013). Also switching between regimes is by far more frequent than commonly suggested (Addison, Bryson, Teixeira, Pahnke, and Bellmann, 2013).

Figure 2.2 displays the evolution of the collective bargaining coverage rate for the same period. In contrast to the previous figure, the coverage rate uses the number of workers subject to collective agreements relative to all workers. The qualitative picture remains unchanged. The share of workers subject to centralized agreements is decreasing between 1996 and 2011. Also the share of workers subject to local agreements is much smaller and almost constant at 10 percent. Therefore, the share of workers not covered by any collective agreement steadily increases between 1996 and 2011. The economic impact however is still significant. In 2011 about 60 percent of all workers have been subject to collective agreements.

The observation that 60 percent of all workers, but only 32 percent of all plants, are covered by collective agreements in 2011 indicates that establishments subject to collective agreements are larger on average. Figure 2.3 displays the evolution of the share of firms covered by collective agreements for different size classes, where size is defined as the number of employees. Also here the overall picture remains unchanged. The share of firms without agreements is increasing over time at the cost of centralized agreements. The differences between size classes are substantial and evolve almost linearly. For instance, in 2011 only 19 percent of small establishments with 1 to 4 employees are subject to collective agreements, for medium sized firms it varies between 30 to 70 percent and reaches almost 90 percent for large plants with more than 500 employees.

Figure 2.1: Collective agreement firm share

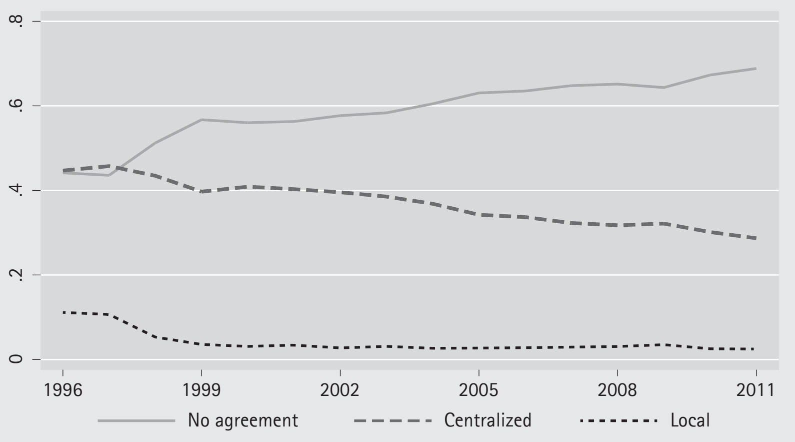


Figure 2.2: Collective bargaining coverage

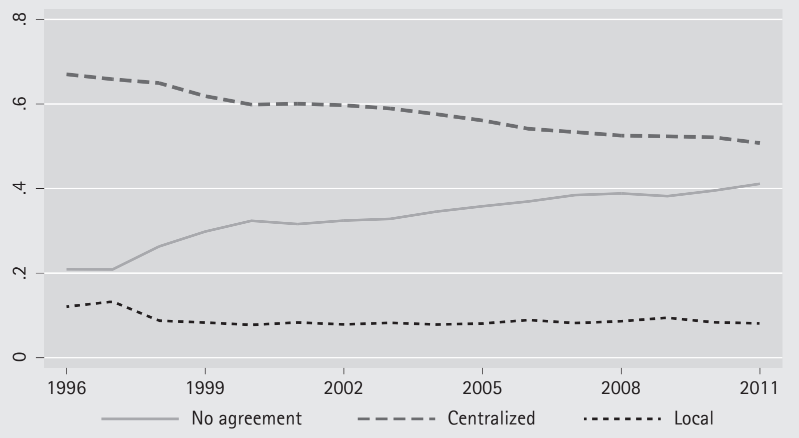


Figure 2.3: Collective agreement firm share, by size classes

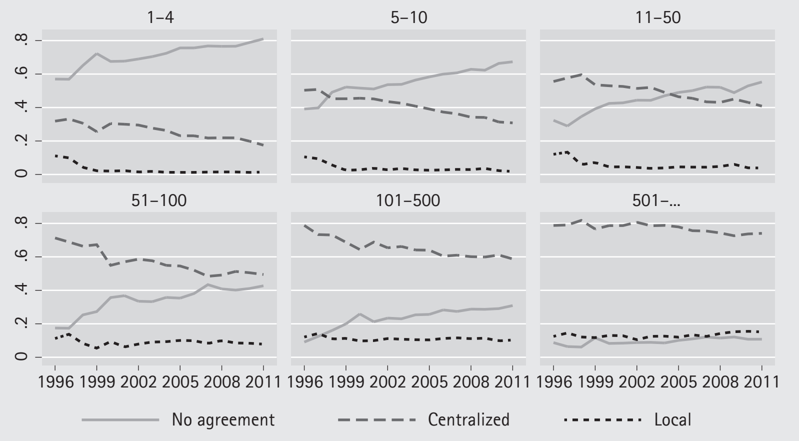


Figure 2.4: Collective agreement firm share, within manufacturing industries

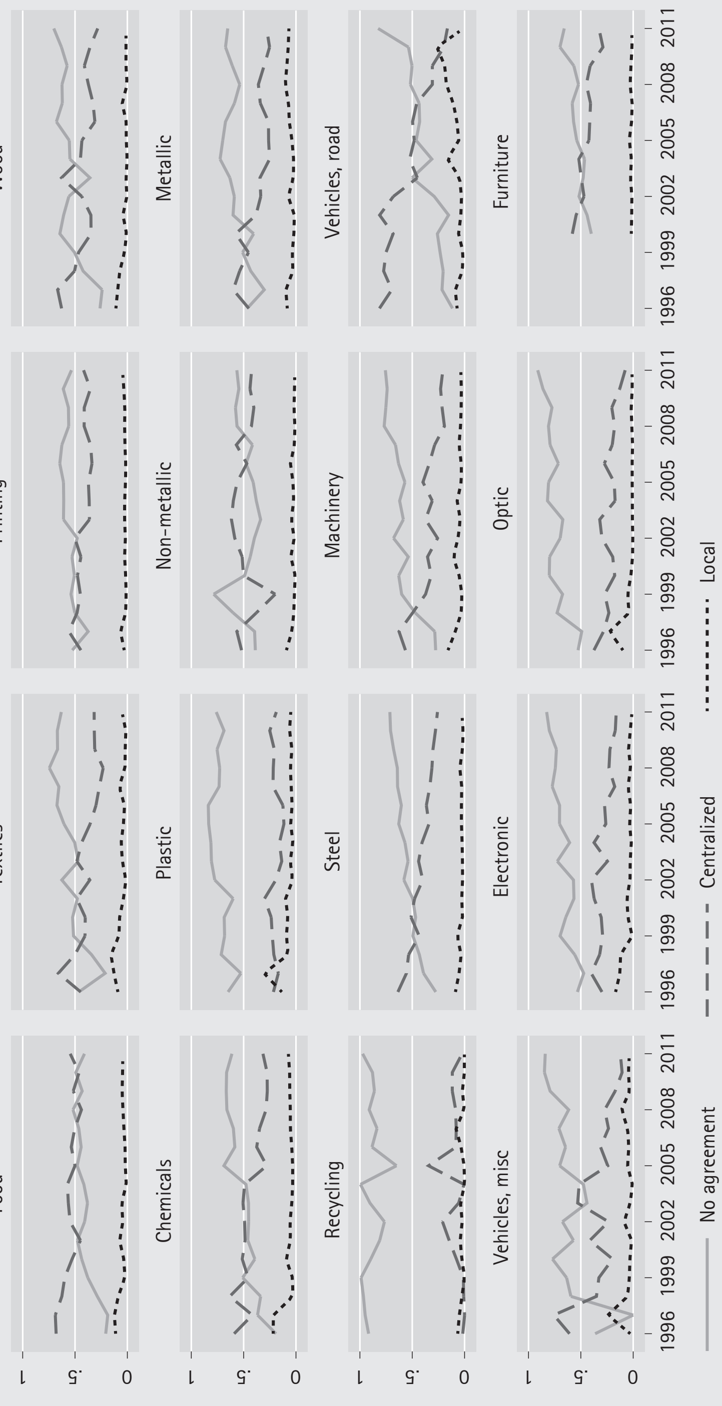


Figure 2.5: Collective agreement firm share, within service industries

Figures 2.4 and 2.5 show the evolution of the collective agreement firm share within manufacturing and service industries. In general the within-sector variation is larger, but the growing importance of firms without agreements is also present here. It is also shown that – with the exception of public administration – union recognition in service industries in generally lower. For instance in manufacturing industries such as machinery, car industries, and metal processing the share is traditionally high. Whereas wholesale and retail traders are almost never covered by collective agreements. In any case, Figures 2.4 and 2.5 document that simultaneous wage regimes are present even within industries and also in sectors where union representation is traditionally low.

These results indicate several stylized facts, which are addressed in the subsequent sections: (i) Union coverage, measured in terms of workers or firms has been decreasing during the last two decades. (ii) This decrease in coverage can be attributed rather to different firm behavior than different firms. (iii) Union recognition is at the discretion of the employer. (iv) Firms subject to collective agreements are larger. (v) Simultaneous regimes are present even within single industries.

2.3 The model

This section extends the standard model of monopolistic competition with simultaneous wage regimes. The main properties are summarized briefly. The economy is endowed with N units of labor supplied inelastically. Workers derive utility from consuming a final output good, which is produced by using different intermediate inputs. Intermediate input producers are monopolistically competitive and are free to choose one of two wage regimes. In the first regime, wages are bargained between the firm and a firm-level union.[10] In the second or non-unionized regime, a competitive wage rate is paid. The main assumption is that different wage formation mechanisms are associated with different cost structures.

Final output producers. Final output Q is homogeneous, produced under perfect competition and used for consumption or payment of costs. Technology of final output producers follows

$$Q = M^{-\frac{1}{\sigma-1}} \left[\int_0^M q_i^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}, \tag{2.1}$$

10 Considering only one bargaining regime is a simplification compared to the previous section to keep the analysis tractable.

where $\sigma > 1$ denotes the elasticity of substitution, M is the mass of differentiated intermediate inputs available for production and q_i denotes the quantity of intermediate input variety i.[11] Profit maximization of final output producers implies that demand for variety i follows

$$q_i = \frac{E}{PM}\left(\frac{p_i}{P}\right)^{-\sigma}, \tag{2.2}$$

where p_i denotes the price of input variety i and $E = PQ$ denotes expenditure on final output. The price P of final output Q, reads

$$P = \left[\frac{1}{M}\int_0^M p_i^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}. \tag{2.3}$$

As shown in (2.2), demand for any variety i increases proportional to real average expenditure per variety, $E/(PM)$, and decreases in its real price, p_i/P, with elasticity σ. If all firms would charge the same price p, it follows from (2.3) that the price of final output becomes $P = p$. In this hypothetical scenario demand for each variety would equal real expeniture per variety.

Intermediate input firms. Intermediate inputs are produced under monopolistic competition.[12] Each firm produces output with labor as the only factor of production and a linear homogeneous production technology,

$$q_i = \phi l_i, \tag{2.4}$$

where ϕ denotes the productivity level which is common to all firms in the economy. Furthermore, by denoting variable costs of firm i by c_i and the corresponding fixed cost of production by f_i, profits of firm i are given by $\pi_i = p_i(q_i)q_i - c_i(q_i/\phi) - Pf_i$. With fixed costs being paid in units of final output.[13] Maximizing profits subject to (2.2) gives the usual constant markup pricing rule over marginal cost,

11 The first term on the right-hand side in (2.1) differs from the standard Dixit-Stiglitz model, as it eliminates external economies of scale effects. Therefore, the mass of varieties has no effect on aggregate output for any given level of aggregate input demand. This specification has been used in various contexts. For a detailed discussion see Felbermayr, Prat, and Schmerer (2011), Egger and Kreickemeier (2009) and Blanchard and Giavazzi (2003).

12 The assumption of monopolistic competition broaden the set of results as it allows to model the interaction of product and labor market imperfections. Considering perfect competition instead does not alter the main conclusions.

13 The specification of fixed costs payments in units of final output is chosen for analytical tractability. The qualitative results would remain the same if, for instance, the fixed costs would be paid in labor. The labor market clearing conditions, however, would be much more complicated (Yeaple, 2005). Furthermore, it is a straightforward extension in models with more than one wage for the fixed costs to be billed in the same unit (Egger and Kreickemeier, 2009).

$$p_i = \frac{\sigma}{\sigma - 1}\frac{c_i}{\phi}, \tag{2.5}$$

where $\sigma/(\sigma - 1)$ denotes the markup over marginal costs. Using the demand equation (2.2) and the constant markup rule (2.5), profits of firm i can be written as

$$\pi_i = \frac{1}{\sigma}\frac{E}{M}\left(\frac{p_i}{P}\right)^{1-\sigma} - Pf_i. \tag{2.6}$$

Wage regimes. There exist two wage regimes in the economy. In one regime, the wage is determined by collective bargaining between a local union and the firm. The bargained wage rate is denoted by w_U. In the other regime, firms are not unionized and pay a competitive wage rate w_N.

The main assumption is that different forms of wage formation are associated with different cost structures.[14] Additionally to general fixed costs of production f, regime specific fixed costs a_j for $j \in \{N, U\}$ are assumed. Therefore, fixed costs of firm i in regime j are

$$f_{i(j)} = \left\{ \begin{array}{c} f_N \\ f_U \end{array} \right\} = f + \begin{cases} a_N & \text{if } j = N, \\ a_U & \text{if } j = U. \end{cases} \tag{2.7}$$

Furthermore, variable costs are composed of wages paid to the worker (w_j) and additional costs specific to the wage regime (b_j)

$$c_{i(j)} = \begin{cases} w_N + b_N & \text{if } j = N, \\ w_U + b_U & \text{if } j = U. \end{cases} \tag{2.8}$$

This difference in cost structures between wage regimes is crucial. There are other examples in the literature with a similar modeling strategy. For instance Lazear (1983) assumes that it is more costly for some firms to defend against unionization than it is for others. To this point it is not specified which regime is more "costly", e.g. $a_U \gtrless a_N$. This will be discussed together with the equilibrium in detail. For the moment it seems reasonable that differences in the wage formation process are also reflected in differences in the cost structure.

14 The nature of this costs is deliberately kept general. Yet, in light of the more recent applications in search environments, one may think of them as bargaining cost (Pissarides, 2009). It seems fair to assume that bargaining itself is not costless but rather involves additional resources such as time. In this case, dealing with a single entity gives rise to economies of scale compared to a situation where the rm engages with each worker individually. Alternatively, one could interpret these costs as all other sorts of (non-wage) labor costs paid by the rm (Lazear, 1983) or the union (MacDonald and Robinson, 1992; Dinlersoz and Greenwood, 2012).

One of the main contributions of this model is that firms are then allowed to choose their wage regime. If they decide to engage in collective agreements, they face a set of costs $\{w_U, b_U, f_U\}$. If they choose the non-unionized regime, they pay $\{w_N, b_N, f_N\}$. Furthermore, firms are allowed to switch regimes instantaneously at no cost. Switching between regimes continues until no firm can be made better off in the other regime. There are three potential outcomes: (i) all firms choose to be non-unionized, (ii) all firms choose to be unionized, and (iii) some firms choose to be unionized while the others refrain from engaging in collective agreements. The emphasis of this modeling approach is on simultaneous wage regimes and therefore the focus will be on the third scenario. Below, the determinants are derived for which both, unionized and non-unionized firms, coexist in equilibrium.

Union wage bargaining. Bargaining between the firm and the union is modeled in a very standard way and involves firm-level wages alone, whereas the firm retains its right-to-manage (Nickell and Andrews, 1983). The bargain is described by the generalized Nash solution such that the bargained wage maximizes $[(w_U - \tilde{w})\, l_U(w_U)]^{\beta} [\pi_U(l_U(w_U)) - \pi_U(0)]^{1-\beta}$, where β represents the bargaining weight of the union and $\tilde{w}$ the fallback wage of workers in case of disagreement. Furthermore, it is assumed that fixed costs are already sunk at the bargaining stage. Therefore the contribution of the firm to the bargain is its operational profit. The solution to this maximization problem is (see Appendix 2.A)

$$w_U = \frac{\sigma - 1 + \beta}{\sigma - 1}\tilde{w} + \frac{\beta}{\sigma - 1} b_U.$$

The bargained wage increases in the workers' fallback option ($\tilde{w}$),[15] the bargaining power of the union (β) and the variable regime costs (b_U). The wage decreases with more competition (higher σ). If $b_U = 0$, equation (2.9) reduces to the standard solution of right-to-manage wage bargaining under monopolistic competition, where the union bargains a markup over the workers' fallback option (e.g Blanchard and Giavazzi, 2003). Defining the union wage markup by $\theta \equiv (\sigma - 1 + \beta)/(\sigma - 1)$ we can write the union wage equation as

$$w_U = \theta\tilde{w} + (\theta - 1)\, b_U. \tag{2.9}$$

15 The specication of the workers' fallback option in the context of simultaneous wage regimes is not self-evident. We will discuss later different alternatives, depending on the framework applied.

Further note that the results do not depend on the assumption of right-to-manage bargaining. Alternative specifications, such as efficient bargaining (McDonald and Solow, 1981) are equally appropriate and would yield qualitatively the very same predictions. The necessary element is that the wage formation process is linked to aggregate values. The choice of right-to-manage bargaining is made for two reasons. First, an explicit description of the wage formation process allows for a closed form solution of the model and therefore a better understanding of the simultaneous wage regime framework. Second, right-to-manage bargaining is closer tailored towards the European model of industrial relations.

Equilibrium conditions. Since firms are homogeneous *within* each wage regime, we can drop individual subscript i and refer to the wage regime index $j \in \{N, U\}$ instead. The description of the model is completed by the following set of equilibrium conditions.

Product market clearing: The goods market is cleared if real expenditures (E/P) equal total real revenues $\left(\int_0^M (p_i/P)\, q_i di\right)$. It is easy to verify that this is equivalent with the price index equation in (2.3) to hold. Since firms are equal within each wage regime, the price index can be rewritten in terms of real prices such that

$$1 = (1 - \mu_U)\left(\frac{p_N}{P}\right)^{1-\sigma} + \mu_U\left(\frac{p_U}{P}\right)^{1-\sigma}, \tag{2.10}$$

where μ_U denotes the share of firms in the unionized regime, i.e. $\mu_U = M_U/M$.

Regime indifference condition: Firms are free to choose between regimes at every instance. A simultaneous wage regime equilibrium therefore requires that no firm has an incentive to leave its regime. This is the case if profits are equal in both regimes. This translates formally into

$$\pi_N = \pi_U. \tag{2.11}$$

Free entry condition: There exists a mass of potential entrants to the market. Suppose an initial situation where firms in the market are able to generate positive profits. This will trigger additional entrants into the market and eventually reduce the profits of the incumbent firms. This process will go on until no additional firm has an incentive to enter the market, i.e. until profits are zero

$$\pi_j = 0. \tag{2.12}$$

Labor market clearing: The labor market is cleared if the total mass of persons employed $L \equiv M_N l_N + M_U l_U = L_N + L_U$ is equal to the labor endowment N

$$L = N. \tag{2.13}$$

2.4 Partial equilibrium

2.4.1 Preliminary remarks

First intuition. The aim of this model is to explore the characteristics of simultaneous wage regimes within a given industry. The solution of such a model is quite different compared to the workhorse models of monopolistic competition. The reason for this can be best explained by the goods market clearing condition. Solving (2.10) for the share of union firms gives

$$\mu_U = \frac{1 - (p_N/P)^{1-\sigma}}{(p_U/P)^{1-\sigma} - (p_N/P)^{1-\sigma}}.$$

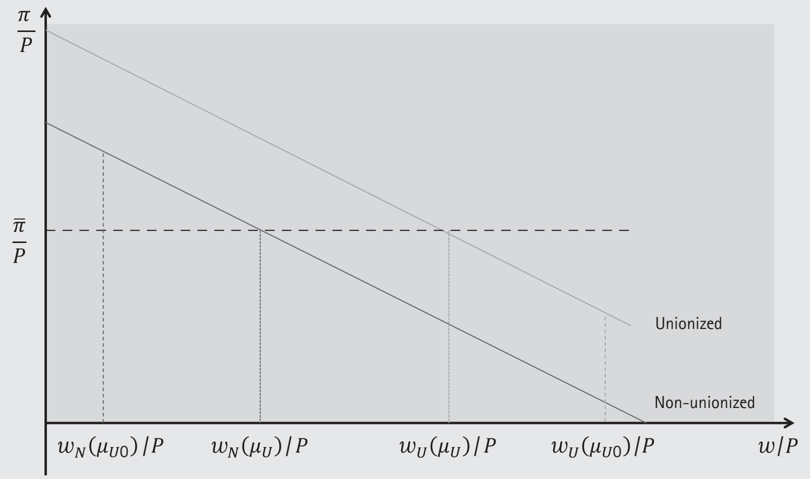
A simultaneous wage regime equilibrium requires $0 < \mu_U < 1$. Therefore, such an equilibrium exists only if $p_N > P > p_U$ or $p_N < P < p_U$. Note that these are two conditions, because we have not determined yet which regime offers the lower prices. Combining both equations and expressing product prices in real terms, gives a central condition for understanding the existence of simultaneous wage regimes, i.e.

$$\frac{p_U}{P} \left\{ \begin{array}{c} > 1 > \\ < 1 < \end{array} \right\} \frac{p_N}{P}. \tag{2.14}$$

Economically, condition (2.14) is almost trivial. It simply states that if firms in one regime charge a price above the "average", the firms in the other regime need to charge a price below the "average". Otherwise one of the two regimes will vanish. It is also important to note that this result depends on the as-sumption of two wage regimes and not on monopolistically competitive price setting. One can easily show that if firms are price takers and production technology exhibits decreasing returns to scale, an equivalent result with respect to the wage sum instead of prices applies.

A second issue is the role of the regime indifference condition in (2.11). It requires that profits are equal in both regimes, say they are equal to an arbitrary value $\bar{\pi}$, which can be positive, negative or zero. Hence $\pi_N = \bar{\pi}$, and $\pi_U = \bar{\pi}$.

Figure 2.6: Profits and the regime indifference condition



Using the markup pricing equation (2.5) in the profit equation (2.6), Figure 2.6 plots real profits in both regimes against real wages. To generate this figure $f_N > f_U$ is assumed, but only for illustrative purposes. Profits of both types of firms are decreasing in wages. However, since $f_N > f_U$ is assumed for this plot, profits in the bargaining regime will be always larger compared to the other regime for any given wage. It is now crucial to note, that the firm's decision problem is *not* about choosing its regime for given wages. As mentioned before, the firm chooses the set $\{w_j, b_j, f_j\}$ for $j \in \{N, U\}$ by comparing its profits. Suppose now that for an initial sorting of firms μ_{U0}, unionized firms pay very high wages and non-unionized firms pay very low wages. For this initial sorting the firm can only pick one of two values $\pi_U(w_U(\mu_{U0}))/P$ or $\pi_N(w_N(\mu_{U0}))/P$. Since profits in the regime without bargaining are higher, more and more firms will move to this regime. However, as the share of non-unionized firms increases, wages in this regime will increase as well. This switching process will continue until the equilibrium sorting is reached and $\pi_U(w_U(\mu_U))/P = \pi_N(w_N(\mu_U))/P = \bar{\pi}/P$. This is shown in Figure 2.6 by the intersection of the horizontal line with both profit curves.

Scenarios and parametrization. So far the relative cost advantages or disadvantages between the two regimes have not been specified and we will continue to do so. The reason is that we want to study cost relations that are consistent with simultaneous wage regimes and therefore the outcome should not be predefined by the assumption. To keep the analysis tractable we will distinguish between two scenarios. *Scenario 1* assumes that unionized firms have high fixed and low variable regime costs, i.e. $f_N > f_U$ and $b_N < b_U$. In *Scenario 2* these cost relations are reversed, $f_N < f_U$ and $b_N > b_U$. The parameter values used during the different numerical exercises are summarized in Table 2.1.

For the baseline most parameters are normalized. The price for the final output good is used as numeraire and therefore set to unity, $P = 1$. Also aggregate values which relate to the size of the economy (and not determined endogenously) are normalized to one. This includes aggregate expenditures E, the mass of firms M, labor endowment N and firm productivity ϕ. The employment share is set to $\chi = 0.9$ to simulate an unemployment rate of 10 percent, a realistic value for European countries. The bargaining weight is set to $\beta = 0.5$ a standard value in the literature (Felbermayr and Prat, 2011) and close to other values used (Acikgöz and Kaymak, 2014). The elasticity of substitution between varieties, governing partly the degree of competition, is set to $\sigma = 3$, which is at the lower bound of a rather wide range of values used in the literature (Delacroix, 2006). Moreover, the value of σ is often calibrated significantly lower for Europe compared to the US (Ebell and Haefke, 2006; Felbermayr and Prat, 2011). Finally, the union fallback wage and the alternative income are set such that they allow for coherent values in the specified framework.

Table 2.1: Benchmark parameter values

Parameter	Name	Value
P	Aggregate price index	1.0
E	Aggregate expenditure	1.0
M	Mass of active firms	1.0
N	Labor endowment	1.0
ϕ	Productivity	1.0
χ	Employment share	0.9
β	Bargaining power	0.5
o	Elasticity of substitution	3.0
$\tilde{w}$	Fallback wage	0.5
ω_0	Alternative income	0.1
	Scenario 1	
f_N	Non-union fixed cost	5.0
f_U	Union fixed cost	1.0
b_N	Non-union variable cost	0.0
b_U	Union variable cost	0.1
	Scenario 2	
f_N	Non-union fixed cost	1.0
f_U	Union fixed cost	5.0
b_N	Non-union variable cost	1.0
b_U	Union variable cost	0.0

2.4.2 Product market equilibrium

The description of the equilibrium is developed in several steps. Starting with the most parsimonious interpretation by keeping most of variables fixed, more and more variables are endogeneized.

The first equation to consider is obviously the goods market clearing condition. But equalizing only product demand and supply gives little insight. It is already summarized in (2.14) and rather tautological. It states that an equilibrium exists if an equilibrium exists. Therefore, we start by considering a product market equilibrium in which the goods market is cleared and all firms made their decisions. The decisions include optimal pricing, hiring, wage bargaining, firm entry/exit and regime choice. This is formalized by the following definition:

Definition 1. *For given values of real expenditure E/P and the real fallback wage $\tilde{w}/P$, a partial (simultaneous wage regime) equilibrium is defined as a decuple $\left\{(q_j, l_j, w_j/P, p_j/P)_{j\in\{N,U\}}, M, \mu_U\right\}$ satisfying (2.2), (2.4), (2.5) for $j \in \{N, U\}$ and (2.9)–(2.12).*

Reduced form. Using the goods market clearing condition (2.10), we can solve for the share of unionized firms in terms of real prices, such that

$$\mu_U = \frac{1 - \left(\frac{p_N}{P}\right)^{1-\sigma}}{\left(\frac{p_U}{P}\right)^{1-\sigma} - \left(\frac{p_N}{P}\right)^{1-\sigma}}. \tag{2.15}$$

Applying the regime indifference condition (2.11) and the free entry condition (2.12), we can write profits in (2.6) as

$$\frac{E}{\sigma PM}\left(\frac{p_N}{P}\right)^{1-\sigma} - f_N = \frac{\bar{\pi}}{P}, \tag{2.16}$$

$$\frac{E}{\sigma PM}\left(\frac{p_U}{P}\right)^{1-\sigma} - f_U = \frac{\bar{\pi}}{P}. \tag{2.17}$$

Combining (2.15)–(2.17) and setting $\bar{\pi} = 0$ we can express the real price of unionized firms in terms of μ_U and exogenous variables, such that

$$\frac{p_U}{P} = \left[\mu_U\left(1 - \frac{f_N}{f_U}\right) + \frac{f_N}{f_U}\right]^{\frac{1}{\sigma-1}}.$$

Using the union wage equation (2.9) in the markup pricing rule (2.5) gives

$$\frac{p_U}{P} = \frac{\sigma}{\sigma - 1} \frac{\theta}{P\phi} \left[\tilde{w} + b_U\right].$$

The partial equilibrium in Definition 1 is a special case, in the sense that there exists a closed form solution. Combining the last two equations we find the share of unionized firms

$$\mu_U = \frac{f_U}{f_U - f_N} \left(\frac{\sigma}{\sigma - 1} \frac{\theta}{P\phi} \left[\tilde{w} + b_U\right] \right)^{\sigma - 1} - \frac{f_N}{f_U - f_N}.$$

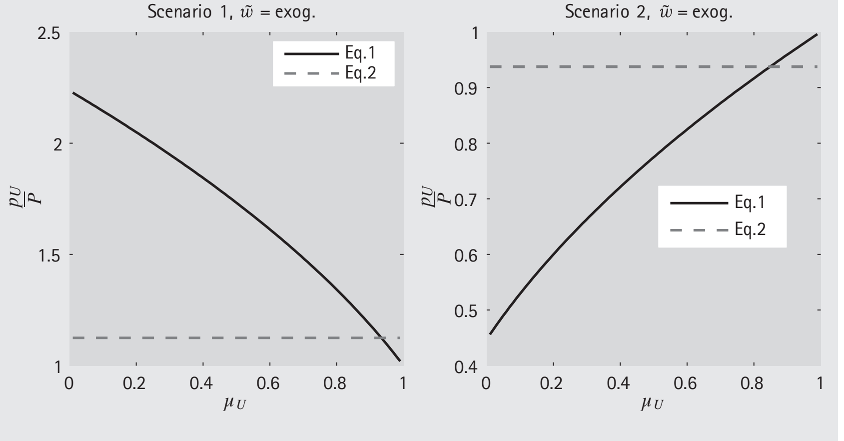
However, as the analysis is refined and developed towards general equilibrium, a closed form solution is not possible. To be consistent with later sections, the reduced form is defined as a system of two unknowns $\{\mu_U, \, p_U/P\}$ and two equations

$$\text{Eq.1:} \quad \frac{p_U}{P} = \left[\mu_U \left(1 - \frac{f_N}{f_U} \right) + \frac{f_N}{f_U} \right]^{\frac{1}{\sigma - 1}}, \tag{2.18}$$

$$\text{Eq.2:} \quad \frac{p_U}{P} = \frac{\sigma}{\sigma - 1} \frac{\theta}{P\phi} \left[\tilde{w} + b_U\right]. \tag{2.19}$$

Figure 2.7 shows the graphical partial equilibrium solution for the two scenarios and parameters specified in Table 2.1. It plots equations (2.18) and (2.19) against $\mu_U \in (0, 1)$. Clearly the equilibrium is determined by the intersection of both curves.

Figure 2.7: Graphical illustration



In both scenarios the equilibrium value of μ_U is rather high, but the value itself is of minor interest at this stage. Since $\tilde{w}$ is treated exogenous one could always set it such that the equilibrium share is calibrated towards real data. The main focus is to see whether an equilibrium exists at all, i.e. (i) if the two lines intersect and (ii) if the intersection lies within the parameter range of μ_U.

Comparative statics. For the comparative static exercises, we always proceed in the same way. Equations (2.18) and (2.19) are solved numerically for each scenario, knowing from Figure 2.7 that a solution exists. Then, the exogenous parameter is reduced and the new equilibrium computed. This step is repeated until no solution is found and the lower bound is reached. Then, we increase the exogenous parameter step by step until again no solution is found and the upper bound is reached. Figure 2.8 plots these steps for the main variable of interest, the union firm share μ_U, against the fallback wage $\tilde{w}$. In the left column, it is assumed that $f_U < f_N$, whereas the opposite is assumed in the right column. Figure 2.8 shows that the union firm share μ_U is decreasing in $\tilde{w}$ if unionized firms have a fixed cost advantage, and vice versa. The key element for this result can be seen by combining (2.16) and (2.17) and inserting the pricing equation (2.5) and union wage equation (2.9), which gives

$$\frac{w_N + b_N}{\theta \tilde{w} + \theta b_U} = \left(\frac{f_U}{f_N} \right)^{\frac{1}{\sigma - 1}} .$$

An increase in the fallback wage $\tilde{w}$ will increase the wages in *both* regimes. However, if $f_U < f_N$, the increase in the non-union wage is less than proportional. Therefore, the resulting increase in the non-union price is less than proportional, favoring the non-union regime. Note that the effect of the fallback wage on the share of unionized firms is independent whether unionized firms pay higher or lower wages. It is only dependent on the relative fixed cost advantage and the results will be reversed for $f_U > f_N$. To summarize these results: an increase in the fallback wage increases the share of firms with the higher fixed costs, because these firms are the ones with the lower prices and will adjust prices less than proportional.

Figure 2.9 repeats the exercise by varying the productivity level ϕ. The effects on the union share are reversed compared to Figure 2.8 because an increase in productivity reduces the prices. The importance of cost advantages remains unaltered.

To complete the discussion, Figure 2.10 varies the elasticity of substitution σ. It shows that the effect of more competition (higher σ) is ambiguous in partial equilibrium and depends on given values of exogenous parameters and the fallback wage. Therefore, the share of unionized firms can be increasing or decreasing with or without a hump shape if the elasticity of substitution changes.

Figure 2.8: Comparative statics with respect to the union fallback wage ($\tilde{w}$)

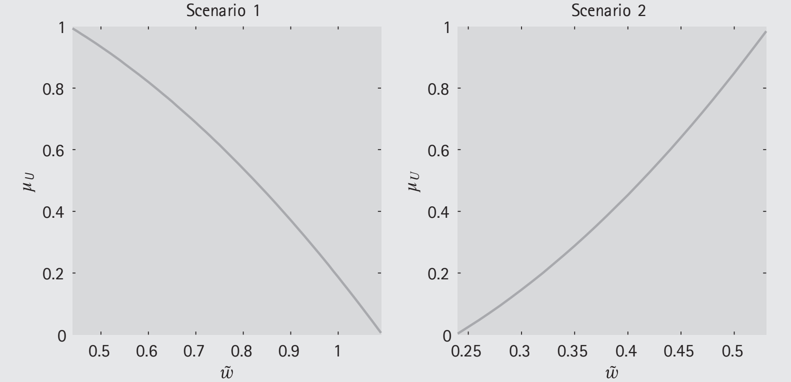


Figure 2.9: Comparative statics with respect to the firms' productivity (ϕ)

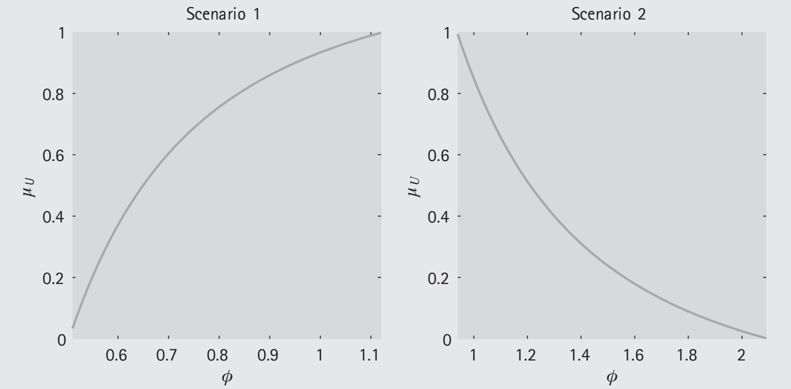
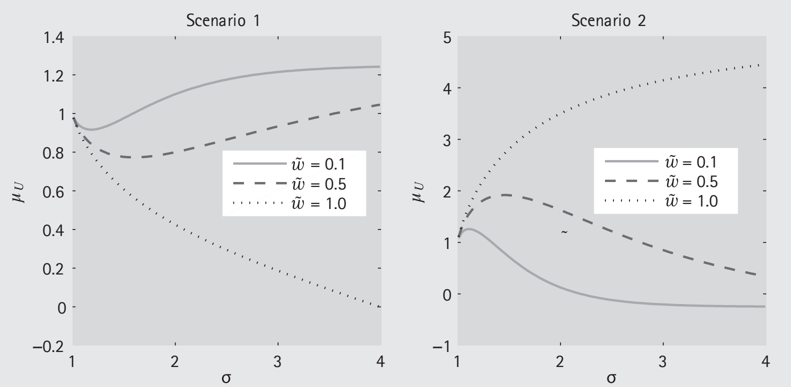


Figure 2.10: Comparative statics with respect to the elasticty of substitution (σ)



2.4.3 Endogeneizing the fallback wage

As a next step the fallback wage is integrated into the analysis. If the bargaining between the firm and the local union fails, workers can look for a job anywhere in the economy. That means they could find a job in unionized firms or non-unionized firms. Since this is a partial equilibrium analysis, there could be additional jobs which belong to neither wage regime and pay wage rate ω_0. Therefore, the fallback wage is the average wage of all workers and reads

$$\tilde{w} = \chi\left[\lambda_N w_N + \lambda_U w_U\right] + (1-\chi)\,\omega_0, \tag{2.20}$$

where χ denotes the employment share of all workers in one of the two regimes and $\lambda_j \equiv L_j/L$ is the employment share in regime $j \in \{N, U\}$.

Parameter χ has also a more convenient interpretation. Since this is a one sector model, there are no jobs outside the sector. Therefore, each worker in the economy can be in one of three states, (i) employed in regime N, (ii) employed in regime U, or (iii) being unemployed and receiving unemployment benefits ω_0. Thus, the unemployment rate is fixed and simply equals to $u = 1 - \chi$, where χ can be interpreted as employment rate.

Equation (2.20) adds an extra condition for the identification of the additional endogenous variable $\tilde{w}$. The definition of this extended equilibrium is:

Definition 2. *For given values of real expenditure E/P and employment share χ, an extended partial equilibrium is defined as an undecuple $\left\{(q_j, l_j, w_j/P, p_j/P)_{j\in\{N,U\}}, M, \mu_U, \tilde{w}\right\}$ satisfying (2.2), (2.4), (2.5) for $j \in \{N, U\}$, (2.9)–(2.12) and (2.20).*

Reduced form. It is shown in Appendix 2.B, that the reduced form solution to the system in Definition 2 is

$$\text{Eq.1:}\quad \frac{p_U}{P} = \left[\mu_U\left(1-\frac{f_N}{f_U}\right)+\frac{f_N}{f_U}\right]^{\frac{1}{\sigma-1}}, \tag{2.21}$$

$$\text{Eq.2:}\quad \frac{p_U}{P} = \frac{\sigma}{\sigma-1}\frac{\theta\left[\tilde{w}+b_U\right]}{P\phi}, \tag{2.22}$$

where

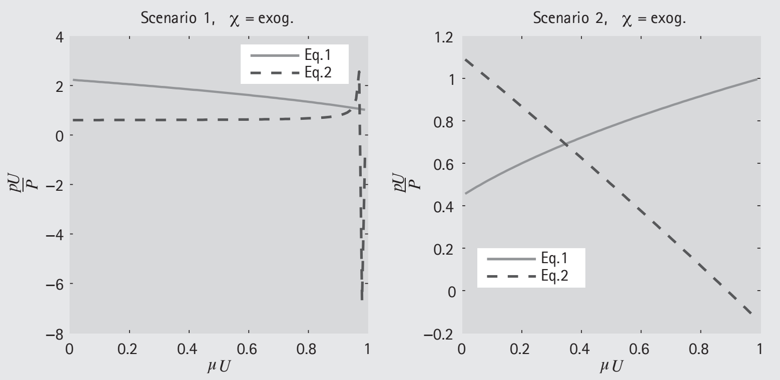
$$\tilde{w}+b_U = \frac{-\chi\rho(\mu_U)\,b_N - \chi b_U + b_U\left(1+\rho(\mu_U)\right) + \left(1+\rho(\mu_U)\right)(1-\chi)\,\omega_0}{\left(1+\rho(\mu_U)\right) - \chi\rho(\mu_U)\,\theta\left(\frac{f_N}{f_U}\right)^{\frac{1}{1-\sigma}} - \chi\theta}, \tag{2.23}$$

and

$$\rho(\mu_U) = \frac{1-\mu_U}{\mu_U}\left(\frac{f_N}{f_U}\right)^{\frac{\sigma}{\sigma-1}}. \tag{2.24}$$

Figure 2.11 shows the graphical solution by plotting (2.21) and (2.22) against $\mu_U \in (0, 1)$ subject to (2.23) and (2.24). The solid line remains unchanged compared to the graphical solution in Figure 2.7. The dashed line however is no longer constant because the fallback wage now evolves according to (2.23) and has a undefined point in Scenario 1. Interestingly, the dashed line still evolves strictly monotone and into the opposite direction as the solid line.

Figure 2.11: Graphical illustration



Comparative statics. The comparative statics are conducted in the same way as in the previous section. The reduced form system is solved numerically at each instant. Since the fallback wage $\tilde{w}$ is now endogenous, the alternative income ω_0 is used instead. Figure 2.12 shows that the share of unionized firms is decreasing in the alternative income ω_0. It is interesting to note that the union share is decreasing in *both* scenarios.

The reason is that *ceteris paribus* and provided an equilibrium exists, ω_0 has a positive (negative) effects on $\tilde{w}$, and $\tilde{w}$ negative (positive) effect on μ_U, depending on the scenario.

The qualitative effect of ϕ on μ_U remains unaffected (Figure 2.13). The reason is that ϕ itself has no direct effect on the fallback wage in (2.23). Therefore the system reacts similar to the previous specification.

Figure 2.14 then shows that the effect of σ on the union share also can remain ambiguous depending for instance on the alternative income ω_0.

2.44 Endogeneizing the employment share

Given the reduced form solution in the previous section, we continue by endogeneizing the employment share χ, which is defined as the share of workers employed in one of the two regimes L over the total mass of workers N, i.e.

$$\chi = \frac{L}{N}. \tag{2.25}$$

Therefore, (2.25) adds an extra equation for the new endogenous variable χ. Formally, the definition of the partial equilibrium is refined to:

Definition 3. *For given values of real expenditure E/P, an extended partial equilibrium is defined as a duodecuple $\{(q_j, l_j, w_j/P, p_j/P)_{j\in\{N,U\}}, M, \mu_U, \tilde{w}, \chi\}$ satisfying (2.2), (2.4), (2.5) for $j \in \{N, U\}$, (2.9)–(2.12), (2.20) and (2.25).*

Figure 2.12: Comparative statics with respect to the alternative income (ω_0)

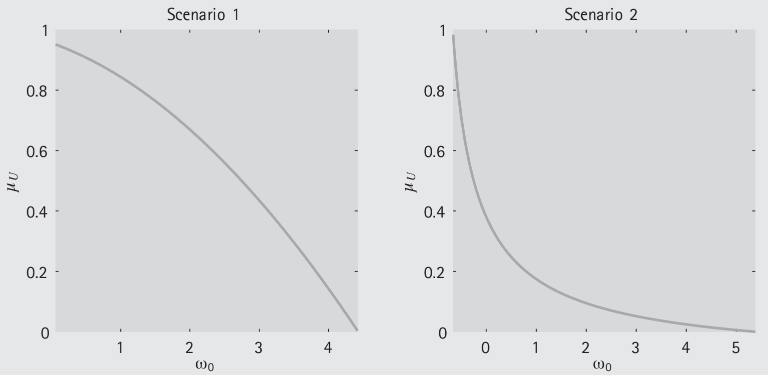


Figure 2.13: Comparative statics with respect to the firms' productivity (ϕ)

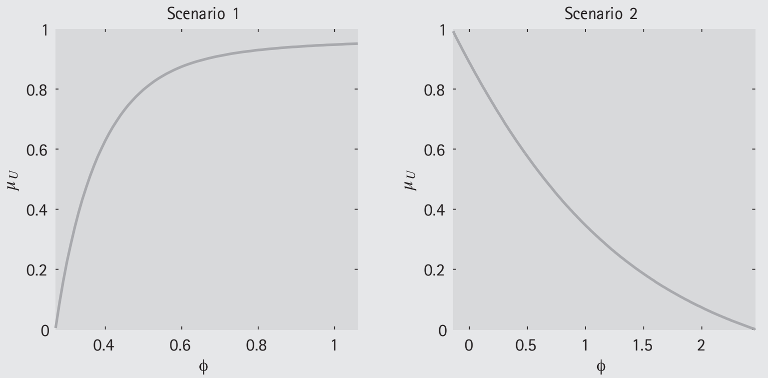
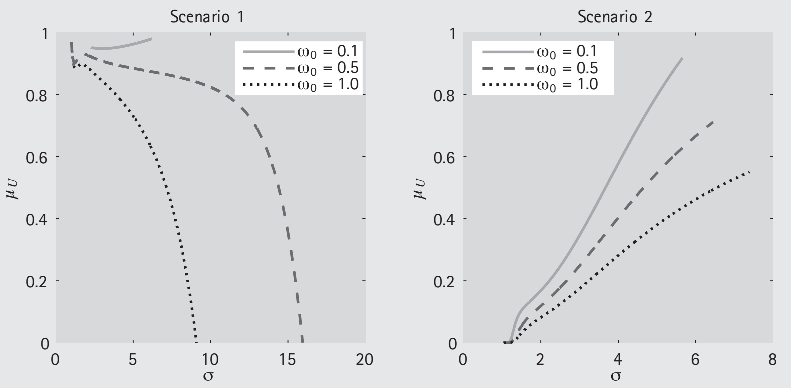


Figure 2.14: Comparative statics with respect to the elasticty of substitution (σ)



Reduced form. It is shown in Appendix 2.B, that the reduced form solution to the system in Definition 3 is given by

$$\text{Eq.1:}\ \frac{p_U}{P} = \left[\mu_U\left(1-\frac{f_N}{f_U}\right)+\frac{f_N}{f_U}\right]^{\frac{1}{\sigma-1}}, \tag{2.26}$$

$$\text{Eq.2:}\ \frac{p_U}{P} = \frac{\sigma}{\sigma-1}\frac{\theta\left[\tilde{w}+b_U\right]}{P\phi}, \tag{2.27}$$

where

$$\tilde{w}+b_U = \frac{-\chi\rho\left(\mu_U\right)b_N-\chi b_U+b_U\left(1+\rho\left(\mu_U\right)\right)+\left(1+\rho\left(\mu_U\right)\right)\left(1-\chi\right)\omega_0}{\left(1+\rho\left(\mu_U\right)\right)-\chi\rho\left(\mu_U\right)\theta\left(\frac{f_N}{f_U}\right)^{\frac{1}{1-\sigma}}-\chi\theta}, \tag{2.28}$$

and

$$\rho\left(\mu_U\right) = \frac{1-\mu_U}{\mu_U}\left(\frac{f_N}{f_U}\right)^{\frac{\sigma}{\sigma-1}}, \tag{2.29}$$

and

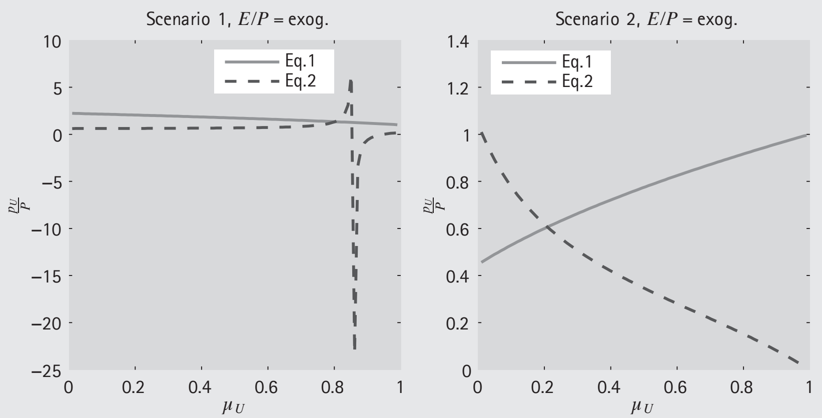
$$\chi = \frac{1}{N}\frac{E}{P\phi}\left[\frac{\left(1-\mu_U\right)\left(f_N\right)^{\frac{\sigma}{\sigma-1}}\mu_U\left(f_U\right)^{\frac{\sigma}{\sigma-1}}}{\left(\left(1-\mu_U\right)f_N+\mu_U f_U\right)^{\frac{\sigma}{\sigma-1}}}\right]. \tag{2.30}$$

The two main conditions are as before equations (2.26) and (2.27). Equations (2.28)–(2.30) are shortcuts which need to be substituted into (2.27) which is skipped here to avoid a very cluttered notation.

The solution for the employment share in (2.30) has further interesting properties. The term within brackets equate to unity evaluated at the corner solutions $\mu_U = 0$ and $\mu_U = 1$. For values in between, the term within brackets will be always larger than one due to Jensen's inequality. That means for given real expenditures, the economy needs to employ more workers if simultaneous wage regimes exist compared to a situation with one single wage regime. Interestingly, this finding resembles the conclusions of Calmfors and Driffill in their seminal paper (Calmfors and Driffill, 1988), yet from a completely different angle. In contrast to Calmfors and Driffill, this hump shape is generated within a single sector and union wage bargaining is not subject to different levels of centralization. The reason for this similarities is the isoelastic demand system, which generates the term in brackets in equation (2.30).

Figure 2.15 shows again the graphical solution for the two scenarios. For the baseline parametrization an endogenous employment share implies *ceteris paribus* a lower union share in both scenarios. Due to the previously discussed hump shape, it is not clear whether this holds for wider range of parameter values. For this, we turn again to the comparative statics.

Figure 2.15: Graphical illustration



Comparative statics. Figure 2.16 shows the comparative statics for ω_0. As in the previous section, the effect of ω_0 on μ_U is the same in both scenarios. This time, however, the effect is positive implying that a higher alternative income outside the two wage regimes is associated with a higher share of unionized firms. One has to keep in mind that this is a partial equilibrium result, i.e. conditioned on given real expenditures.

A higher level of productivity implies a higher union share in Scenario 1 and a mostly lower union share in Scenario 2 (see Figure 2.17). In the second scenario, the effect is generally undetermined due to the ambiguous relation between the union share and the employment share discussed in the reducedform section.

The results of ϕ are almost reversed when we focus on the effects of σ in Figure 2.18. In Scenario 1, a higher σ is associated with a lower μ_U, but is ambiguous in Scenario 2.

Summarizing the results of these exercises, we find that for this type of equilibrium the range of solutions is rather limited in Scenario 1. With exception of the effects of ϕ, the possible set of solutions is very limited and even after small changes in the exogenous parameter no numerical solution is found. In Scenario 2 on the other hand, the effects are mostly ambiguous depending on the actual parametrization.

2.5 General equilibrium

To this point, all but one equation have been used for the description of several stages of partial equilibria. The remaining process that needs to be determined is the wage formation process in the non-unionized regime to solve for the general equilibrium of this model. The last equation of the model which has not been used so far is the labor market clearing condition in (2.13). It states that the mass of workers employed in the two regimes has to equal to the labor endowment, i.e.

$$L = N. \tag{2.31}$$

In other words, in general equilibrium, wages in the non-unionized regime adjust until the labor market is cleared. In this sense, the wage w_N resembles the market clearing wage in the standard model of frictionless labor markets.

In principal, there is an alternative general equilibrium specification. If wages in the non-unionized regime are determined by any process $w_N = w_N(.)$, the general equilibrium of this model would imply an unemployment rate different from zero. Possible processes include all sorts of wage determination which are in line with the modeling framework, such as individual bargaining, efficiency wages, etc. This modeling approach is beyond the scope of this chapter for two reasons: The first one is for rather technical matters because the hump shape of the employment share in (2.30) gives rise to multiple equilibria. The second reason is that the aim of this model is to study the properties of simultaneous wage regimes. If labor demand equals labor supply, the textbook model of monopolistic competition is the corner solution without unionized firms, i.e. μ_U = 0. This allows for a direct evaluation, in the sense that all differences to the workhorse model can be traced back to simultaneous wage regimes.

Figure 2.16: Comparative statics with respect to the alternative income (ω_0)

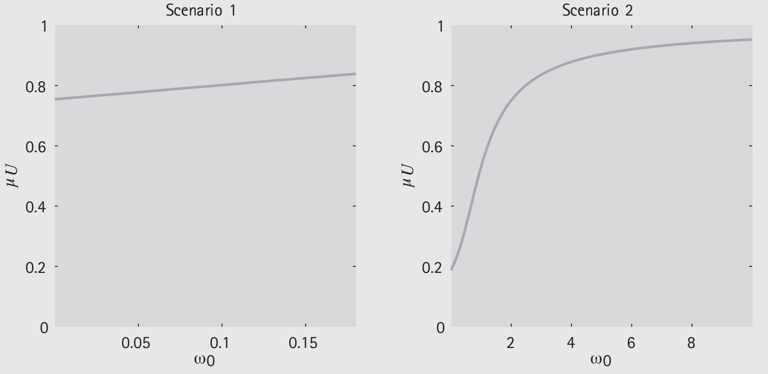


Figure 2.17: Comparative statics with respect to the firms' productivity (ϕ)

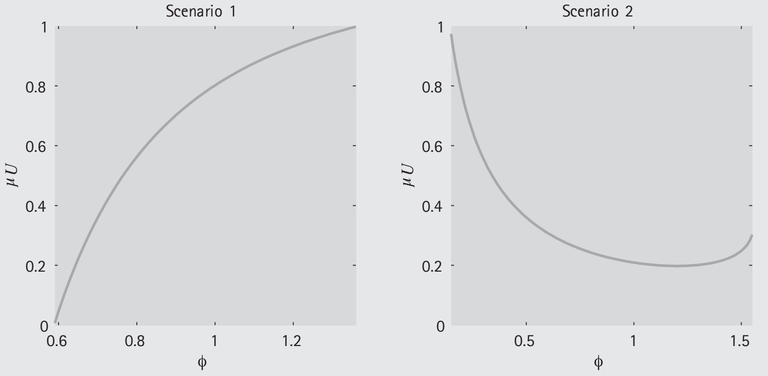
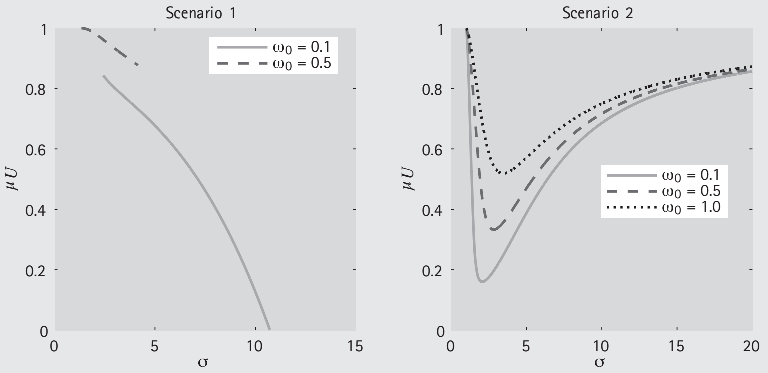


Figure 2.18: Comparative statics with respect to the elasticty of substitution (σ)



2.5.1 Reduced form

The reduced form in general equilibrium can be derived instantaneously based on the equations of the previous sections. If labor demand equals labor supply the employment share is simply equal to one. Substituting $\chi = 1$ into the previous reduced form system, we can write

$$\text{Eq.1} \quad : \quad \frac{p_U}{P} = \left[\mu_U\left(1-\frac{f_N}{f_U}\right)+\frac{f_N}{f_U}\right]^{\frac{1}{\sigma-1}}, \tag{2.32}$$

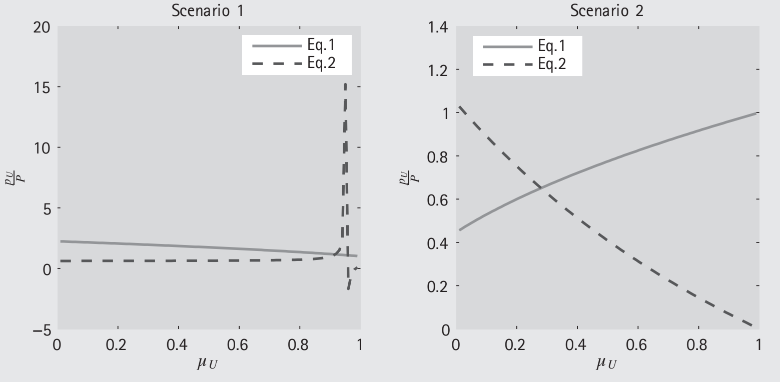
$$\text{Eq.2} \quad : \quad \frac{p_U}{P} = \frac{\sigma}{\sigma-1}\frac{\theta\left[\tilde{w}+b_U\right]}{P\phi}, \tag{2.33}$$

where

$$\tilde{w}+b_U = \frac{b_U-b_N}{1-\theta\left(\frac{f_N}{f_U}\right)^{\frac{-1}{\sigma-1}}-\frac{\theta-1}{\rho(\mu_U)}}. \tag{2.34}$$

As in the previous section, the analysis starts with plotting the graphical solution in Figure 2.19. Again, an equilibrium exists and is unique for both scenarios in the baseline parametrization. The visual solution does not change significantly in general equilibrium.

Figure 2.19: Graphical illustration



2.5.2 Equilibrium condition

The simpler structure in general equilibrium also allows to define the equilibrium analytically and is summarized in the following proposition.

Proposition 1. *A general equilibrium with simultaneous wage regimes and endogenous regime selection exists and is unique if*

$$\left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}} - \theta > \frac{\sigma}{\sigma-1}\frac{\theta\left[b_U - b_N\right]}{P\phi}. \tag{2.35}$$

Proof. The proof is provided in Appendix 2.C

The condition in (2.35) offers several insights as both scenarios are summarized in one equation. (i) Differences in cost structures between the two regimes is a necessary condition for simultaneous wage regimes with endogenous selection. Otherwise this condition cannot be satisfied. (ii) Differences in variable and fixed regime costs are necessary to guarantee that both scenarios are potential equilibrium outcomes. If variable regime costs are equal, i.e. $b_N = b_U$, an equilibrium exists (if at all) only if $f_N > f_U$. If fixed regime costs are equal, i.e. $f_N = f_U$, an equilibrium possibly exists if $b_N > b_U$. (iii) A less technical explanation can be given if we rewrite the condition in terms of real product prices which gives

$$\frac{p_U\left(w_U\right)}{\theta p_N\left(w_N\right)} - 1 > \frac{p_U\left(w\right)}{P} - \frac{p_N\left(w\right)}{P}.$$

Assuming for instance that unionized firms are the ones with the higher prices (Scenario 1) this condition states that the price difference between unionized and non-unionized firms has to be larger than the union wage markup over the fallback wage, adjusted for differences in variable bargaining costs. Loosely speaking, it states that if some firms pay above the average wage, there need to be some other firms paying below the average wage.

Not surprisingly, regime cost differences are the crucial component in this setup. Without this element one could not explain why otherwise identical firms choose to behave differently. The other assumptions do not necessarily affect the results. Monopolistic competition in the product market allows to model the notion of a firm more explicitly and extends the analysis for different degrees of imperfect competition. With perfect competition the mass of firms would be undetermined but the properties implied by labor market clearing would be unaffected. The right-to-manage wage bargaining model could be replaced by other theories of wage formation, such as efficient bargaining, efficiency wages or even monopoly unions. The model could also be extended to allow for search and matching frictions. Costly search generates rents for matched worker-firm pairs and would imply that workers in the non-unionized sector bargain individually. The system of equations would be augmented by an additional equation and the labor market clearing condition would be extended to allow for unemployment.

Although the system of equations keeps its structure, the model's analytical tractability would be reduced tremendously.

2.5.3 Comparative statics

Eight exogenous parameters describe the general equilibrium in (2.32) and (2.33). We will not discuss each parameter because for some, the results are embedded in the assumptions. For instance, the share of unionized firms decreases in its own regime specific fixed costs and increases in the fixed costs of the others. Instead, we discuss the productivity level ϕ, the elasticity of substitution σ, the union bargaining weight β, and the regime independent fixed costs component f.[16] Figure 2.20 displays the comparative statics for ϕ. The union share μ_U is increasing in Scenario 1 and decreasing in Scenario 2, because equation (2.33) is shifted downwards for an increasing productivity level. Figure 2.21 shows that an increase in σ, decreases the union share in Scenario 1, because higher values of σ, lower the relative price. Lower relative prices imply lower relative wages and outweigh the effect of a lower wage markup which would favor union recognition. The opposite effect holds for Scenario 2. Figure 2.22 plots the comparative statics for increasing values of β. Not surprisingly a higher bargaining weight reduces the union firm share in both scenarios. Finally, Figure 2.23 shows the effects of changes in the regime independent fixed cost component f. An increase in f decreases the relative price and therefore highlights the importance of differences in fixed costs. In Scenario 1, the higher f, the more weight is attributed to the higher union wage, and therefore the lower is μ_U. In Scenario 2 the opposite holds because the non-unionized regime is less attractive as a higher f increases the importance of the variable regime costs b_N.

16 This fixed cost component has been defined in equation (2.7).

Figure 2.20: Comparative statics with respect to the firms' productivity (ϕ)

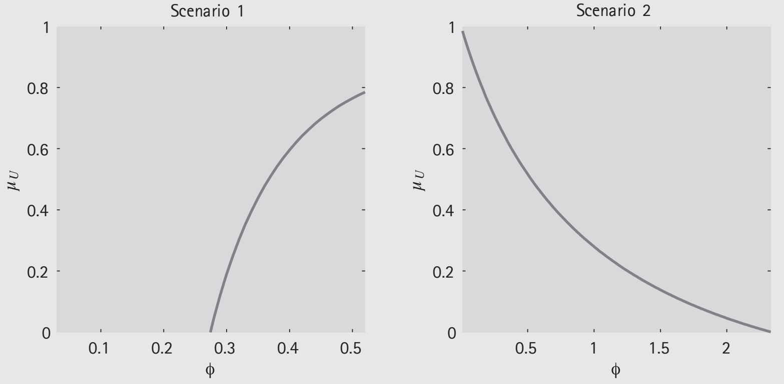


Figure 2.21: Comparative statics with respect to the elasticty of substitution (σ)

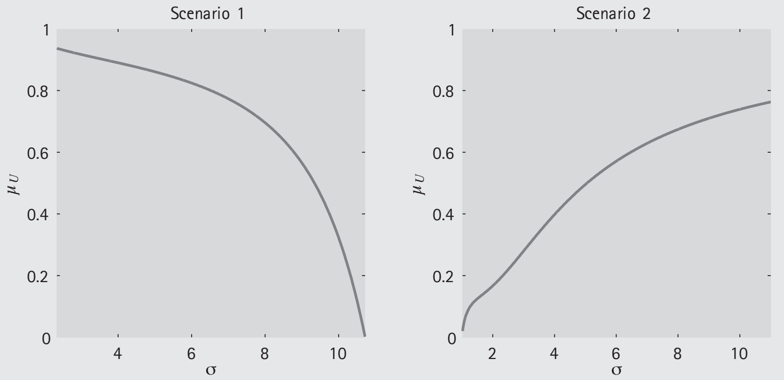


Figure 2.22: Comparative statics with respect to the union bargaining weight (β)

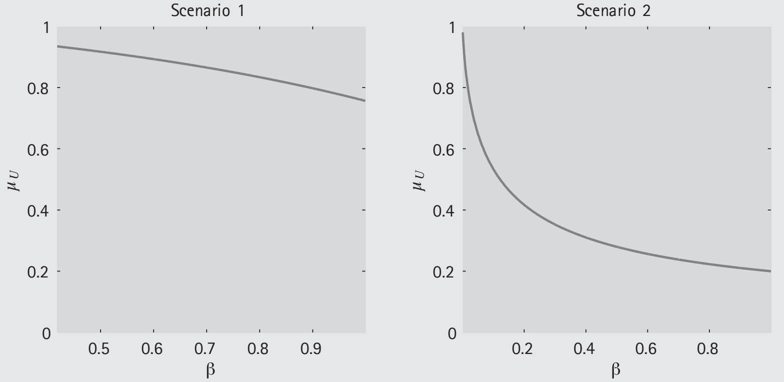
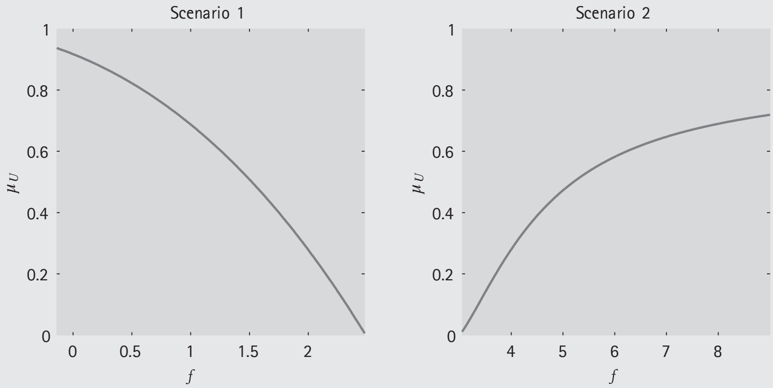


Figure 2.23: Comparative statics with respect to the firms' fixed costs of production (f)



2.6 Discussion of the results

How can this model help to explain and understand the decrease in collective bargaining coverage rates during the last two decades? The answer to this question first depends on whether one assumes that the union wage regime is associated with high fixed costs and low variable costs or *vice versa.* Once differences in fixed costs are incorporated into a theoretical model, they ultimately result in differences in firm size. Firms with higher fixed costs, need to sell more output and hire more workers to cover these fixed costs. Especially in a framework of constant markup pricing. One of the most distinct empirical characteristics between firms in collective bargaining regimes and those who are not, is that they are larger. Therefore, the results that have been labeled as "Scenario 2" in the previous sections seem to be more realistic and are the preferred specification. In Scenario 2, unionized firms have higher fixed costs and are consequently larger. However, one has to keep in mind that these size differences are conditioned on the wage regime choice.

In the light of the results of Scenario 2 in the previous section, a decrease in collective bargaining coverage rates is consistent with a higher technological level, a lower elasticity of substitution, a higher union bargaining weight, and higher regime independent fixed costs. The results are now discussed in more detail.

Technology. Suppose the technology level ϕ increases due to a positive technology shock. This has a direct and positive effect on all wages because the pie that can be distributed has become larger. But since all wages are increasing, so does the average wage, and consequently also the bargained wage. Whereas the non-unionized workers are only affected by the first effect, unionized workers can also benefit from the positive effect of the non-unionized workers. Both effects combined generate a larger wage increase in the unionized regime. A relatively higher union wage makes this wage regime less attractive for employers. The stronger the technological shock the more firms will switch to the non-unionized regime. This result resembles the finding of Donado and Wälde (2012) in the sense that unions are the victims of their own success.

Bargaining power. An increase in the bargaining weight β increases the wage markup over the fallback wage and by that increases union wages alone. Clearly, this reduces the attractiveness of the unionized regime. Put differently, this result states that the collective bargaining coverage is decreasing because of growing union power.

This result seems questionable but a few comments are in order here. First, this result emphasizes the importance of endogenous wage regime choices. The higher the union wage demand, the lower the attractiveness for the employer. Opting out of a collective agreement is more complicated in reality, but in the long-run unions will be met by a larger opposition from the employer side. This effect is new to the trade union literature. Standard trade union models assume that unions simply exist and their wage demands are only restricted by the effects on the employment chances of their members. Here, a new channel is added by denying the union the possibility to represent their members in wage negotiations.

Second, summarizing all union behavior in one parameter is very stylized.

Therefore several different components could be embedded in this single parameter. It is sometimes suggested in the literature that the union power can be approximated by the union density, i.e. the share of workers the unions are able to mobilize. Since union membership numbers are declining over the last decades, this seems not reasonable in this context. Alternatively, one could assume that unions choose their wage markup endogenously. In this case, the results would indicate that unions have increased their wage demands at the cost of loosing part of the workforce they represent. But it is admittedly a drawback of the chosen modeling approach to reduce union behavior to one single parameter.

Third, the results refer to within sector considerations. Allowing for a multi-sector setup could help to reconcile these findings.

Elasticity of substitution. An increase in the elasticity of substitution σ increases the share of unionized firms. The reason for this is that higher values of σ reduce the relative goods price by dampening the effect of differences in fixed costs. At the same time a higher elasticity of substitution reduces the wage markup of the union and by this the wage in the unionized regime. Therefore, the wage in the unionized regime is dampened more than proportional and the attractiveness of this regime increases.

Higher values of σ also reduce the price markup over marginal costs. Therefore the elasticity of substitution is commonly used as proxy for the degree of competition. Does this imply that the results suggest that the decrease in collective bargaining coverage rates can be attributed to lower competition? The answer depends on how well a constant elasticity of substitution captures the degree of competition. This has been criticized in the literature because a constant elasticity of substitution implies that the price markup is independent of the number of incumbent firms (e.g. Zhelobodko, Kokovin, Parenti, and Thisse, 2012). Several authors in the literature have therefore departed from the CES approach when studying the interactions between product and labor market imperfections (Blanchard and Giavazzi, 2003; Ebell and Haefke, 2009; Felbermayr and Prat, 2011). These authors model elasticity of substitution to be dependent on the number of firms in the market, at least in the long run. The approach of Blanchard and Giavazzi (2003) is closely related to the one presented herein. In fact, instead of non-unionized firms their model features unemployed workers. They show that in the long-run, the elasticity of substitution has no effect on unemployment.

Regime independent fixed costs. As the regime independent fixed costs f increase, the differences in variable regime costs become important. Therefore, an increase in f is associated with a larger share of unionized firms. This result is interesting as it includes two explanations. First, one could think of f as part of the production technology. In that case, the model explains the decline in collective bargaining coverage rates as result of technical progress. This is similar to result on the productivity level.

Second, f could also be interpreted as a market entry barrier.[17] It could comprise product market regulations or other formal or informal payments. Then, the interpretation would be that union coverage rates have decreased due to product market deregulation. One can also think about the reduction of tariffs and formal standardization in the course of the economic integration of the European Union. These interpretations of f are not mutually exclusive.

2.7 Conclusion

The main contribution of this chapter is to model collective bargaining as a distinct firm choice, considering the cost structures of different wage-setting regimes.

17 Again, this interpretation is used by Blanchard and Giavazzi (2003).

This approach is in line with the system of industrial relations in many European countries but has attracted almost no attention so far in the theoretical literature. It also challenges the view that firms oppose unions per se because they reduce profits due to higher wages. Selection into wage regimes is driven by differences in the cost structure. It is shown that these differences are sufficient to allow for simultaneous wage regimes. Furthermore, the comparative statics show that the results are consistent with several stylized facts and the related literature if we assume that fixed costs are larger and variable regime costs are lower (Scenario 2). Firms which opt for collective bargaining are larger than those choosing individual level wage contracts. Moreover, collective bargaining coverage is decreasing as technology advances and product markets are deregulated.

The model captures nicely the main idea that the choice between different regimes of wage bargaining is determined by differences in the cost structure from the employers' perspective. Nevertheless, several extensions could help to deepen and underpin the understanding of the wage setting processes. For instance, firm size is conditioned on the wage regime, i.e. firms are large because they are unionized. But one could also think about a setting where firms are unionized because they are large. From a theoretical point of view, this can be introduced via two channels. First, additional heterogeneity in production technology would yield this result. If unionization implies larger fixed costs, more productive firms can benefit from economics of scale effects. Second, similar effects arise if collective bargaining is also costly for the union. Also in that case unions would target larger firms first.

Another, extension would model the wage setting in the non-union regime explicitly. As discussed before, this would introduce unemployment into the model and opens thus a new set of interesting implications such as the effects of unemployment benefits on unemployment *and* collective bargaining coverage. Furthermore, within a dynamic framework, one could study the adjustment path to exogenous shocks. The presumption is that the endogenous selection of wage regimes add an additional margin for the adjustment of economies to economic shocks. Therefore, different wage regimes could yield different adjustment paths in this setting. Finally, one of the big advantages of using collective agreements to study the process of wage formation is that there exist data. Therefore, different hypotheses can be tested against each other. We can thus conclude that studying the endogenous choice between different wage bargaining regimes in a framework with different structures of transaction costs is a fruitful area for future research.

Appendix

2.A Detailed derivations of Section 2.3

Demand. The production function of the competitive homogeneous final output good follows

$$Q = \left[\left(\frac{1}{M} \right)^{\frac{1}{\sigma}} \int_0^M q_i^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} . \tag{2.36}$$

For each variety, the representative final output producer maximizes

$$\max_{q_k} \pi_Q = PQ - \int_0^M p_i q_i di, \tag{2.37}$$

subject to (2.36). The first order condition, $\partial \pi_Q / \partial q_k = 0$ implies

$$\begin{aligned} p_k &= PM^{-\frac{1}{\sigma-1}} \left[\int_0^M q_i^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}-1} q_k^{-\frac{1}{\sigma}}, \\ \Leftrightarrow p_k &= P \left(\frac{Q}{M} \right)^{\frac{1}{\sigma}} q_k^{-\frac{1}{\sigma}}, \\ \Leftrightarrow q_k &= \frac{E}{PM} \left(\frac{p_k}{P} \right)^{-\sigma}, \end{aligned} \tag{2.38}$$

where expenditure on the final output is defined as $E = PQ$. Inserting (2.38) into (2.36) yields the aggregate price index

$$\begin{aligned} Q &= \left[\left(\frac{1}{M} \right)^{\frac{1}{\sigma}} \int_0^M \left(\frac{E}{PM} \left(\frac{p_k}{P} \right)^{-\sigma} \right)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}, \\ \Leftrightarrow P &= \left[\frac{1}{M} \int_0^M p_i^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} . \end{aligned} \tag{2.39}$$

Optimal pricing. Any firm i maximizes its profits

$$\pi_i (q_i) = p_i (q_i) q_i - c_i (q_i / \phi) - P f_i, \tag{2.40}$$

subject to $\frac{\partial p_i(q_i)}{\partial q_i} \frac{q_i}{p_i(q_i)} = -\frac{1}{\sigma}$. The first order condition, $\partial \pi_i (q_i) / \partial q_i = 0$, implies

$$\begin{aligned} p_i'(q_i)\,q_i + p_i &= \frac{c_i}{\phi}, \\ \Leftrightarrow \left[-\frac{1}{\sigma}+1\right] p_i &= \frac{c_i}{\phi}, \\ \Leftrightarrow p_i &= \frac{\sigma}{\sigma-1}\frac{c_i}{\phi}. \end{aligned} \tag{2.41}$$

Firm profits. Given optimal pricing in (2.5), we can rewrite firm profits as

$$\begin{aligned} \pi_i(q_i) &= p_i(q_i)\,q_i - c_i\frac{q_i}{\phi} - Pf_i, \\ \Leftrightarrow \pi_i(q_i) &= p_i(q_i)\,q_i - \frac{\sigma-1}{\sigma}p_i(q_i)\,q_i - Pf_i, \\ \Leftrightarrow \pi_i &= \frac{1}{\sigma}p_i(q_i)\,q_i - Pf_i. \end{aligned} \tag{2.42}$$

Using the demand equation in (2.2) gives $p_i(q_i)\,q_i = \frac{PQ}{M}\left(\frac{p_i}{P}\right)^{1-\sigma}$, and therefore firm profits become

$$\pi_i = \frac{1}{\sigma}\frac{PQ}{M}\left(\frac{p_i}{P}\right)^{1-\sigma} - Pf_i. \tag{2.43}$$

Union wage bargaining. The bargained wage maximizes

$$\ln\left[(w_U - \tilde{w})\right] + \ln\left[l_U(w_U)\right] + \left(\frac{1-\beta}{\beta}\right)\ln\left[\pi_U(w_U) - \pi_U(0)\right], \tag{2.44}$$

subject to

$$l_U(w_U) = \frac{1}{\phi}\frac{E}{PM}\left(\frac{\sigma}{\sigma-1}\frac{w_U+b_U}{P\phi}\right)^{-\sigma}, \tag{2.45}$$

and

$$\pi_U(w_U) - \pi_U(0) = \frac{1}{\sigma}\frac{E}{M}\left(\frac{\sigma}{\sigma-1}\frac{w_U+b_U}{P\phi}\right)^{1-\sigma}. \tag{2.46}$$

Therefore, the first order condition subject to w_U implies

$$\frac{w_U}{w_U-\tilde{w}} + \frac{l_U'(w_U)\,w_U}{l_U(w_U)} = -\left(\frac{1-\beta}{\beta}\right)\frac{\pi_U'(w_U)\,w_U}{\pi_U(w_U)-\pi_U(0)}. \tag{2.47}$$

Using (2.45) and (2.46) we can write the two elasticities as

$$\frac{l_U'(w_U)\,w_U}{l_U(w_U)} = (-\sigma)\frac{w_U}{w_U+b_U}, \tag{2.48}$$

and

$$\frac{\pi'_U(w_U)\,w_U}{\pi_U(w_U)-\pi_U(0)} = (1-\sigma)\frac{w_U}{w_U+b_U}. \tag{2.49}$$

Plugging (2.48) and (2.49) into (2.47) we find after some rearrangements

$$\begin{aligned} \frac{w_U}{w_U-\tilde{w}} &= \frac{\sigma-1+\beta}{\beta}\frac{w_U}{w_U+b_U}, \\ \Leftrightarrow w_U &= \frac{\sigma-1+\beta}{\sigma-1}\tilde{w}+\frac{\beta}{\sigma-1}b_U. \end{aligned} \tag{2.50}$$

2.B Detailed derivations of Section 2.4

2.B.1 Product market equilibrium

System of equations. The system of equations specified in Definition 1 reads

$$q_N = \frac{E}{PM}\left(\frac{p_N}{P}\right)^{-\sigma}, \tag{2.51}$$

$$q_U = \frac{E}{PM}\left(\frac{p_U}{P}\right)^{-\sigma}, \tag{2.52}$$

$$l_N = \frac{q_N}{\phi}, \tag{2.53}$$

$$l_U = \frac{q_U}{\phi}, \tag{2.54}$$

$$p_N = \frac{\sigma}{\sigma-1}\frac{w_N+b_N}{\phi}, \tag{2.55}$$

$$p_U = \frac{\sigma}{\sigma-1}\frac{w_U+b_U}{\phi}, \tag{2.56}$$

$$w_U = \theta\tilde{w}+(\theta-1)\,b_U, \tag{2.57}$$

$$1 = (1-\mu_U)\left(\frac{p_N}{P}\right)^{1-\sigma}+\mu_U\left(\frac{p_U}{P}\right)^{1-\sigma}, \tag{2.58}$$

$$\frac{1}{\sigma}\frac{E}{PM}\left(\frac{p_N}{P}\right)^{1-\sigma} = f_N, \tag{2.59}$$

$$\frac{1}{\sigma}\frac{E}{PM}\left(\frac{p_U}{P}\right)^{1-\sigma} = f_U. \tag{2.60}$$

Solution. Combining (2.59) and (2.60) gives

$$\left(\frac{p_N}{p_U}\right)^{1-\sigma} = \frac{f_N}{f_U}. \tag{2.61}$$

Solving (2.58) for p_U/P and plugging in (2.61) gives

$$\frac{p_U}{P} = \left(\mu_U\left[1-\frac{f_N}{f_U}\right]+\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}}. \tag{2.62}$$

Comining (2.56) and (2.57), we can also solve for p_U/P in terms of exogenous terms, such that

$$\frac{p_U}{P} = \frac{\sigma}{\sigma-1}\frac{\theta}{P\phi}\left[\tilde{w}+b_U\right]. \tag{2.63}$$

Combining (2.62) and (2.63) gives the closed form partial equilibrium solution

$$\mu_U = \frac{f_U}{f_U-f_N}\left(\frac{\sigma}{\sigma-1}\frac{\theta}{\phi}\left[\tilde{w}+b_U\right]\right)^{\sigma-1} - \frac{f_N}{f_U-f_N}. \tag{2.64}$$

2.B.2 Endogeneizing the fallback wage

The fallback wage is given by

$$\tilde{w} = \chi\left[\left(1-\lambda_U\right)w_N+\lambda_U w_U\right]+\left(1-\chi\right)\omega_0, \tag{2.65}$$

where

$$\lambda_U = \frac{M\mu_U l_U}{L} = \frac{1}{1+\rho\left(\mu_U\right)} = \frac{1}{1+\frac{1-\mu_U}{\mu_U}\left(\frac{f_N}{f_U}\right)^{\frac{\sigma}{\sigma-1}}}. \tag{2.66}$$

The wage w_N can be expressed in terms of $\tilde{w}$ by combining (2.55), (2.56), (2.57) and (2.61)

$$w_N = \theta\left[\tilde{w}+b_U\right]\left(\frac{f_N}{f_U}\right)^{\frac{1}{1-\sigma}} - b_N. \tag{2.67}$$

Plugging (2.57), (2.66) and (2.67) into (2.65) and solving for $\tilde{w}$ gives

$$\tilde{w}+b_U = \frac{-\chi\rho\left(\mu_U\right)b_N-\chi b_U+b_U\left(1+\rho\left(\mu_U\right)\right)+\left(1+\rho\left(\mu_U\right)\right)\left(1-\chi\right)\omega_0}{\left(1+\rho\left(\mu_U\right)\right)-\chi\rho\left(\mu_U\right)\theta\left(\frac{f_N}{f_U}\right)^{\frac{1}{1-\sigma}}-\chi\theta}. \tag{2.68}$$

Solution with endogeneous fallback wage. Therefore, the solution to this system is the tuple $\{\mu_U, p_U/P\}$, which solves (2.62) and (2.63) subject to (2.68)

2.B.3 Endogeneizing the employment share

Combining (2.58), (2.59) and (2.60) we can write real expenditures and prices in terms of μ_U such that

$$\frac{E}{\sigma PM} = (1-\mu_U) f_N + \mu_U f_U, \tag{2.69}$$

$$\left(\frac{p_N}{P}\right)^{1-\sigma} = \frac{f_N}{(1-\mu_U) f_N + \mu_U f_U}, \tag{2.70}$$

$$\left(\frac{p_U}{P}\right)^{1-\sigma} = \frac{f_U}{(1-\mu_U) f_N + \mu_U f_U}. \tag{2.71}$$

Total labor employed follows the accounting condition

$$L = M(1-\mu_U) l_N + M\mu_U l_U. \tag{2.72}$$

Using (2.51), (2.52), (2.53), (2.54), (2.70), and (2.71) in (2.72) gives

$$L = \frac{E}{P\phi}\left[\frac{(1-\mu_U)(f_N)^{\frac{\sigma}{\sigma-1}} + \mu_U (f_U)^{\frac{\sigma}{\sigma-1}}}{((1-\mu_U) f_N + \mu_U f_U)^{\frac{\sigma}{\sigma-1}}}\right]. \tag{2.73}$$

The employment share is therefore

$$\chi = \frac{1}{N}\frac{E}{P\phi}\left[\frac{(1-\mu_U)(f_N)^{\frac{\sigma}{\sigma-1}} + \mu_U (f_U)^{\frac{\sigma}{\sigma-1}}}{((1-\mu_U) f_N + \mu_U f_U)^{\frac{\sigma}{\sigma-1}}}\right]. \tag{2.74}$$

Solution with endogenous employment share. The solution is the tuple $\{\mu_U, p_U/P\}$, which solves (2.62) and (2.63) subject to (2.68) and (2.74).

2.C Detailed derivations of Section 2.5

Applying the last equation. In general equilibrium the the wage in the non-unionized sector is such that the labor market is cleared, i.e.

$$L = N. \tag{2.75}$$

Therefore, the employment share is equal to one, $\chi = 1$, and by (2.68) the fallback wage becomes

$$\tilde{w} + b_U = \frac{b_U - b_N}{1 - \theta \left(\frac{f_N}{f_U}\right)^{\frac{-1}{\sigma-1}} - \frac{\theta - 1}{\rho(\mu_U)}}. \tag{2.76}$$

Solution. The solution is the tuple $\{\mu_U, p_U/P\}$, which solves (2.62) and (2.63) subject to (2.76).

Proofs of uniqueness and exisitence. In Scenario 1 ($f_N > f_U$ and $b_N < b_U$) an equilibrium exists an is unique if (i) Eq.1 is strictly decreasing (ii) Eq.2 is strictly increasing, (iii) Eq.1 is larger than Eq.2 evaluated at $\mu_U = 0$ and (iv) the pole point is before the threshold.

It is easily established that the slopes of the two equations follow $\frac{\partial p_U/P}{\partial \mu_U}|_{\text{Eq.1}} < 0.$ and $\frac{\partial p_U/P}{\partial \mu_U}|_{\text{Eq.2}} > 0$. The third condition requires that $\frac{p_U}{P}|_{\text{Eq.1},\mu_U=0} > \frac{p_U}{P}|_{\text{Eq.2},\mu_U=0}$ implying that

$$1 > \frac{\sigma}{\sigma - 1} \frac{\theta}{P\phi} \frac{b_U - b_N}{\left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}} - \theta}, \tag{2.77}$$

needs to holds. For the fourth condition we need to find a firm share for which the denominator in (2.76) equates to zero. This is the case for a μ_U^0 which solves $\frac{\mu_U^0}{1-\mu_U^0} = \frac{1}{\theta-1}\left(\frac{f_N}{f_U}\right)^{\frac{\sigma}{\sigma-1}} - \frac{\theta}{\theta-1}\left(\frac{f_N}{f_U}\right)$. Therefore, $0 < \mu_U^0 < 1$ holds if

$$\left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}} > \theta. \tag{2.78}$$

Therefore, combining the conditions (2.77) and (2.78) gives

$$\left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}} - \theta > \frac{\sigma}{\sigma - 1} \frac{\theta\,[b_U - b_N]}{P\phi}.$$

For Scenario 2 ($f_N < f_U$ and $b_N > b_U$) the proof follows almost along the same lines. An equilibrium exists and is unique if (i) Eq.1 is strictly decreasing (ii) Eq.2 is strictly increasing, (iii) Eq.1 smaller than Eq.2 evaluated at $\mu_U = 0$ and (iv) Eq.1 larger than Eq.2 evaluated at $\mu_U = 1$. Again it is easy to verify that $\frac{\partial p_U/P}{\partial \mu_U}|_{\text{Eq.1}} > 0$ and $\frac{\partial p_U/P}{\partial \mu_U}|_{\text{Eq.2}} < 0$. The third condition requires $\frac{p_U}{P}|_{\text{Eq.1},\mu_U=0} < \frac{p_U}{P}|_{\text{Eq.2},\mu_U=0}$ which is equivalent to

$$1 < \frac{\sigma}{\sigma-1}\frac{\theta}{P\phi}\frac{b_U - b_N}{\left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}} - \theta}. \tag{2.79}$$

The fourth condition $\frac{p_U}{P}\Big|_{\text{Eq.1},\mu_U=1} > \frac{p_U}{P}\Big|_{\text{Eq.2},\mu_U=1}$ is always fullfilled because it evaluates to $1 > 0$. Rearranging condition (2.79) gives again.

$$\left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}} - \theta > \frac{\sigma}{\sigma-1}\frac{\theta\left[b_U - b_N\right]}{P\phi}.$$

Chapter 3

Collective bargaining in exporting firms

3.1 Introduction

Wage inequality has increased strongly in most OECD countries in recent decades (OECD, 2011).[1]

Much of the increase has taken place within worker groups defined by education, age, or experience, and is therefore of the residual type. Globalization, technological change, and institutional reforms are often cited as the determinants of this evolution. In this paper, we shed light on the importance of the international activities of firms and how these interact with collective bargaining in shaping the distribution of residual wages across workers. Germany is an ideal laboratory for this exercise because it is Europe's largest economy, a major exporting nation, and it has seen a strong increase in wage inequality in recent decades.[2] The international activities of firms can affect the wage distribution via various channels. The channel most relevant for our study is rent-sharing between firms and workers. If international activities affect rents, and if firms and workers bargain about the distribution of these rents, exporting or outsourcing can affect wages. Recent theoretical contributions based on Melitz (2003) have shown that different firms are affected differently by trade liberalization, with lower trade costs typically resulting in a more unequal distribution of ex post profits (quasi-rents). In the presence of rent-sharing, greater variation across firms in terms of rents yields greater variation in terms of wages.

In this paper, we use German linked employer-employee data to investigate how the international activities of firms affect rent-sharing and wages in the presence of different bargaining regimes.[3] In Germany, as in other countries, collective agreements (CAs) – whether conducted at the plant level or at the industry level – still play an important role in the wage determination process.[4] Our wage data on German manufacturing industries between 1996 and 2007 are well suited for our purposes because these data contain information on the export participation and the type of bargaining regime.

1 This chapter is joint work together with Gabriel Felbermayr (Ifo Institute Munich) and Hans-Jörg Schmerer (IAB Nuremberg), compare Felbermayr, Hauptmann, and Schmerer (2014).

2 Dustmann, Ludsteck, and Schönberg (2009) have documented the evidence for Germany. They have found that at least two-thirds of the increase in inequality between 1974 and 2004 is the result of a rise in within-group inequality.

3 In the remainder of this paper, the terms "firm" and "plant" are used interchangeably, because the majority of plants in our empirical analysis are single unit firms.

4 For a description of the German system of labor relations, see Keller and Kirsch (2010). Addison, Bryson, Teixeira, Pahnke, and Bellmann (2010); Addison, Teixeira, Bryson, and Pahnke (2011) have provided a descriptive overview of the structure and developments in the German collective bargaining system. We expect that plants covered by plant-level agreements can more easily respond to local changes. For Germany, Gürtzgen (2009b) has found that wages in plants covered by firm-level agreements are positively associated with quasi-rents, which is an indication of rent-sharing. In addition, Gürtzgen (2009a) has shown that wages are lower in industries characterized by stronger plant-heterogeneity if wages are bargained at the industry level.

In our empirical exercise, we study a theoretical mechanism recently put forward by Egger and Etzel (2012), who have combined endogenous markups and collective bargaining. They have shown that exporting might lead to lower wages. While firms in more productive industries always pay higher wages, exporting lowers per worker profits because mark-ups on foreign markets are smaller than those on domestic markets and exporting increases the labor demand elasticity. Hence, unions are more cautious about the negative employment effects and moderate their wage demand. This wage-reducing competition effect dominates the more standard wageenhancing scale effect resulting from the export-driven increase in firms' profits and output. Egger and Etzel (2012) extended their model to centralized bargaining at the industry level, which yields qualitatively similar results.[5]

Clearly, rent-sharing on the firm level can arise for alternative reasons, such as fair wage concerns or convex adjustment costs. Egger and Kreickemeier (2009) have modeled residual wage inequality in a Melitz (2003) constant markup framework with fair wages. They have shown that exporters pay a wage premium and lower trade costs increase inequality. Cosar, Guner, and Tybout (2011) have used a search-and-matching framework with convex adjustment costs. In their model, individual bargaining yields residual inequality because expanding firms are more strongly constrained as a result of convex recruitment costs, and thus face higher rents.[6] Fair wage preferences or convex adjustment costs are not directly observable in the data, whereas collective bargaining coverage is.

To explore the role of rent-sharing, we propose a plant-level profitability proxy that is free from composition effects. Using spell fixed-effects to control for unobserved workplace characteristics, our Mincerian wage regressions show that wages are higher in more profitable plants; this holds, regardless of whether a firm is covered by collective bargaining. However, only in the subsample of plants under collective bargaining do we find that the export exposure of a plant negatively affects the extent of rent-sharing. This result is consistent with the argument of Egger and Etzel (2012). At average profitability, the wage premium paid by a firm achieving 40 percent of its sales in foreign markets versus a purely domestic firm is close to zero. The exporter wage premium is substantial (about 3.9 percent) in plants with profitability levels that are two standard deviations below the mean, but it becomes negative (-2.5 percent) for plants that are two standard deviations above the mean.

5 Montagna and Nocco (2013) have introduced collective bargaining into the heterogeneous mark-up framework of Melitz and Ottaviano (2008) and have come to the same conclusions as Egger and Etzel (2012).

6 Interestingly, with constant mark-ups and linear adjustment costs, collective bargaining does not lead to wage dispersion, because firm-level productivity differences are completely absorbed by employment adjustment (see Helpman, Itskhoki, and Redding, 2010; Felbermayr, Prat, and Schmerer, 2011).

While the existence of the exporter wage premium is well documented in the literature,[7] our focus is on the interaction between rent-sharing, collective bargaining, and export behavior, which has not yet received much attention. Comfortingly, however, our analysis reveals an unconditional positive correlation between wages and exports at the plant level. Yet, controlling for observed and unobserved worker and workplace characteristics, the (residual) exporter wage premium decreases significantly (see also Schank, Schnabel, and Wagner (2007). This indicates that the positive premium is largely driven by assortative matching.[8] Hence, differences in wages are at least partly driven by differences in workforce characteristics.[9] Furthermore, Klein, Moser, and Urban (2010) have provided evidence of the existence of a negative exporter wage premium for low-skilled workers for Germany. Based on the same data, Schmillen (2011) has demonstrated that the exporter wage premium only shows up in plants that export to more remote markets.

In the following section, we discuss the data used for our empirical analysis. In Section 3.3 we outline the empirical strategy, and in Section 3.4 we present the estimation results. In Section 3.5, we offer some concluding remarks.

3.2 Data

Matched employer–employee data for Germany. Our study is based on matched employer–employee data for Germany, which is provided in the LIAB dataset – the linked employer–employee data from the Institute for Employment Research (IAB).[10] We focus on the manufacturing sector for the years 1996–2007, which allows us to include all German regions.[11] The core of this dataset is the IAB establishment panel, an annual survey conducted by the IAB in Nuremberg. Using a common plant identifier, administrative worker-level information from the German Federal Employment agency is matched to the survey.[12]

7 See the leading work by Bernard, Jensen, and Lawrence (1995) and the studies surveyed by Schank, Schnabel, and Wagner (2007) or Wagner (2012).

8 Differences in the workforce composition are also in line with the models of, for example, Helpman, Itskhoki, and Redding (2010), Davidson, Matusz, and Shevchenko (2008), or Yeaple (2005). Krishna, Poole, and Senses (2011) and Davidson et al. (2010) have also found empirical evidence for matching effects and sorting. In a similar context, Krishna, Poole, and Senses (2011) have shown, for Brazil, that the impact of trade openness on wages becomes insignificant if match effects are simultaneously considered.

9 Frias, Kaplan, and Verhoogen (2012) have presented evidence for the exporter wage premium using Mexican data. Baumgarten (2010) has investigated the implications of exports and worker characteristics on wage inequality in Germany.

10 Alda, Bender, and Gartner (2005) have provided an overview of these data.

11 East German plants were not covered in the waves 1993–1995.

12 The data can be accessed freely at the data research centre at the IAB.

IAB establishment panel. The IAB establishment survey applies very high-quality standards. Data are collected in face-to-face interviews by TNS Infratest, a renowned market research unit in Germany. The response rate lies between 63 and 73 percent; this guarantees continuity in the sample because plants are repeatedly interviewed over time.[13] Data are checked and cross-checked for consistency, based on the answers given in previous years. Inconsistent answers are validated in an additional telephone interview held with the respective establishment's interviewee. The advantage of the IAB panel over official registry data is that it contains information about a plant's global stance and details regarding its industrial labor relations. In particular, plants are asked about how their employees are organized, including detailed information about the role of trade unions and CAs.

The sampling strategy is such that, within appropriately defined sample cells, plants are drawn randomly to ensure representativeness.[14] The number of draws is set to ensure, within each cell, the feasibility of statistical inference. Cells (strata) are defined by region, industry, and size class. This might lead to oversampling of large firms relative to the universe of firms, in particular in the service industry (where small firms are common). For this reason, we exclude the services sector in our analysis. For the purpose of obtaining representative descriptive statistics, the LIAB provides appropriate weights. In econometric analysis, the peculiarities of the sampling process are best dealt with by controlling for the strata variables, which are plant size, region, and industry (Fischer, Janik, Müller, and Schmucker, 2008).

Worker-level data. The data for individual employees cover all workers, subject to social-security contributions. This amounts to about 80 percent of German workers (excluding the self-employed, civil servants, workers in marginal employment, and family workers). The data also contain detailed information on several individual characteristics, such as age, gender, nationality, tenure, and wage compensation. It is compulsory for plants to report these data at the end of each year, and at the beginning and end of each employment spell. In our analysis, we focus on full-time employees only, because wages are average gross daily wages without any information on working hours. Therefore, we exclude all observations for part-time workers, apprentices, interns, and persons working at home. Because the real gross daily wage will be of particular interest, we also have to deal with an additional

13 The response rate of continuing establishments is stable at 81–84 percent.

14 Fischer, Janik, Müller, and Schmucker (2009) have provided a detailed discussion about the sampling methods.

issue.[15] Because of a reporting ceiling in the German social-security system, wages are right-censored at the contribution limit. As usual, we use Tobit regressions to impute wages above the cut-off level (Dustmann, Ludsteck, and Schönberg, 2009). For each year, we run a separate regression using age, age squared, tenure, tenure squared, gender, and foreign nationality, as well as a full set of industry dummies as controls. The censored daily wages are replaced by predicted values obtained from the Tobit regression (for details, see Gartner, 2005). We use industry-level price deflators from the OECD in order to deflate all Euro values.

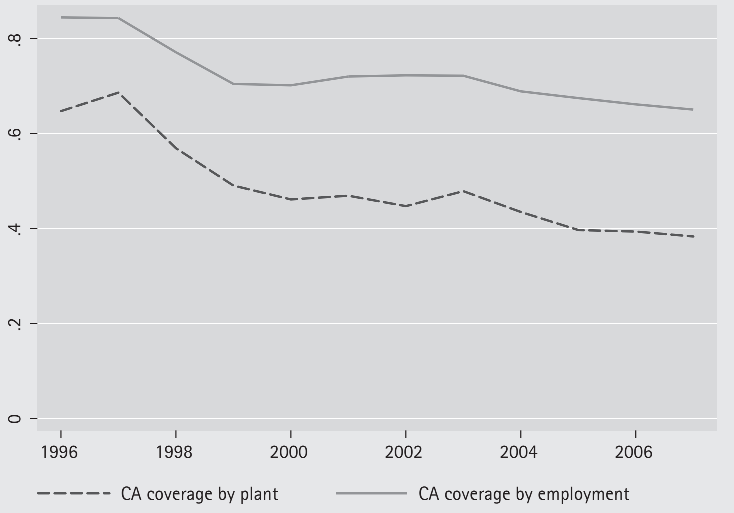
Measuring international activity. At the plant-level, our data comprise information about the export intensity of the plant, measured as the share of sales obtained in export markets. Unfortunately, we cannot address outsourcing directly at the plant level because of missing information about imported intermediates. Moreover, there is no information available about the export destination. We interpret exporting as a valid measure of a plant's broader international activities, which also include importing. This is in line with recent evidence (see Kasahara and Lapham, 2013). Anecdotal evidence suggests that exporting plants might find it easier to outsource parts of production through foreign affiliates. In addition to the plant-level information about exports, we also use an industry-level openness measure taken from the OECD in order to tie our analysis closer to that of Egger and Etzel (2012).[16]

Collective bargaining. Collective agreements are still widely applied and predominantly conducted at the industry or regional level, as well as at the plant or firm level. These agreements constitute a legally binding wage floor between the two bargaining parties. Moreover, firms normally extend this agreement to all workers, even to non-members. Therefore, for our purposes, the bargaining coverage is a better indicator than union density. Figure 3.1 shows that, although declining over time, in 2007, about 70 percent of all employees in German manufacturing were still covered by CAs.

15 Please note that, because of some reporting inconsistencies by the employer, educational attainment has been adjusted following Fitzenberger, Osikominu, and Völter (2006).

16 Our preferred measure is the world market share by industry reported in the OECD Structural Analysis (STAN) database.

Figure 3.1: CA coverage, German manufacturing 1996–2007



3.3 Empirical strategy

Main regression set-up. To shed light on the interaction between rent-sharing and the international activities of the plant, we estimate

$$\ln w_{it} = \gamma \ln TFP_{j(i)t} + \xi EXP_{j(i)t} + \kappa \ln TFP_{j(i)t} \times EXP_{j(i)t} + \alpha_1' Z_{it} + \alpha_2' Z_{j(i)t} + \nu_t + \theta_i \times \phi_{j(i)} + \upsilon_{it}, \quad (3.1)$$

where the index $j(i)$ identifies the plant at which worker i is employed at time t. The dependent variable is the imputed log wage, ln w_{it}, observed for worker i at time t. As variables of interest, we include the plant's export share EXP, to proxy exposure to international competition, and total factor productivity (TFP), to proxy its profitability. From a theoretical point of view, rent-sharing is directly linked to productivity through the positive productivity/profits relationship.[17]

Besides the identification of the exporter wage-premium and the magnitude of rent-sharing between plants and workers, our focus is also on the interaction between them. We include vectors of worker and plant characteristics, Z_{it} and $Z_{j(i)t}$, respectively, to purge the wage data from observable worker and plant heterogeneity. More precisely, the vector Z_{it} includes controls for worker

17 This standard outcome of heterogeneous firm models as in Melitz (2003) can translate into a positive productivity/wage relationship (see Egger and Kreickemeier, 2009).

characteristics, such as tenure, age, tenure squared, age squared, a white-collar dummy, and the level of skill attained by the respective employee. Unobservable differences in skill or ability are controlled for by including spell fixed-effects $\theta_i \times \phi_{j(i)}$. At the plant level, the vector $Z_{j(i)t}$ includes controls such as log-employment to capture plant size, capital intensity measuring the relative capital to labor ratio on the plant level, the shares of females and part-timers, and variables indicating whether a plant is covered by a collective agrement at the plant or industry level, and whether it has a work council. Industry, time, and region dummies are included in all regressions.

In a first step, we compare ordinary least-squares (OLS) and spell fixed-effects regressions, based on the whole set of observations. Coefficients in the spell fixed-effects regressions are identified using the within-variation in a certain plant–worker combination. A spell ends either because of the successful switch of a worker from one to another plant, or because of a layoff. Spell fixed-effects are preferred over person fixed-effects as long as the decomposition of the time-invariant effect into its worker- and plant-specific component is not a separate object of interest. Also, there is the advantage that the identification is independent of the number of movers. Standard errors are clustered at the plant level. For the main part of the analysis, we also report random-effects regression results. Random effects have the advantage that identification relies on both the within- and between-variation of the data, which is important for our analysis because the export intensity displays relatively little variation over time.

Measuring plant-level profitability. As argued in the introduction, we are mainly interested in rent-sharing between employers and workers, and to what extent the rent-sharing intensity hinges on the export behavior of the plant. For this purpose, we need a plant-level profitability measure that is not plagued by workforce composition. Our preferred proxy is total factor productivity (TFP), which we construct as the residual obtained from estimating firm-level production functions. The TFP measure is superior to alternative proxies, such as reported profits, because it allows us to account for possible endogeneity problems arising from unobserved productivity shocks and for assortative matching.

The endogeneity issue is addressed using the semiparametric approach proposed by Levinsohn and Petrin (2003), who have suggested the use of intermediate inputs as proxies for unobserved productivity shocks.

Assortative matching poses a more complex problem. Without accounting for work-force composition, we would interpret a link between profitability and wages as rent-sharing, while the relationship might simply be the result of more efficient plants hiring more productive workers. In the following, we briefly describe how to deal with this problem.[18] We deviate from the standard production function framework used in the empirical body of literature by differentiating between different worker types within firms. For this purpose, we write the firm-specific composite labor input as a constant elasticity of substitution aggregate over workers' human capital within the firm. Following Iranzo, Schivardi, and Tosetti (2008), we compute an index of worker-level human capital based on a Mincer wage regression.[19] The index combines the measured contribution of observed human capital characteristics (age, experience, etc.) to the marginal product of labor (the wage rate) and a time-invariant component as captured by a worker fixed effect.

Substituting into a Cobb-Douglas production function, and taking a second-order Taylor series expansion, we obtain a log-linear representation that can be estimated using the method of Levinsohn and Petrin (2003). To estimate the TFP, we need measures for capital stocks. These are constructed following Müller (2008, 2010) who has suggested a perpetual inventory method that exploits the detailed information about a plant's investments in order to generate capital stocks.[20]

Our production function estimates imply reasonable coefficients for capital between 0.2 and 0.4, and for labor between 0.7 and 0.75. Differentiating between exporter and non-exporter plants does not point towards important differences between these two groups.[21] Comparing the standard Levinsohn and Petrin (2003) productivity measure and the skill-free Iranzo, Schivardi, and Tosetti (2008) productivity measure for the years 1996, 2002, and 2007, it emerges that exporters have, on average, higher levels of productivity.[22] Moreover, the gap between exporting and non-exporting plants is smaller when controlling for work-force composition. However, the gap between non-exporter and exporter productivity increases over time and across different percentiles of the productivity distribution. This productivity gap between exporters and non-exporters decreases by 3–6 percent, on average, when controlling for work-force composition.[23]

18 In the Appendix, we provide details about the employed methodology (see Appendix 3.A).

19 See Table 3.A.1 in the Appendix for the results.

20 Plants in the sample report investment volumes and type of investment, which makes it possible to proxy the capital stock by summing per-period investments and taking investmentspecific depreciation rates into account.

21 Table 3.A.2 in the Appendix reports detailed results.

22 See Table 3.B.2 in the Appendix. The kernel density plots on the productivity distribution, reported in Figure 3.B.1 of the Appendix reveal the well-known stylized fact that exporting plants are more productive.

23 Following Del Gatto, Ottaviano, and Pagnini (2008), we also test whether TFP is Pareto-distributed. However, the estimated shape parameter is at a rather low k = 1.14 and R^2 is lower than the proposed threshold reported in Del Gatto, Ottaviano, and Pagnini (2008). See Table 3.B.3 in the Appendix for details.

3.4 Regression results

Exporter wage premium and rent-sharing: direct effects. In a first step, we confirm that our data reproduce well-documented stylized facts from the literature (see Table 3.C.1 in the Appendix). In particular, using OLS on equation (3.1) without the interaction term, we find that plants more strongly exposed to trade pay higher wages. An increase in the export share by 10 percentage points is associated with an average increase of the wage rate by 0.43 percent. The magnitude of this effect is comparable to previous findings (see Schank, Schnabel, and Wagner, 2007). Profitability (measured by $lnTFP$) is also positively related to wages. Ceteris paribus, a 10 percent increase in TFP leads to a 0.25 percent wage increase, on average. The statistical significance and quantitative importance of these variables does not depend on whether or not they are entered simultaneously into the regression. However, it appears that the use of spell fixed-effects reduces the coefficient on the export share to zero, but leaves the one on TFP statistically significant and positive, although approximately halved.[24] We show that our main results hold regardless of whether spell fixed-effects are used or not.

Exporter wage premium and rent-Sharing: interactions. Table 3.1 presents our core result. Based on Egger and Etzel (2012), the conjecture is that rent-sharing (i.e., the effect of profitability on wages) is less pronounced in firms that are more strongly exposed to international markets. To test this link between the export status of the establishment and its profitability (TFP), we include the interaction between both variables. We expect both TFP and the exporter variable to have positive coefficients, but we expect the interaction to have a negative coefficient. The implication of this, of course, is that the exporter wage premium is smaller in more profitable firms (where wages are pushed up directly by higher TFP).

Columns (1) and (2) investigate the role of plant-level openness to trade, while Columns (3) and (4) consider industry-level openness in order to nudge our analysis closer to the theoretical model of Egger and Etzel (2012). We focus first on Columns (1) and (2). Interestingly, allowing for the interaction between TFP and export share, even in the presence of spell fixed-effects, both the profitability measure and the export share have positive signs and are statistically different from zero at the 1 percent level. The coefficient on the interaction term is negative in sign and is also significant at the 1 percent level. All estimates are algebraically smaller under the spell fixed-effects specification. The results provide evidence for an exporter wage

24 Taking the Melitz (2003) model literally, exporting is directly related to productivity, making simultaneous inference on either difficult. The correlation between the two measures is 0.2599, meaning that collinearity is not a severe problem in our regressions.

premium and for rent-sharing. However, the importance of rent-sharing declines in the export share of the firm: the elasticity of TFP on the wage is 0.029 in a purely domestic firm, but only 0.017 in a firm with an average export share (0.41). The elasticity is zero in a firm that exports all of its output. The exporter wage premium also declines with TFP: the wage paid by an average exporter is about 0.13 percent higher than that paid by an average domestic firm.[25] If a firm with an average export share has a level of TFP two standard deviations above the mean, it pays a wage that is 1.9 percent lower than a purely domestic firm.[26] However, if a firm has a level of TFP two standard deviations below the mean, it pays a wage 2.14 percent higher than a purely domestic firm.[27] A firm exporting its entire output with an average level of TFP has a wage rate about 0.31 percent higher than a similarly profitably purely domestic firm.[28] Please note that these interpretations of our findings make a ceteris paribus assumption. In reality, we know that profitability and export status are positively correlated (see footnote 25), which means that some caution is warranted.

Table 3.1: The export wage-premium and the role of TFP

Dependent variable: Logarithm of individual daily wage				
	(1) OLS	(2) Spell FE	(3) OLS	(4) Spell FE
TFP (ln)	0.071***	0.029***	0.108***	0.053**
	(0.007)	(0.006)	(0.011)	(0.021)
Exports (share)	0.785***	0.243***		
	(0.111)	(0.074)		
Exports × TFP	–0.089***	–0.029***		
	(0.013)	(0.009)		
Openness			0.056***	0.033
			(0.018)	(0.021)
Openness × TFP			–0.005***	–0.002**
			(0.001)	(0.001)
R^2	0.623	0.181	0.622	0.188
Plants	5,040	5,040	5,003	5,003
Observations	4,658,595	4,658,595	4,654,547	4,654,547

Notes: Standard errors in parentheses clustered at the plant level in (1)-(2) and at the industry level in (3)-(4). ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Controls included but not reported are age, age squared, tenure, tenure squared, medium-, high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and dummies for the existence of a worker council and collective agreements at the firm or industry level. Additionally, all estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo, Schivardi, and Tosetti (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks. See Table 3.D.1 in the Appendix for complete results.

25 100% × (0.243 × 0.410 – 0.029 × 8.271 × 0.410) = 0.129%.

26 100% × (0.243 × 0.410 – 0.029 × (8.271 + 2 × 0.845) × 0.410) = −1.881%.

27 100% × (0.243 × 0.410 – 0.029 × (8.275 – 2 × 0.845) × 0.410) = 2.138%.

28 100% × (0.243 – 0.029 × 8.271) = 0.314%.

Columns (3) and (4) replace the firm-level export share measure with an industry-level variable in order to tie our empirics closer to that of Egger and Etzel (2012). These regressions confirm that wages in more open industries tend to be higher. Moreover, at the plant level, we also find that the magnitude of rent-sharing tends to be more pronounced in industries that are less open. As a general lesson, because of rent-sharing, it is profitable for a worker to be employed in a highly productive firm; if that firm exports, rent appropriation becomes more difficult for workers.

The role of collective bargaining. There is a positive link between the distribution of wages and the distribution of firm-level profits in theoretical models featuring fair wages (Egger and Kreickemeier, 2009) or search-and-matching with convex adjustment costs (Cosar, Guner, and Tybout, 2011), as well as in models featuring collective bargaining. In this section, we test whether the form of wage determination matters for the existence of an exporter wage premium and for the role of internationalization on rent-sharing.

Table 3.2 reports coefficients obtained from regressions either including observations for plants without collective bargaining in Columns (1)–(3), or plants subject to plant- or centralized-bargaining agreements in Columns (4)–(6). The upper panel employs the information in the plant-level export share, whereas the lower panel exploits industry-level data as a globalization proxy. We compare pooled OLS, spell fixed-effects, and spell random-effects estimators. Both regimes are comparable because the same number of plants is included in both regressions.[29]

Whether wages are bargained collectively or not, we find that more profitable plants pay higher wages. The magnitude of the direct effect is very similar across regressions using plants without or with collective bargaining coverage. Strikingly, however, a direct positive exporter wage premium exists only in the sample of collectively bargained plants. In this sample, we also find that rent-sharing is reduced by international activities. Plants not covered by collective bargaining feature an inconsistent and statistically insignificant sign pattern on the export variables. This picture is robust to using an industry-level openness measure instead of the plant-level export share; see the lower panel of Table 3.2. The results suggest that the pattern in the data is best understood against the background of the model by Egger and Etzel (2012), where collective bargaining and variable mark-ups interact to give rise to a negative interaction between exporting and rent-sharing.

29 Although we have different numbers of observations, the results are comparable because we cluster standard errors on the plant level.

Table 3.2: Role of collective agreements

Dependent variable: Logarithm of individual daily wage						
	No collective agreement			Collective agreement		
	OLS	**Spell FE**	**Spell RE**	**OLS**	**Spell FE**	**Spell RE**
Plant level						
TFP (ln)	0.083***	0.031***	0.045**	0.066***	0.028***	0.041***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.007)
Exports (share)	0.287	–0.100	0.018	0.726***	0.244***	0.423***
	(0.207)	(0.183)	(0.164)	(0.124)	(0.088)	(0.079)
Exports × TFP	–0.037	0.008	–0.004	–0.081***	–0.029***	–0.049***
	(0.026)	(0.023)	(0.020)	(0.015)	(0.011)	(0.009)
R^2	0.590	0.126		0.597	0.192	
Plants	2,626	2,626	2,626	3,302	3,302	3,302
Observations	491,828	491,828	491,828	4,166,767	4,166,767	4,166,767
Industry level						
TFP (ln)	0.101***	0.058	0.078**	0.104***	0.050**	0.073***
	(0.027)	(0.044)	(0.039)	(0.013)	(0.020)	(0.014)
Openness	0.053	0.048	0.055	0.052**	0.030	0.039**
	(0.037)	(0.042)	(0.040)	(0.018)	(0.020)	(0.018)
Openness × TFP	–0.003	–0.002	–0.003	–0.005***	–0.002**	–0.004***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
R^2	0.592	0.152		0.596	0.196	
Plants	2,594	2,594	2,594	3,284	3,284	3,284
Observations	489,410	489,410	489,410	4,165,137	4,165,137	4,165,137

Notes: Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Controls included but not reported are age, age squared, tenure, tenure squared, medium-, high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and a dummy for the existence of a worker council. Additionally, all estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo, Schivardi, and Tosetti (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks. See Tables 3.D.2 and 3.D.3 in the Appendix for complete results.

The right-most column in the upper panel of Table 3.2 suggests that, at average profitability, the wage premium paid by a firm achieving 40 percent of its sales on foreign markets over a purely domestic firm is close to zero. The exporter wage premium is substantial (about 3.9 percent) in plants with profitability levels two standard deviations below the mean, while it becomes negative (-2.5 percent) for plants two standard deviations above the mean.

Does more exposure to trade reduce wages? One direct test of whether globalization reduces rent-sharing between plants and workers under collective bargaining is to look at changes in wages and plant-level trade exposure.[30]

30 We are grateful to an anonymous referee for suggesting this test.

However, inference is impaired by the fact that export status does not change or does not change significantly for a substantial fraction of firms. For this reason, we use a sample of plants that switch their export status at least once in the entire period.[31] Table 3.3 reports estimation results for regressions where we regress the change in wages on the change in exports. Moreover, we also distinguish between blue- and white-collar workers in order to shed light on the role of skills. All other controls, except for the time, sector, and region dummies, also enter the regression in first differences.[32]

Table 3.3: Does more export reduce wages?

Dependent variable: Logarithm of individual daily (first differences)						
	Collective agreements					
	No CA	**CA**	**No CA**	**CA**	**CA**	**CA**
BC and/or WC workers	All	All	All	All	BC	WC
Exports (dummy, first diff.)	0.007**	–0.006*				
	(0.003)	(0.003)				
Export (share, first diff.)			0.002	–0.018***	–0.020**	–0.013**
			(0.014)	(0.007)	(0.008)	(0.006)
R^2	0.087	0.053	0.086	0.053	0.075	0.034
Plants	807	864	807	864	846	813
Observations	113,854	747,981	113,854	747,981	484,942	263,039

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Constant estimated but not reported. All variables are in first differences. The sample only includes plants that switch their export status at least once during the entire period. Column (1) estimates the change of wages on the change of export dummy for non collective agreement plants. Column (2) includes collective agreement plants only. Columns (3) to (4) replicates columns (1) and (2) including the export share. Columns (5) to (6) replicates column (4) but for blue collar (BC) and white collar workers (WC) separately.

Columns (1) and (2) differentiate between those firms that are not covered by collective bargaining and those that are. The hypothesis is that wages in the former group should not be affected by exporting behavior, while those in the latter group should be affected negatively. When looking at the exporter dummy variable, we find that, under collective bargaining, exporting does indeed depress wages. In the absence of collective bargaining, the opposite effect is seen. However, this finding is not robust to using the export share instead of the dummy; see Columns (3) and (4). An increase in the export share has zero effects on wages in non-collective bargaining plants but significantly reduces the wages of workers employed in

31 Thus, the sample of plants is slightly different from the sample used in the earlier analysis.

32 Some variables do not change over time and are thus excluded. Table 3.D.4 in the Appendix provides details. Capital intensity is excluded in order to maximize the number of observations.

collective bargaining plants. This confirms the results of Egger and Etzel (2012) and Montagna and Nocco (2013).

Columns (5) and (6) rerun the regression reported in Column (4), but for blue- and white-collar workers separately. The effect is much smaller for white-collar workers compared to blue-collar workers. In line with the discussion about rising wages at the top, but declining wages at the bottom of the income distribution, we find that this negative coefficient seems to be driven by a reduction in blue-collar wages. This is consistent with the fact that collective bargaining is more prevalent for blue-collar workers. To the extent that worker-level wage innovations do not correlate with firm-level export variables, Table 3.3 allows a causal interpretation of the export intensity to wage moderation hypothesis tested in this paper. However, the results in Table 3.3 also reveal that the effect is small in magnitude.

Can we interpret our results as causal? In equation (3.1), our key identification assumption is that TFP and the export share are both uncorrelated to the error term υ_{it}. While we have no reason to believe that the correlation is exactly zero, we can argue that, in practice, it is very small. This is because the TFP and export share variables vary at the firm level and not at the worker level: individual worker-level shocks are therefore unlikely to cause firm-level behavior.[33] TFP and exports can be driven by firm-level shocks, but the main candidates for such shocks are among the variables that we include in the regression: trade exposure and productivity. Moreover, the use of spell fixed-effects and a large array of worker characteristics implies that any correlation between υ_{it} and firm-level variables cannot be a result of observed or unobserved human capital characteristics. For example, we fully account for the possibility that a firm hires a better educated or more able work force with higher wages with the aim of starting to export.

When we condition on the bargaining regime of a firm, similar arguments apply. However, a number of additional observations are important. First, in Germany, there is no official rule forcing firms above any specific size or wage bill threshold to engage in collective bargaining, so there is no automatic correlation between TFP or export status and the bargaining regime. Second, the frequently cited argument that more openness leads to higher demand for insurance and, thus, possibly to stronger union presence, has little impact in a country that offers generous unemployment benefits and employment protection. Furthermore, we have based our point on two separate samples: one where all plants are always covered by collective bargaining, and the other where this is not the case. Our

33 Unless, of course, they are correlated across workers within firms. However, this possibility is taken care of by including spell fixed-effects (which nest firm effects).

results are consequently entirely driven by within-group variation within these samples. For these reasons, we are confident that our results are not spurious.

Further robustness checks. In the Appendix, we show that our results are robust across white- and blue-collar workers (Tables 3.C.2 and 3.C.3) and that they hold for the subsamples of firms covered by firm-level and industry-level agreements, respectively (Tables 3.C.4 and 3.C.5).

3.5 Conclusion

In this paper, we shed light on the implications of global competition for the wage-setting mechanism in the presence of unions. Our results suggest that the bargaining positions of unions are weaker in more internationally active plants. Our analysis is motivated by recent theoretical work, which shows that the combination of variable mark-ups and collective bargaining implies lower rent-sharing in firms that achieve a higher share of their sales in exports markets, where profit margins are lower.

Our preferred measure for rent-sharing is a profitability measure that is purged from the plant's skill-composition. In line with the theoretical predictions outlined in the introduction, we are able to show that a surge in the export intensity of collective bargaining plants is negatively associated with wages. The well-known exporter wage premium appears in our regressions when the identification is based on both the within- and the between-variation of the data, and/or if we explicitly allow for interactions between exports and productivity by taking a plant's profitability into account. Moreover, the export share turns out to be significant only in plants that either bargain wages collectively or individually on the firm level. To the best of our knowledge, this is the first paper to connect different wage-bargaining regimes to the exporter wage premium, based on matched employer–employee data.

Appendix

3.A Details on the calculation of profitability measures

A generalized production function framework. Our approach is based on Iranzo, Schivardi, and Tosetti (2008). Using plant-level panel data, we estimate the following production function for plant j

$$Y_{jt} = A_{jt} \cdot K_{jt}^{\alpha} \cdot \tilde{L}_{jt}^{\beta} \quad , \tag{3.2}$$

where the stock of capital is K_{jt}, the composite labor input is $\tilde{L}_{jt}$, and A_{jt} is TFP. The composite labor input is constructed by using consistent estimates of workers' abilities h:

$$\tilde{L}_{jt} = L_{jt} \cdot \left(1/L_{jt} \cdot \sum_{i=1}^{L_{jt}} h_i^{\rho}\right)^{1/\rho} , \tag{3.3}$$

where L_{jt} is total employment, and ρ measures the degree of substitutability across different human capital levels. Using a second-order Taylor series expansion of the production function around the plant's mean ability we obtain

$$\ln Y_{jt} \simeq \alpha \ln K_{jt} + \beta \ln L_{jt} + \beta \ln \left[\bar{h}_{jt} + \frac{1}{2}(\rho - 1)\left(\frac{\sigma_{jt}^2}{\bar{h}_{jt}}\right)\right] + \varepsilon_{jt}. \tag{3.4}$$

To apply linear estimation techniques, this expression can be further approximated as:

$$\ln Y_{jt} \simeq \alpha \ln K_{jt} + \beta \ln \left(L_{jt}\bar{h}_{jt}\right) + \delta \left(\frac{\sigma_{jt}}{\bar{h}_{jt}}\right)^2 + \varepsilon_{jt} \quad , \tag{3.5}$$

where $\delta = \beta\frac{1}{2}(\rho - 1)$.[34] The average ability of the workforce, $\bar{h}_{jt}$, and the plant's standard deviation in its workers' ability, σ_{jt}, are constructed using the consistently estimated worker productivity measures as explained in the following section.

Olley and Pakes (1996) or Levinsohn and Petrin (2003) stress the importance of controlling for unobservable short-run productivity shocks when estimating total factor productivity. Olley and Pakes (1996) use firms' investment as a proxy, whereas Levinsohn and Petrin (2003) use information about the firms' input of intermediate goods to weed out the simultaneity bias caused by omitting the unobserved productivity shocks. The authors are able to show that the advantage of using intermediate inputs as proxy is that it allows to tackle another bias caused by zero investment flows. At each point in time, employers are more likely to use intermediate inputs than to invest in their capital stock. We use the

34 The approximation makes use of $ln(x + y) = lnx + ln(1 + y/x)$ and $ln(1 + y/x) \approx y/x$.

method suggested by Levinsohn and Petrin (2003) (later denoted LP) and estimate equation (3.5) in order to obtain ability-free estimates for our profitability proxy.

Measuring human capital. Following Abowd, Kramarz, and Margolis (1999) in general, and Andrews, Gill, Schank, and Upward (2008) as a particular application to German data, we run a Mincerian wage regression to estimate worker productivity measures. Abowd, Kramarz, and Margolis (1999) suggest that the superior identification strategy is "persons first and firms second". We thus estimate

$$\ln w_{it} = x_{it}\eta + y_{j(i)t}\mu + \theta_i + \phi_{j(i)t} + \varepsilon_{it} \quad , \tag{3.6}$$

where w_{it} is the imputed daily compensation of individual worker i at time t and $\bar{w}$ is the grand mean of the imputed wage rate averaged over time. Worker and plant characteristics are gathered in the vectors x_{it} and $y_{j(i)t}$, respectively, while θ_i and $\phi_{j(i)t}$ denote worker and plant fixed effects.

The auxiliary model in equation (3.6) differs from our main specification in equation (3.1) in the paper for two reasons. First of all we have to decompose the spell-fixed effect into its plant- and its worker component. Moreover, we also use a different set of control variables in order to maximize the number of movers in the sample. The identification of the plant fixed-effect hinges on the number of movers between plants. The sample size decreases rapidly in the number of plant-controls. The higher the total number of plants in the sample, the more likely it gets that plants are connected through workers switching jobs between two plants that are both observed in the sample. In order to reduce the number of plants that drop out of the sample we follow Abowd, Kramarz, and Margolis (1999) by treating small plants as one group.

The plant dummy absorbs some of the unobserved heterogeneity on the plant-level. Not controlling for plant fixed effects would yield a biased estimator of the person fixed effects including both person and establishment time-invariant components. As Abowd, Kramarz, and Margolis (1999) demonstrate, neglecting the plant fixed effect would yield estimates for $\phi_{j(i)t}$ which would also include the "employment-duration weighted average plant effect ϕ_j", provided that the other assumptions are not violated.[35]

35 Andrews, Gill, Schank, and Upward (2008) use their estimation strategy and analyze the importance of a sufficient number of movers between employers to increase the quality of the estimated plant fixed effect. Their focus lies on identifying the plant fixed effects in Abowd, Kramarz, and Margolis (1999), which allows them to maximize the number of movers by using the full-sample of workers. Our sample is smaller and relies on information about the plant. We thus need matched employer-employee data, which also reduces the number of movers. We therefore also propose a different identification strategy which relies more on the plant-level information when we estimate the plant-component.

The human capital index then constructed as the sum of predicted worker effects, i.e.

$$\hat{h}_{it} = x_{it}\hat{\eta} + \hat{\theta}_i. \tag{3.7}$$

The index thus comprises time-varying and time-constant characteristics related to the worker. The predicted $\hat{h}_{it}$ allows constructing the first and second moments of the human-capital distribution within the plant, which facilitates the estimation of equation (3.5).

Results for the human capital estimates. Results of the estimation of equation (3.6) are reported in Table 3.A.1.[36] Column 1 displays the results when only worker information (age, age squared and age cubed) is controlled for. Column 2 adds the employer size and it is our preferred specification. This parsimonious setup is chosen to maximize the number of movers between plants. As a further robustness check, we include capital intensity in column 3.

Results for the production function estimates. Results of the production function estimation of are reported in Table 3.A.2.[37] Panel A displays the results when only employment and capital are included. The results of estimating equation (3.5) are reported in panel B. Furthermore estimations are conducted for non-exporters and exporters separately in columns (2) and (3). The residual of the estimation in column (1) in panel B is our preferred TFP measure.

36 In particular we use the Stata routine felsdvreg provided by Cornelißen (2008).

37 We use the Stata routine levpet provided by Petrin, Poi, and Levinsohn (2004) for the estimation of the production function.

Table 3.A.1: FELSDV results

Dependent variable: Logarithm of individual daily wage *Variables of interest: Firm and person fixed effects*			
	(1)	(2)	(3)
Age	0.076***	0.075***	0.073***
	(0.001)	(0.001)	(0.001)
$Age^2/100$	–.084***	–.082***	–.079***
	(0.001)	(0.001)	(0.001)
$Age^3/1000$	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)
Employment (ln)		0.039***	0.034***
		(0.001)	(0.001)
Capital intensity (ln)			0.023***
			(0.001)
Observations	10,107,425	10,107,382	7,611,812

Notes: Robust standard errors in parenthesis. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Person, firm, year, and industry dummies included in all regressions. Person fixed effects of column (2) are used to construct human capital measures consisting of observed and unobserved characteristics. These human capital measures are in turn used to construct firm-level human capital index variables such as the mean $\bar{h}_{jt}$ and the standard deviation σ_{jt}.

Table 3.A.2: Production function estimates

Dependent variable: Value added (ln)			
		Non-exporter	Exporter
	(1)	(2)	(3)
	Panel A: Without controlling for workforce composition		
Employment (ln)	0.698***	0.688***	0.728***
	(0.016)	(0.022)	(0.021)
Capital (ln)	0.200***	0.155*	0.200*
	(0.056)	(0.088)	(0.109)
CRS-Test (p-value)	[0.065]	[0.093]	[0.515]
	Panel B: Controlling for the workforce composition		
Employment × $\bar{h}_{jt}$ (ln)	0.733***	0.727***	0.755***
	(0.017)	(0.022)	(0.017)
Capital (ln)	0.189***	0.153*	0.357***
	(0.061)	(0.091)	(0.094)
$VC(h_{jt})^2$	2.866***	3.237***	1.453
	(0.948)	(0.989)	(1.674)
CRS-Test (p-value)	[0.221]	[0.214]	[0.234]
Observations	20,581	9,273	11,308

Notes: Standard errors in parenthesis. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. All estimations include industry and time fixed effects. Estimation method: Levinsohn and Petrin (2003). Standard errors are bootstrapped in columns (1)–(3). The second panel controls for the plant-level workforce composition by including the mean and the squared variance coefficient of the human capital index. Probability of the sum of parameter estimates on labor and capital to be equal to one in brackets.

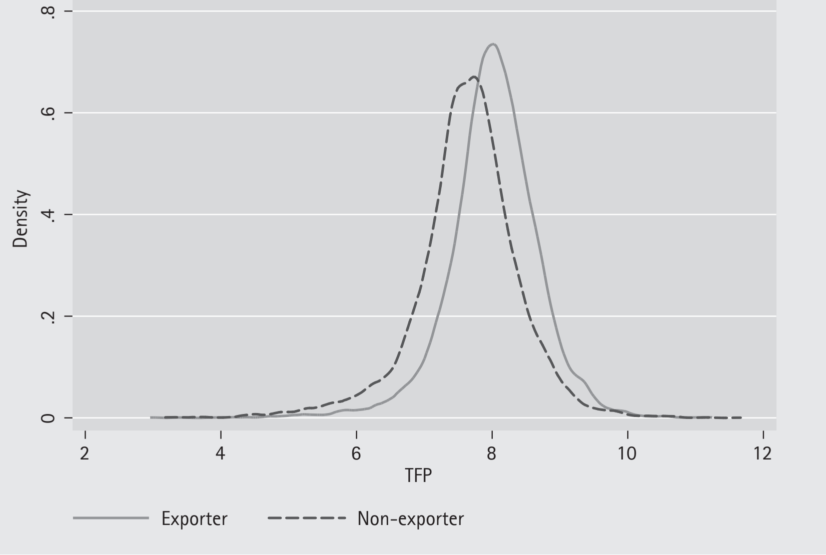
3.B Summary statistics

Summary statistics. Table 3.B.1 reports further information about the variables used in the regressions. We distinguish between individual- and establishment-level, where variables are collapsed to the establishment-year dimension for the establishment-level summary reports.

Exporter vs. non-exporter. Our analysis hinges on the constructed total factor productivity measure which is our preferred proxy for firm profitability. Table 3.B.2 compares the mean, the standard deviation and three different percentiles of our productivity measure for non-exporters and exporters in 1996, 2000, and 2007. For comparison in panel A the standard Levinsohn and Petrin (2003) estimator is used, whereas the Iranzo, Schivardi, and Tosetti (2008) estimator is displayed in panel B. In all cases we find that exporters are more productive.

The kernel density plot in Figure 3.B.1 also indicates that, in our sample, exporters are on average more productive. Moreover, the plot also reveals that the two distributions strongly overlap. Thus, there is no clear cutoff as predicted by Melitz (2003).

Figure 3.B.1: Kernel density plot of the profitability measure



Pareto test for the TFP estimates. To test whether our TFP measure is Pareto distributed we follow Del Gatto, Ottaviano, and Pagnini (2008): "Formally, consider a random variable X (e.g., our TFP) with observed cumulative distribution F(X). If the variable is distributed as a Pareto with shape parameter ks, then the OLS estimate of the slope parameter in the regression of ln(1 – F(X)) on ln(X) plus a constant is a consistent estimator of – ks and the corresponding R^2 is close to one." Table 3.B.3 displays the results for the pooled sample, as well as for different subsamples by year or industry. The R^2 only rarely exceeds 0.8.

Table 3.B.1: Summary statistics

	Individual level		Plant level	
	Mean	Std. Dev.	Mean	Std. Dev.
Individual characteristics				
Daily imputed wage (ln)	4.595	0.390	4.222	0.383
Daily non-imputed wage (ln)	4.571	0.353	4.214	0.374
Female worker (dummy)	0.175	0.380	0.250	0.231
Foreign worker (dummy)	0.092	0.289	0.046	0.091
White-collar worker (dummy)	0.348	0.476	0.299	0.240
Low-skilled worker (dummy)	0.170	0.376	0.129	0.182
Medium-skilled worker (dummy)	0.703	0.457	0.790	0.201
High-skilled worker (dummy)	0.126	0.332	0.081	0.126
Age (years)	41.507	10.014	41.424	4.512
Tenure (years)	11.444	8.204	7.989	4.261
Experience (years)	17.056	8.360	14.204	4.904
Establishment characteristics				
Exporting plant (dummy)	0.890	0.313	0.549	0.498
Exports (share of total sales)	0.410	0.272	0.183	0.252
TFP (ln)	8.271	0.845	7.840	0.748
Labor productivity (ln)	11.160	0.884	10.787	0.787
Employment (ln)	7.361	1.865	4.050	1.792
Value added (ln)	18.520	2.139	14.837	2.156
Capital intensity (ln)	11.389	0.931	10.646	1.271
Female workers (share)	0.206	0.153	0.269	0.212
Part-time workers (share)	0.047	0.060	0.080	0.125
CA, industry-level (dummy)	0.754	0.431	0.457	0.498
CA, firm-level (dummy)	0.141	0.348	0.093	0.290
Existence worker council (dummy)	0.933	0.250	0.465	0.499
Industry-level characteristics				
Sectoral trade openness (share)	13.505	3.832	11.846	3.712

Notes: German matched employer-employee data (LIAB), 1996-2007, manufacturing industries. All monetary variables are expressed in real terms using a two-digit industry value added deflator. All industry-level variables are taken from the OECD STAN database.

Table 3.B.2: Total factor productivity distribution by export status

	Mean	Std. Dev.	p10	p50	p90
Panel A: Levinsohn and Petrin without workforce-composition controls					
	Mean	**Std. Dev.**	**p10**	**p50**	**p90**
1996					
Non-exporter	74.6	53.2	27.3	63.0	142.3
Exporter	104.0	93.1	44.0	85.7	170.5
2000					
Non-exporter	82.8	86.7	19.9	66.9	140.9
Exporter	103.4	89.4	31.8	86.2	176.0
2007					
Non-exporter	75.4	63.6	28.4	58.0	139.3
Exporter	102.6	92.3	42.1	81.5	163.8
Panel B: Levinsohn and Petrin including workforce-composition controls					
	Mean	**Std. Dev.**	**p10**	**p50**	**p90**
1996					
Non-exporter	78.3	53.2	31.4	65.9	131.9
Exporter	101.5	69.0	48.3	84.3	171.7
2000					
Non-exporter	83.3	77.3	21.5	67.7	145.4
Exporter	98.9	69.9	36.9	85.9	159.9
2007					
Non-exporter	78.5	60.7	34.3	63.0	139.8
Exporter	102.3	90.0	44.2	81.4	166.8

Notes: TFP is constructed following Levinsohn and Petrin (2003). The means, standard deviations, 10th, 50th, and 90th percentile of TFP are separately reported for non-exporters and exporters in the years 1996, 2002, and 2007. All values are expressed as percentage of the yearly-industry average, weighted by inverse drawing probability weights.

Table 3.B.3: Is TFP Pareto distributed?

	k-parameter	R^2	Obs.
Pooled sample			
Total	1.144	0.734	20,580
By year			
1996	1.204	0.741	955
1997	1.114	0.724	936
1998	1.059	0.692	1,093
1999	1.130	0.714	1,309
2000	1.103	0.718	2,008
2001	1.128	0.724	2,213
2002	1.058	0.700	2,145
2003	1.079	0.700	2,158
2004	1.138	0.734	2,134
2005	1.119	0.740	1,990
2006	1.307	0.820	1,839
2007	1.309	0.808	1,789

By industry			
Textiles	1.032	0.698	664
Printing	1.036	0.695	1,093
Wood	1.225	0.779	1,138
Chemicals	1.134	0.766	1,198
Plastic	1.083	0.596	1,122
Non-metallic	1.192	0.725	1,116
Metallic	1.199	0.695	1,636
Recycling	1.073	0.766	178
Steel	1.273	0.678	2,599
Machinery	1.206	0.695	2,947
Vehicles a	1.076	0.722	1,124
Vehicles b	1.066	0.733	324
Electronic	1.179	0.758	1,730
Optic	1.229	0.712	1,190
Furniture	1.006	0.627	570

3.C Further results and robustness checks

Exporter wage premium and rent-sharing: direct effects. Table 3.C.1 reports the results of estimating equation (3.1) without including the interaction effect.

Differential effects according to skill-type. To check whether the wage imputation for workers beyond the social security income threshold matters for our results, we run regressions separately for blue and white collar workers. Wage censoring is not an issue for blue collar workers whose income is almost always below the censoring ceiling. Results are reported in Tables 3.C.2 and 3.C.3. The interaction is significant only for plants that set wages collectively and the magnitude of rent-sharing is lower for blue than for white collar workers. Regressions based on the sample of white collar workers confirm the results from the benchmark regressions that also include spell-fixed effects. Again this could be driven by the wage censoring that results in a more compressed wage profile around the wage ceiling.

Firm-level versus industry-level agreements. Tables 3.C.4 and 3.C.5 report results for different levels of bargaining regimes. Regressions reported in the first panel include the export-share as openness measure, whereas industry-level openness was used in the lower panel. Columns (1)–(3) in each panel focus on plants that indicate the use of firm-level collective agreements, whereas columns (4)–(6) in each panel are based on the subsample of centralized collective bargaining plants. All regressions still reveal a positive relationship between plant profitability and wages paid to the workers. Additionally, the export-share and the interaction between export-share and the plant-level profitability measure are negative and significant for OLS and random-effects.

Cross-check for representativeness of our results. We rerun all of our key regressions using cross-sectional weights in order to check for representativeness of our data. Results are reported in Table 3.C.6. Columns (1) to (3) replicate the key pooled OLS results reported in Table 3.1, column (1), and column (1) and column (4) in the upper panel of Table 3.2. Coefficients obtained from the weighted regressions have the same signs and level of significance but all coefficients are slightly lower in the weighted regressions.

Additional differential bargaining regime results. The following tables report results where we run regression setups separately for collective and non-collective bargaining plants. Table 3.C.7 displays the results for the direct effects for completeness. Table 3.C.8 and 3.C.9 report results that include interaction terms between the export share and the collective bargaining dummy or interaction terms between total factor productivity and the collective bargaining dummy. We are concerned about the fact that the export intensity reveals little variation over time. We therefore focus on the results discussed in the paper, where we do the same for plants that report significant changes in their export behavior.

Table 3.C.1: The export wage-premium and the role of TFP

Dependent variable: Logarithm of individual daily wage						
	(1) OLS	(2) Spell FE	(3) OLS	(4) Spell FE	(5) OLS	(6) Spell FE
Exports (share of total sales)	0.043***	–0.016			0.049***	0.001
	(0.014)	(0.018)			(0.014)	(0.016)
TFP (ln)			0.025**	0.011***	0.026***	0.011***
			(0.010)	(0.003)	(0.009)	(0.004)
Employment (ln)	0.027***	0.024	0.028***	0.033	0.026***	0.033
	(0.004)	(0.025)	(0.004)	(0.026)	(0.004)	(0.026)
Capital intensity (ln)	0.024***	0.033	0.026***	0.045**	0.024***	0.045**
	(0.004)	(0.020)	(0.004)	(0.020)	(0.004)	(0.020)
Female workers (share)	–0.334***	–0.072**	–0.322***	–0.069**	–0.319***	–0.068**
	(0.027)	(0.033)	(0.026)	(0.032)	(0.026)	(0.032)
Part-time workers (share)	–0.063	0.059	–0.068	0.047	–0.067	0.047
	(0.061)	(0.056)	(0.055)	(0.062)	(0.055)	(0.062)
Worker council (dummy)	0.103***	0.003	0.100***	0.002	0.098***	0.002
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Age (years)	0.025***	0.027***	0.025***	0.027***	0.025***	0.027***
	(0.001)	(0.006)	(0.001)	(0.006)	(0.001)	(0.006)
$Age^2/100$	–0.026***	–0.035***	–0.026***	–0.034***	–0.026***	–0.034***
	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)	(0.005)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000*	–0.000***	–0.000*	–0.000***	–0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.120***	0.004	0.120***	0.000	0.120***	0.000
	(0.004)	(0.007)	(0.004)	(0.006)	(0.004)	(0.006)
High-skilled (dummy)	0.357***	0.072***	0.358***	0.059***	0.356***	0.059***
	(0.011)	(0.019)	(0.011)	(0.019)	(0.011)	(0.019)
White-collar (dummy)	0.257***	0.079***	0.256***	0.079***	0.256***	0.079***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)
CA, industry-level (dummy)	0.066***	–0.003	0.063***	–0.003	0.063***	–0.003
	(0.011)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
CA, firm-level (dummy)	0.043***	–0.006	0.046***	–0.006	0.047***	–0.007
	(0.013)	(0.011)	(0.012)	(0.011)	(0.012)	(0.011)
R^2	0.618	0.177	0.620	0.180	0.621	0.180
Plants	5040	5040	5040	5040	5040	5040
Observations	4658595	4658595	4658595	4658595	4658595	4658595

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.2: Subsample of blue-collar workers

Dependent variable: Logarithm of individual daily wage						
	Blue collar workers					
	Non-collective agreements			Collective agreements		
	OLS	Spell FE	Spell RE	OLS	Spell FE	Spell RE
TFP (ln)	0.073***	0.030***	0.042***	0.053***	0.030***	0.039***
	(0.010)	(0.010)	0.010)	(0.008)	(0.008)	(0.007)
Exports (share)	0.037	–0.205	–0.150	0.529***	0.269***	0.379***
	(0.230)	(0.233)	(0.202)	(0.132)	(0.093)	(0.082)
TFP × Exports	–0.007	0.022	0.016	–0.057***	–0.032***	–0.043***
	(0.028)	(0.030)	(0.025)	(0.016)	(0.011)	(0.010)
Employment (ln)	0.038***	0.070***	0.047***	0.026***	0.045	0.035***
	(0.006)	(0.026)	(0.006)	(0.004)	(0.033)	(0.004)
Capital intensity (ln)	0.030***	0.051***	0.034***	0.024***	0.031	0.024***
	(0.004)	(0.019)	(0.005)	(0.004)	(0.027)	(0.004)
Female workers (share)	–0.392***	–0.019	–0.245***	–0.424***	–0.111***	–0.338***
	(0.030)	(0.037)	(0.030)	(0.036)	(0.042)	(0.029)
Part-time workers (share)	0.116	0.063*	0.034	0.058	0.132**	0.072
	(0.092)	(0.036)	(0.039)	(0.069)	(0.065)	(0.047)
Worker council (dummy)	0.051***	–0.039**	0.008	0.064***	0.010	0.034***
	(0.012)	(0.018)	(0.013)	(0.012)	(0.012)	(0.007)
Age (years)	0.018***	0.003	0.020***	0.015***	0.027***	0.021***
	(0.001)	(0.008)	(0.002)	(0.001)	(0.006)	(0.002)
$Age^2/100$	–0.021***	–0.023***	–0.025***	–0.017***	–0.029***	–0.025***
	(0.001)	(0.007)	(0.003)	(0.001)	(0.006)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000	–0.000***	–0.000***	–0.000	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.139***	0.010	0.132***	0.109***	0.002	0.086***
	(0.010)	(0.013)	(0.011)	(0.003)	(0.006)	(0.010)
High-skilled (dummy)	0.334***	0.015	0.282***	0.218***	0.004	0.160***
	(0.018)	(0.053)	(0.021)	(0.014)	(0.013)	(0.021)
R^2	0.536	0.118		0.493	0.188	
Plants	2512	2512	2512	3238	3238	3238
Observations	344930	344930	344930	2692308	2692308	2692308

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.3: Subsample of white-collar workers

Dependent variable: Logarithm of individual daily wage						
	White collar workers					
	Non-collective agreements			Collective agreements		
	OLS	Spell FE	Spell RE	OLS	Spell FE	Spell RE
TFP (ln)	0.104***	0.028***	0.049***	0.082***	0.020***	0.044***
	(0.011)	(0.011)	(0.010)	(0.010)	(0.008)	(0.007)
Exports (share)	0.854***	0.022	0.297**	0.974***	0.175**	0.482***
	(0.220)	(0.136)	(0.126)	(0.129)	(0.084)	(0.086)
TFP × Exports	–0.103***	–0.007	–0.038**	–0.110***	–0.020**	–0.055***
	(0.027)	(0.017)	(0.016)	(0.016)	(0.010)	(0.010)
Employment (ln)	0.063***	0.090***	0.073***	0.019***	0.023	0.024***
	(0.005)	(0.024)	(0.006)	(0.004)	(0.026)	(0.004)
Capital intensity (ln)	0.032***	0.048***	0.037***	0.024***	0.045**	0.027***
	(0.005)	(0.019)	(0.006)	(0.004)	(0.023)	(0.005)
Female workers (share)	–0.160***	–0.004	–0.092***	–0.114***	–0.057	–0.108***
	(0.036)	(0.032)	(0.027)	(0.033)	(0.041)	(0.032)
Part-time workers (share)	–0.186***	0.036	–0.095**	–0.225**	–0.064	–0.114**
	(0.058)	(0.036)	(0.047)	(0.094)	(0.087)	(0.054)
Worker council (dummy)	0.036***	–0.010	0.012	0.154***	0.000	0.090***
	(0.013)	(0.015)	(0.012)	(0.019)	(0.008)	(0.016)
Age (years)	0.053***	–0.033*	0.053***	0.061***	0.055***	0.065***
	(0.002)	(0.017)	(0.002)	(0.001)	(0.008)	(0.002)
Age^2/100	–0.052***	–0.048***	–0.052***	–0.058***	–0.061***	–0.063***
	(0.002)	(0.006)	(0.003)	(0.001)	(0.006)	(0.002)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure^2/100	–0.000***	–0.000	–0.000**	–0.000***	–0.000	–0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.109***	0.014	0.099***	0.108***	0.046***	0.109***
	(0.018)	(0.018)	(0.016)	(0.016)	(0.010)	(0.017)
High-skilled (dummy)	0.376***	0.039	0.353***	0.322***	0.065***	0.316***
	(0.018)	(0.030)	(0.016)	(0.020)	(0.021)	(0.024)
R^2	0.477	0.168		0.479	0.212	
Plants	2246	2246	2246	3046	3046	3046
Observations	146898	146898	146898	1474459	1474459	1474459

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.4: Firm- vs. industry-level agreements, firm-level openness

Dependent variable: Logarithm of individual daily wage						
	Firm-level agreement			Industry-level agreement		
	OLS	Spell FE	Spell RE	OLS	Spell FE	Spell RE
TFP (ln)	0.068***	0.019**	0.039***	0.055***	0.032***	0.043***
	(0.013)	(0.010)	(0.009)	(0.009)	(0.010)	(0.008)
Exports (share)	0.789***	0.129	0.399***	0.347**	0.186	0.248**
	(0.157)	(0.142)	(0.113)	(0.164)	(0.135)	(0.123)
TFP × Exports	–0.089***	–0.017	–0.047***	–0.037*	–0.022	–0.029**
	(0.018)	(0.015)	(0.012)	(0.020)	(0.016)	(0.015)
Employment (ln)	0.044***	0.023	0.046***	0.020***	0.029	0.027***
	(0.004)	(0.034)	(0.005)	(0.004)	(0.033)	(0.005)
Capital intensity (ln)	0.031***	0.025	0.034***	0.024***	0.044	0.026***
	(0.005)	(0.031)	(0.006)	(0.005)	(0.031)	(0.005)
Female workers (share)	–0.374***	–0.005	–0.287***	–0.325***	–0.113**	–0.261***
	(0.055)	(0.074)	(0.046)	(0.034)	(0.051)	(0.031)
Part-time workers (share)	–0.076	–0.027	–0.093	–0.019	0.049	0.026
	(0.101)	(0.109)	(0.074)	(0.066)	(0.102)	(0.052)
Worker council (dummy)	0.058***	–0.011	0.049***	0.092***	0.011	0.048***
	(0.020)	(0.017)	(0.017)	(0.014)	(0.012)	(0.009)
Age (years)	0.023***	0.000	0.025***	0.026***	0.031***	0.031***
	(0.001)	(0.013)	(0.004)	(0.001)	(0.006)	(0.002)
$Age^2/100$	–0.024***	–0.020*	–0.026***	–0.025***	–0.036***	–0.031***
	(0.001)	(0.011)	(0.004)	(0.001)	(0.006)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000*	–0.000**	–0.000***	–0.000	–0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.109***	–0.005	0.050***	0.122***	0.003	0.117***
	(0.006)	(0.011)	(0.018)	(0.004)	(0.008)	(0.006)
High-skilled (dummy)	0.298***	0.022	0.224***	0.360***	0.109***	0.383***
	(0.028)	(0.020)	(0.055)	(0.010)	(0.015)	(0.012)
White-collar (dummy)	0.280***	0.060**	0.245***	0.251***	0.077***	0.209***
	(0.016)	(0.023)	(0.006)	(0.008)	(0.010)	(0.009)
R^2	0.685	0.156		0.584	0.206	
Plants	845	845	845	2804	2804	2804
Observations	654761	654761	654761	3512006	3512006	3512006

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.5: Firm- vs. industry-level agreements, industry-level openness

Dependent variable: Logarithm of individual daily wage						
	Firm-level agreement			Industry-level agreement		
	OLS	Spell FE	Spell RE	OLS	Spell FE	Spell RE
TFP (ln)	0.109***	0.033	0.070*	0.075***	0.041*	0.050***
	(0.034)	(0.034)	(0.038)	(0.015)	(0.021)	(0.016)
Openness	0.072***	0.032	0.050*	0.032	0.024	0.023
	(0.024)	(0.032)	(0.030)	(0.019)	(0.021)	(0.020)
Openness × TFP	–0.005***	–0.001	–0.003*	–0.003**	–0.001	–0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Employment (ln)	0.049***	0.039	0.047***	0.021**	0.026	0.027***
	(0.005)	(0.039)	(0.003)	(0.007)	(0.035)	(0.006)
Capital intensity (ln)	0.031***	0.033	0.033***	0.024***	0.041	0.026***
	(0.005)	(0.034)	(0.008)	(0.005)	(0.038)	(0.004)
Female workers (share)	–0.369***	–0.028	–0.292***	–0.323***	–0.123	–0.263***
	(0.066)	(0.090)	(0.068)	(0.041)	(0.101)	(0.046)
Part-time workers (share)	–0.120	–0.102	–0.155*	–0.028	0.049	0.021
	(0.113)	(0.090)	(0.091)	(0.075)	(0.123)	(0.086)
Worker council (dummy)	0.071***	–0.010	0.052***	0.098***	0.011	0.050***
	(0.013)	(0.024)	(0.015)	(0.026)	(0.017)	(0.014)
Age (years)	0.023***	–0.001	0.024***	0.026***	0.030***	0.031***
	(0.001)	(0.014)	(0.004)	(0.003)	(0.006)	(0.003)
$Age^2/100$	–0.024***	–0.019**	–0.025***	–0.025***	–0.035***	–0.031***
	(0.001)	(0.009)	(0.004)	(0.003)	(0.006)	(0.004)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000*	–0.000**	–0.000***	–0.000*	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.109***	–0.005	0.050*	0.122***	0.002	0.117***
	(0.010)	(0.015)	(0.026)	(0.010)	(0.008)	(0.013)
High-skilled (dummy)	0.299***	0.020	0.223***	0.362***	0.107***	0.384***
	(0.034)	(0.021)	(0.070)	(0.015)	(0.021)	(0.015)
White-collar (dummy)	0.281***	0.059**	0.246***	0.250***	0.076***	0.208***
	(0.015)	(0.025)	(0.011)	(0.015)	(0.007)	(0.017)
R^2	0.684	0.160		0.584	0.210	
Plants	838	838	838	2790	2790	2790
Observations	654524	654524	654524	3510613	3510613	3510613

Notes: Standard errors in parentheses clustered at the industry level. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.6: (Un)weighted results

Dependent variable: Logarithm of individual daily wage						
	Unweighted			Cross-sectional plant-level weights		
	OLS	OLS	OLS	OLS	OLS	OLS
	All	CA=yes	CA=no	All	CA=yes	CA=no
TFP (ln)	0.071***	0.083***	0.066***	0.060***	0.059***	0.058***
	(0.007)	(0.010)	(0.008)	(0.006)	(0.011)	(0.007)
Exports (share)	0.773***	0.287	0.726***	0.372**	–0.181	0.448***
	(0.110)	(0.207)	(0.124)	(0.151)	(0.253)	(0.151)
Exports $\times$ TLP	–0.088***	–0.037	–0.081***	–0.044**	0.020	–0.052***
	(0.013)	(0.026)	(0.015)	(0.018)	(0.031)	(0.018)
R^2	0.621	0.590	0.597	0.554	0.504	0.543
Plants	5040	2626	3302	5040	2626	3302
Observations	4658595	491828	4166767	4658595	491828	4166767

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Controls included but not reported are age, age squared, tenure, tenure squared, medium-, high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and a dummy for the existence of a worker council. Additionally, all estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.7: The export wage-premium and the role of TFP by bargaining regime (I)

Dependent variable: Logarithm of individual daily wage						
	No collective agreement					
	OLS	**Spell FE**	**OLS**	**Spell FE**	**OLS**	**Spell FE**
Exports (share)	0.009	–0.033			–0.013	–0.034
	(0.022)	(0.027)			(0.020)	(0.027)
TFP (ln)			0.073***	0.033***	0.074***	0.033***
			(0.007)	(0.009)	(0.007)	(0.008)
R^2	0.579	0.113	0.590	0.125	0.590	0.126
Plants	2626	2626	2626	2626	2626	2626
Observations	491828	491828	491828	491828	491828	491828
	Collective agreement					
	OLS	**Spell FE**	**OLS**	**Spell FE**	**OLS**	**Spell FE**
Exports (share)	0.048***	–0.012			0.055***	0.005
	(0.015)	(0.019)			(0.015)	(0.016)
TFP (ln)			0.022**	0.010***	0.023***	0.010***
			(0.010)	(0.003)	(0.008)	(0.004)
R^2	0.592	0.188	0.593	0.191	0.595	0.191
Plants	3302	3302	3302	3302	3302	3302
Observations	4166767	4166767	4166767	4166767	4166767	4166767

Notes: Standard errors in parentheses clustered at the plant level in the upper panel and the industry level in the lower panel. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Controls included but not reported are age, age squared, tenure, tenure squared, medium-, high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and a dummy for the existence of a worker council. Additionally, all estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.8: The export wage-premium and the role of TFP by bargaining regime (II)

Dependent variable: Logarithm of individual daily wage				
	(1) **OLS**	**(2)** **Spell FE**	**(3)** **OLS**	**(4)** **Spell FE**
Exports (share)	0.063**	–0.006	0.046***	0.000
	(0.025)	(0.022)	(0.014)	(0.016)
TFP (ln)	0.026***	0.011***	0.082***	0.026***
	(0.009)	(0.004)	(0.009)	(0.006)
Coll. Agg. (dummy)	0.065***	–0.007	0.539***	0.120**
	(0.014)	(0.007)	(0.090)	(0.055)
Coll. Agg. × Exports	–0.015	0.008		
	(0.026)	(0.025)		
Coll. Agg. × TFP			–0.060***	–0.016**
			(0.011)	(0.007)
R^2	0.621	0.180	0.622	0.181
Plants	5040	5040	5040	5040
Observations	4658595	4658595	4658595	4658595

Notes: Standard errors in parentheses clustered at the plant-level in (1)-(2) and at the industry-level in (3)-(4). ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Controls included but not reported are age, age squared, tenure, tenure squared, medium-, high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and dummies for the existence of a worker council. Additionally, all estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.C.9: The export wage-premium and the role of TFP by bargaining regime (III)

Dependent variable: Logarithm of individual daily wage				
	(1) **OLS**	**(2)** **Spell FE**	**(3)** **OLS**	**(4)** **Spell FE**
Exports (share)	–0.032	0.004	0.050***	0.001
	(0.021)	(0.023)	(0.014)	(0.016)
TFP (ln)	0.027***	0.011***	0.020**	0.012***
	(0.009)	(0.004)	(0.009)	(0.004)
Coll. Agg. × Exports	0.090***	–0.002		
	(0.020)	(0.026)		
Coll. Agg. × TFP			0.007***	–0.001
			(0.001)	(0.001)
R^2	0.620	0.180	0.620	0.180
Plants	5040	5040	5040	5040
Observations	4658595	4658595	4658595	4658595

Notes: Standard errors in parentheses clustered at the plant-level in (1)-(2) and at the industry-level in (3)-(4). ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Controls included but not reported are age, age squared, tenure, tenure squared, medium-, high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and dummies for the existence of a worker council. Additionally, all estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

3.D Detailed regression output tables

Table 3.D.1: Detailed output to Table 3.1

Dependent variable: Logarithm of individual daily wage				
	(1) **OLS**	**(2)** **Spell FE**	**(3)** **OLS**	**(4)** **Spell FE**
TFP (ln)	0.071***	0.029***	0.108***	0.053**
	(0.007)	(0.006)	(0.011)	(0.021)
Exports (share)	0.785***	0.243***		
	(0.111)	(0.074)		
TFP × Exports	–0.089***	–0.029***		
	(0.013)	(0.009)		
Sectoral trade openness (share)			0.056***	0.033
			(0.018)	(0.021)
TFP × Openness			–0.005***	–0.002**
			(0.001)	(0.001)
Employment (ln)	0.024***	0.029	0.025***	0.027
	(0.004)	(0.026)	(0.008)	(0.019)
Capital intensity (ln)	0.026***	0.041**	0.026***	0.040
	(0.004)	(0.020)	(0.004)	(0.023)
Female workers (share)	–0.323***	–0.068**	–0.313***	–0.073
	(0.026)	(0.032)	(0.039)	(0.065)
Part-time workers (share)	–0.017	0.051	–0.053	0.026
	(0.054)	(0.062)	(0.081)	(0.080)
Worker council (dummy)	0.088***	0.001	0.097***	0.002
	(0.010)	(0.010)	(0.010)	(0.007)
Age (years)	0.025***	0.027***	0.025***	0.026***
	(0.001)	(0.006)	(0.002)	(0.006)
$Age^2/100$	–0.025***	–0.034***	–0.025***	–0.033***
	(0.001)	(0.005)	(0.002)	(0.004)
Tenure (days)	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000*	–0.000***	–0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.120***	0.000	0.120***	0.002
	(0.004)	(0.006)	(0.010)	(0.008)
High-skilled (dummy)	0.357***	0.060***	0.358***	0.063**
	(0.011)	(0.020)	(0.022)	(0.028)
White-collar (dummy)	0.255***	0.079***	0.254***	0.078***
	(0.007)	(0.008)	(0.014)	(0.008)
CA, industry-level (dummy)	0.064***	–0.003	0.064***	–0.001
	(0.010)	(0.009)	(0.009)	(0.009)
CA, firm-level (dummy)	0.044***	–0.007	0.045***	–0.006
	(0.012)	(0.011)	(0.010)	(0.005)
R^2	0.623	0.181	0.622	0.188
Plants	5040	5040	5003	5003
Observations	4658595	4658595	4654547	4654547

Notes: Standard errors in parentheses clustered at the plant level in (1)–(2) and at the industry level in (3)–(4). ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.D.2: Detailed output to Table 3.2, upper panel

Dependent variable: Logarithm of individual daily wage						
	No collective agreement			Collective agreement		
	OLS	Spell FE	Spell RE	OLS	Spell FE	Spell RE
TFP (ln)	0.083***	0.031***	0.045***	0.066***	0.028***	0.041***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.007)
Exports (share)	0.287	–0.100	0.018	0.726***	0.244***	0.423***
	(0.207)	(0.183)	(0.164)	(0.124)	(0.088)	(0.079)
TFP × Exports	–0.037	0.008	–0.004	–0.081***	–0.029***	–0.049***
	(0.026)	(0.023)	(0.020)	(0.015)	(0.011)	(0.009)
Employment (ln)	0.044***	0.075***	0.054***	0.023***	0.028	0.031***
	(0.005)	(0.025)	(0.005)	(0.004)	(0.030)	(0.004)
Capital intensity (ln)	0.031***	0.050***	0.035***	0.025***	0.036	0.027***
	(0.004)	(0.018)	(0.005)	(0.004)	(0.026)	(0.005)
Female workers (share)	–0.344***	–0.015	–0.201***	–0.332***	–0.086**	–0.254***
	(0.029)	(0.035)	(0.028)	(0.031)	(0.042)	(0.028)
Part-time workers (share)	0.023	0.062*	–0.001	–0.024	0.050	0.019
	(0.079)	(0.034)	(0.038)	(0.069)	(0.083)	(0.045)
Worker council (dummy)	0.050***	–0.031*	0.009	0.088***	0.009	0.049***
	(0.011)	(0.017)	(0.013)	(0.012)	(0.011)	(0.008)
Age (years)	0.025***	–0.005	0.027***	0.025***	0.030***	0.030***
	(0.001)	(0.007)	(0.002)	(0.001)	(0.006)	(0.002)
$Age^2/100$	–0.027***	–0.029***	–0.029***	–0.025***	–0.034***	–0.031***
	(0.001)	(0.006)	(0.003)	(0.001)	(0.006)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000	–0.000***	–0.000***	–0.000*	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.147***	0.010	0.137***	0.119***	–0.001	0.100***
	(0.010)	(0.012)	(0.011)	(0.004)	(0.006)	(0.010)
High-skilled (dummy)	0.432***	0.052**	0.431***	0.351***	0.058***	0.351***
	(0.012)	(0.022)	(0.012)	(0.011)	(0.022)	(0.025)
White-collar (dummy)	0.239***	0.080***	0.206***	0.255***	0.077***	0.215***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)	(0.009)
R^2	0.590	0.126		0.597	0.192	
Plants	2626	2626	2626	3302	3302	3302
Observations	491828	491828	491828	4166767	4166767	4166767

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.D.3: Detailed output to Table 3.2, lower panel

Dependent variable: Logarithm of individual daily wage						
	No collective agreement			Collective agreement		
	OLS	Spell FE	Spell RE	OLS	Spell FE	Spell RE
TFP (ln)	0.101***	0.058	0.078**	0.104***	0.050**	0.073***
	(0.027)	(0.044)	(0.039)	(0.013)	(0.020)	(0.014)
Sectoral openness (share)	0.053	0.048	0.055	0.052**	0.030	0.039**
	(0.037)	(0.042)	(0.040)	(0.018)	(0.020)	(0.018)
TFP $\times$ openness	–0.003	–0.002	–0.003	–0.005***	–0.002**	–0.004***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Employment (ln)	0.043***	0.090***	0.054***	0.024***	0.025	0.031***
	(0.004)	(0.014)	(0.006)	(0.007)	(0.026)	(0.006)
Capital intensity (ln)	0.029***	0.058***	0.034***	0.025***	0.033	0.026***
	(0.004)	(0.013)	(0.006)	(0.005)	(0.028)	(0.004)
Female workers (share)	–0.343***	–0.010	–0.193***	–0.323***	–0.094	–0.252***
	(0.020)	(0.017)	(0.017)	(0.043)	(0.084)	(0.046)
Part-time workers (share)	0.013	0.040	–0.017	–0.052	0.024	–0.011
	(0.087)	(0.034)	(0.034)	(0.091)	(0.099)	(0.071)
Worker council (dummy)	0.051***	–0.028**	0.009	0.100***	0.009	0.051***
	(0.007)	(0.012)	(0.006)	(0.017)	(0.013)	(0.009)
Age (years)	0.024***	–0.003	0.027***	0.025***	0.029***	0.030***
	(0.002)	(0.008)	(0.002)	(0.003)	(0.007)	(0.002)
$Age^2/100$	–0.027***	–0.028***	–0.029***	–0.025***	–0.033***	–0.030***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.005)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000	–0.000***	–0.000***	–0.000***	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.148***	0.017*	0.139***	0.119***	0.001	0.101***
	(0.011)	(0.008)	(0.014)	(0.009)	(0.008)	(0.019)
High-skilled (dummy)	0.432***	0.065***	0.433***	0.353***	0.060*	0.352***
	(0.015)	(0.018)	(0.019)	(0.022)	(0.030)	(0.038)
White-collar (dummy)	0.240***	0.081***	0.204***	0.255***	0.076***	0.215***
	(0.014)	(0.007)	(0.011)	(0.014)	(0.007)	(0.015)
R^2	0.592	0.152		0.596	0.196	
Plants	2594	2594	2594	3284	3284	3284
Observations	489410	489410	489410	4165137	4165137	4165137

Notes: Standard errors in parentheses clustered at the industry level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 3.D.4: Detailed output to Table 3.3

Dependent variable: Logarithm of individual daily (first differences)						
	Collective agreements					
	No CA	CA	No CA	CA	CA	CA
BC and/or WC workers	All	All	All	All	BC	WC
Exports (dummy)	0.007**	–0.006*				
	(0.003)	(0.003)				
Export (share)			0.002	–0.018***	–0.020**	–0.013**
			(0.014)	(0.007)	(0.008)	(0.006)
Employment (ln)	0.045***	0.036***	0.044***	0.036***	0.048***	0.024***
	(0.012)	(0.007)	(0.012)	(0.007)	(0.009)	(0.008)
Female workers (share)	–0.024	0.004	–0.022	0.009	0.015	–0.000
	(0.024)	(0.023)	(0.025)	(0.022)	(0.027)	(0.021)
Part-time workers (share)	–0.038	–0.007	–0.038	–0.005	–0.020	0.019
	(0.024)	(0.035)	(0.025)	(0.035)	(0.038)	(0.040)
Worker council (dummy)	0.004	0.007	0.004	0.006	0.005	0.008
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
Tenure (days)	0.000*	0.000	0.000*	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^3/1000$	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
White-collar worker (dummy)	0.077***	0.045***	0.076***	0.045***		
	(0.014)	(0.006)	(0.014)	(0.006)		
Low-skilled worker (dummy)	–0.022	–0.046***	–0.022	–0.046***	0.016	–0.064***
	(0.021)	(0.015)	(0.021)	(0.015)	(0.014)	(0.021)
Medium-skilled worker (dummy)	–0.005	–0.037***	–0.005	–0.037***	0.019	–0.032**
	(0.015)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)
R^2	0.086	0.052	0.085	0.052	0.074	0.033
Plants	807	864	807	864	846	813
Observations	113854	747981	113854	747981	484942	263039

Notes: Standard errors in parentheses clustered at the plant level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. All estimations include a full set of region, sector, and time dummies. Constant estimated but not reported. All variables are in first differences. The sample only includes plants that switch their export status at least once during the entire period. Column (1) estimates the change of wages on the change of export dummy for non collective agreement plants. Column (2) includes collective agreement plants only. Columns (3) to (4) replicates columns (1) and (2) including the export share. Columns (5) to (6) replicates column (4) but for blue collar (BC) and white collar workers (WC) separately.

Chapter 4

International trade and the fair wage premium

4.1 Introduction

Do exporters really pay higher wages than non-exporting firms?[1] Bernard, Jensen, and Lawrence (1995); Bernard and Jensen (1999) sparked off a rapidly growing number of studies that raised this question for numerous countries. Most of those studies provide evidence that exporters pay higher average wages compared to domestic firms, even after controlling for firm size, capital intensity, industry affiliation, and firm-fixed effects. However, it is also well established that this premium decreases considerably once worker and workplace characteristics are accounted for (Schank, Schnabel, and Wagner, 2007). In this sense, the answer to the question posed above highly depends on the identification strategy. The common practice is to estimate wage premiums building on standard Mincer equations either at the employer or the employee level, and to account for observable characteristics and employer-, employee-, or spell-fixed effects. This approach, however, identifies the wage premium on the within variation of the data alone. One might argue that the export status or the export intensity exhibits a low variation over time, leading to imprecise estimates.

Based on this, a number of recent contributions also provide theoretical explanations for this stylized exporter wage premium. Imperfect labor markets together with rent sharing imply that workers in exporting firms can materialize some of the relative gains from exporting. In Egger, Egger, and Kreickemeier (2011), the rent-sharing mechanism is introduced by workers' fair-wage concerns. Workers may reduce their effort if the wage actually paid by their employers falls short of what they might consider to be the fair one. Therefore, profit-maximizing firms have an incentive to pay this fair wage in order to motivate their workers to invest full effort. Besides general elements, such as the expected average wage in the economy, fair wages also depend on the firm's "ability to pay", its operating profits. Loosely speaking, an exporter wage premium (conditional on productivity) arises as exporting firms increase their profits by extra business abroad.[2]

The aim of this paper is to provide empirical support for the"fair-wage exporter premium".[3] One particular feature of the fair-wage approach is that employers have their own incentive to pay higher wages than just the lowest wage possible.

1 This chapter is joint work together with Hans-Jörg Schmerer (IAB Nuremberg), compare Hauptmann and Schmerer (2013).

2 By now there are several other contributions with exporters paying higher wages than non-exporters, e.g. Egger and Kreickemeier (2009), Helpman, Itskhoki, and Redding (2010), Davis and Harrigan (2011), and Amiti and Davis (2012). However, heterogeneous firms and labor market imperfections do not always lead to a premium conditional on productivity. Furthermore, in Felbermayr, Prat, and Schmerer (2011), not even an unconditional premium arises.

3 The focus of this paper is on the particular channel of fair wages and does not deny the existence of other channels.

Using German plant-level data, we propose a new identification strategy based on voluntary payments above the agreed wage floor for employers subject to collective agreements.[4] Germany is the ideal laboratory for such an experiment, due to its high collective agreement coverage. The bargained wage between the employer (or employer's association) and the union constitutes a wage floor, which is legally binding from below. Employers, however, are always allowed to make their employees better off in terms of for example wages (*Günstigkeitsprinzip*). Roughly 50% of the unionized plants indicate payments above the union wage floor.

Our test is based on the IAB establishment panel, a survey of German plants that employ at least one employee subject to social security contributions. The data set contains information about plant size, revenues, input of intermediates, and the international interdependency as measured by the share of revenues generated through exports of goods to foreign markets.[5] For more information, see Fischer, Janik, Müller, and Schmucker (2009) and Kölling (2000). The plants' capital stock is constructed using the perpetual inventory method as proposed by Müller (2008, 2010). We merge industry-level STAN data on U.S. global trade shares obtained from the OECD database in order to instrument plant export intensity. We focus on the period between 1996 and 2007, because 1996 was the first year Eastern Germany was included in the survey. Furthermore, we restrict the sample to plants in manufacturing industries. Summary statistics of our estimation sample are provided in Table 4.1.

Table 4.1: Summary statistics–estimation sample

	Mean	Std.Dev.
Wage drift (in percent)	5.807	7.028
Exports (percent of total sales)	18.804	24.059
Employment (ln)	4.228	1.881
Capital (ln)	14.883	2.530
Labor productivity (ln)	10.865	0.738
Part-time workers (share)	0.082	0.117
Short-time workers (share)	0.034	0.057
Female workers (share)	0.262	0.204
West-Germany (dummy)	0.653	0.475
IT investment (dummy)	0.644	0.364
Transport investment (dummy)	0.310	0.341
Global US trade share	10.554	3.714

4 Focusing on the wage drift inevitably shifts the focus towards larger firms.

5 Unfortunately we only observe exports in general, and therefore we cannot distinguish between different export destinations.

Besides this rich set of plant characteristics, the data cover detailed information on whether plants are subject to firm-level or industry-level collective agreements. Even more important, we know whether the firm pays more than the union wage rate, and by how much.[6] Thus, we can circumvent the standard fixed-effects approach and exploit the information made available by the plants directly.

An important contribution of the present paper is the way we address endogeneity. Our instrumental variable (IV) approach allows us to interpret the derived exporter wage premium as a causal relationship between the export intensity and the wage nexus. We use the industry-level export share for the U.S. to instrument the plant's export intensity. At the plant level we also include the average investment in IT and transportation equipment. Purging the data from the simultaneity bias increases the magnitude of the exporter wage premium closer to the numbers obtained from the structural estimation in Egger, Egger, and Kreickemeier (2011).

4.2 Econometric specification and data

To identify whether exporting plants are more inclined towards paying higher wages than the collectively agreed wage floor, we estimate

$$WD_i = \alpha + \lambda EXP_i + \beta X_i + \epsilon_i, \tag{4.1}$$

where WD_i denotes the wage drift of plant i measured in percentage above the collectively agreed wage. Our choice of this dependent variable restricts the sample to plants subject to collective agreements. Coefficient α is the estimated constant, EXP_i denotes export intensity measured in percentage of total revenues, and the vector X_i comprises various plant controls. The analysis will be carried out at the cross-sectional plant level to account for the missing values in the dependent variable within entire waves.[7]

It can be argued that neither the export intensity nor the wage drift measures exhibit enough variation over time. This raises the question whether the application of estimators that rely on the within variation of the data is appropriate. The exclusion of fixed-effect controls, however, gives rise to potential endogeneity concerns. We use an IV regression approach in order to purge the simultaneity bias from the regressions. Our preferred instruments are the U.S. industry openness and investment dummies. Due to its outstanding relevance for German exporters, we

6 The question utilized in our analysis is: "... please approximate the percentage rate by which the salaries and wages paid by your company exceed the collectively agreed scale?".

7 We generate mean values for all variables included in the regression.

expect the plant-level export intensity to be highly correlated with U.S. openness at the industry level. On the other hand, there should be no direct link between the U.S. openness and German wages, so the instrument should be orthogonal to the dependent variable. We also include the share of IT investments and investment in transport and equipment as instruments. Firms that export more likely have higher investments into communication and transportation equipment for a better handling of transactions across borders. Both investment shares are highly correlated with the export intensity, but there are no obvious reasons for a direct link to abovetariff payments. These additional instruments allow us to run a Hansen test of overidentification.

To account for the fact that our dependent variable is truncated from below, we use corner-solution (IV-)Tobit models. Indeed, a substantial number of plants report zero wage drift, which may bias our results.

4.3 Main results

Table 4.1 summarizes the regression coefficients of the variable of interest, the export intensity. Results are obtained from different model setups. The coefficients are significant and positive in the majority of regression setups, thereby indicating a positive exporter (fair) wage premium. In the upper panel, the results obtained from standard OLS in columns (1)–(3) indicate a relatively small exporter wage premium close to the results reported based on matched employer–employee data (see Schank, Schnabel, and Wagner, 2007; Klein, Moser, and Urban, 2010). Including labor productivity in column (2) only slightly reduces the magnitude of the effect. It rather indicates that the reported wage drift is more than a pure productivity premium. Specification (3) adds a West Germany dummy. All specifications also include control variables for employment, capital, as well as several workforce characteristics such as the share of female, short-time and part-time workers. Only the inclusion of the West Germany dummy yields insignificant results for the export share.

Next, the effect might be downward biased due to a general wage restraint policy after the year 2000. Wages were stagnant, but the export intensity increased, so the true exporter wage premium is underestimated in our cross-sectional regressions. Regression (4)–(6) treat export intensity as endogenous by constructing an exogenous export intensity in the first stage, based on the U.S. openness and the IT plant investment dummy. The first-stage R-squared and the first-stage F-statistic do not reject the validity of the instruments according to the Stock–Yogo critical values for the test on weak identification. The first-stage F-statistics are all higher than the critical thresholds. To test the validity of our instruments, we include a second instrument to run the Hansen test. The test does not reject the null hypothesis that the instruments are valid. The results are robust against variations in the model setup.

Table 4.2: Regression output

Dependent variable: Payment above union wage floor (in percent)						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Panel A: Whole sample including plants with at least one observation						
	OLS	OLS	OLS	IV	IV	IV
Exports (percent of total sales)	0.018***	0.014***	0.005	0.141***	0.133***	0.131***
	(0.005)	(0.005)	(0.005)	(0.041)	(0.047)	(0.047)
	Tobit	Tobit	Tobit	IV-Tobit	IV-Tobit	IV-Tobit
Exports (percent of total sales)	0.017***	0.012***	0.001	0.126***	0.113***	0.112***
	(0.005)	(0.005)	(0.005)	(0.037)	(0.042)	(0.043)
Labor productivity	.	×	×	.	×	×
West Germany dummy	.	.	×	.	.	×
Hansen J-statistic	.	.	.	0.116	0.136	0.094
Kleibergen-Paap Wald F-statistic	.	.	.	44.34	38.665	38.429
Panel B: Sample including plants with at least three observations						
	OLS	OLS	OLS	IV	IV	IV
Exports (percent of total sales)	0.018***	0.014**	0.006	0.118***	0.108**	0.115**
	(0.006)	(0.006)	(0.006)	(0.042)	(0.050)	(0.049)
	Tobit	Tobit	Tobit	IV-Tobit	IV-Tobit	IV-Tobit
Exports (percent of total sales)	0.016***	0.012**	0.002	0.100***	0.084*	0.095**
	(0.005)	(0.005)	(0.005)	(0.038)	(0.044)	(0.046)
Labor productivity	.	×	×	.	×	×
West Germany dummy	.	.	×	.	.	×
Hansen J-statistic	.	.	.	0.135	0.147	0.072
Kleibergen-Paap Wald F-statistic	.	.	.	44.576	37.919	38.298

Notes: Robust standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Plants subject to collective agreements only. Observations collapsed over time to the cross sectional establishment level. Only the variable of interest reported. Controls for size, capital, share of part-time, short-term, and female workers included in all regressions. Export intensity is instrumented by transport expansion investment dummy, IT expansion investment dummy, and U.S. industry-level openness in (4) to (6) employing 2sls IV and IV-TOBIT estimators. Marginal effects reported only. First-stage test statistics are obtained from the 2sls estimation. The upper panel includes all plants that report the wage drift at least once during the whole sample period (4179 observations), the lower panel includes plants that report the wage drift at least three times during the whole sample period (3562 observations). The detailed regression output is reported in the Appendix.

Starting with a more parsimonious setup in column (4) that excludes labor productivity and the West Germany dummy, we obtain a 14% premium over the whole distribution of export intensity that goes from 0 to 100. The additional inclusion of labor productivity in column (5) reduces the magnitude of the effect by 0.8% points. Specification (6) differs by controlling for the general location of the plant. Generally speaking, wages in West Germany are higher, which does not necessarily affect the export intensity to wage drift nexus. All coefficients of the export share are significant.

Coefficients reported in the second row account for the cornersolution problem by re-estimating the models reported in the first row using Tobit and IV-Tobit regressions. The coefficients reported are marginal effects, and thus are comparable to the results reported in the first row. The coefficients reveal qualitatively the same results, albeit the magnitude of the effect appears to be slightly weaker, especially in the IV regressions.

Results in the upper panel are obtained by collapsing the data over the time dimension without accounting for the fact that our panel is unbalanced. Coefficients reported in the lower panel are based on a sample that excludes outliers by restricting the sample to plants that report the wage drift at least three times. The results are robust, but the point estimates based on the restricted sample are lower in magnitude.[8]

4.4 Conclusion

Our analysis of the exporter wage determination yields several interesting insights. (i) Besides paying higher average wages, exporters are also more likely to pay above an agreed union wage floor. With some qualifications, these payments are voluntary, and therefore consistent with certain fair-wage considerations. (ii) Also, in magnitude, the estimates support the findings documented in the structural model of Egger, Egger, and Kreickemeier (2011). (ii) The advantage of our approach is that the identification strategy does not rely on the relatively low variance of the wage drift over time. Taking into account the lower wage bound of plants, we can base the analysis on cross-sectional data. (iii) The results are robust to several specifications. In particular, the inclusion of productivity and workforce characteristics does not alter the results, which is in favor of the fair-wage hypothesis.

8 Detailed regression output tables including further robustness checks are available in the Appendix.

Appendix

4.A Detailed estimation results of Table 4.1

Table 4.A.1: Detailed results of row 1 in Table 4.1

Dependent variable: Payment above union wage floor in percent						
	(1) OLS	**(2) OLS**	**(3) OLS**	**(4) IV**	**(5) IV**	**(6) IV**
Exports (percent of total sales)	0.018***	0.014***	0.005	0.141***	0.133***	0.131***
	(0.005)	(0.005)	(0.005)	(0.041)	(0.047)	(0.047)
Employment (ln)	–0.122	–0.042	–0.230**	–0.714***	–0.645**	–0.839***
	(0.123)	(0.121)	(0.117)	(0.219)	(0.261)	(0.250)
Capital (ln)	0.460***	0.332***	0.257***	0.248**	0.200**	0.128
	(0.086)	(0.094)	(0.090)	(0.112)	(0.101)	(0.097)
Part-time workers (share)	2.487**	2.545***	–2.754***	2.894***	2.900***	–1.707*
	(0.975)	(0.970)	(0.914)	(1.031)	(1.024)	(1.032)
Short-time workers (share)	–5.380***	–4.517**	–3.076	–3.951**	–3.627*	–2.326
	(1.979)	(2.023)	(1.887)	(1.983)	(1.985)	(1.884)
Female workers (share)	–1.832***	–1.409**	–0.248	–1.312**	–1.144*	–0.117
	(0.564)	(0.584)	(0.558)	(0.605)	(0.605)	(0.587)
Labor productivity (ln)		0.908***	0.374*		0.421	–0.069
		(0.217)	(0.220)		(0.363)	(0.347)
West-Germany (dummy)			4.450***			3.884***
			(0.218)			(0.273)
Observations	4,179	4,179	4,179	4,179	4,179	4,179
R^2	0.032	0.040	0.114	–0.092	–0.074	–0.013
R^2 uncentered				0.351	0.362	0.398
Hansen J statistic				0.116	0.136	0.094
Kleibergen-Paap Wald F-statistic				44.340	38.665	38.429

Notes: Robust standard errors in parentheses. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. Observations collapsed to the establishment level. Export intensity is instrumented by transport expansion investment dummy, IT expansion investment dummy, and U.S. industry-level openness in (4) to (6) employing a 2sls IV estimator. Constant estimated but not reported.

Table 4.A.2: Detailed results of row 2 in Table 4.1

Dependent variable: Payment above union wage floor in percent						
	(1) TOBIT	**(2) TOBIT**	**(3) TOBIT**	**(4) IV-TOBIT**	**(5) IV-TOBIT**	**(6) IV-TOBIT**
Exports (percent of total sales)	0.017***	0.012***	0.001	0.126***	0.113***	0.112***
	(0.005)	(0.005)	(0.005)	(0.037)	(0.042)	(0.043)
Employment (ln)	–0.021	0.072	–0.187	–0.541***	–0.439*	–0.721***
	(0.122)	(0.120)	(0.116)	(0.202)	(0.232)	(0.233)
Capital (ln)	0.505***	0.357***	0.289***	0.310***	0.241**	0.171*
	(0.086)	(0.092)	(0.088)	(0.104)	(0.097)	(0.094)
Part-time workers (share)	3.181***	3.231***	–3.504***	3.522***	3.517***	–2.483**
	(1.103)	(1.097)	(1.044)	(1.138)	(1.133)	(1.108)
Short-time workers (share)	–6.556***	–5.734**	–4.145*	–5.157**	–4.851**	–3.338
	(2.286)	(2.328)	(2.166)	(2.207)	(2.245)	(2.092)
Female workers (share)	–1.818***	–1.332**	0.164	–1.336**	–1.094*	0.273
	(0.584)	(0.593)	(0.567)	(0.613)	(0.609)	(0.584)
Labor productivity (ln)		1.061***	0.427**		0.636**	0.029
		(0.185)	(0.190)		(0.283)	(0.286)
West-Germany (dummy)			5.550***			4.958***
			(0.256)			(0.283)
Observations	4,179	4,179	4,179	4,179	4,179	4,179

Notes: Robust standard errors in parentheses. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. Observations collapsed to the establishment level. Export intensity is instrumented by transport expansion investment dummy, IT expansion investment dummy, and U.S. industry-level openness in (4) to (6) employing a IV-TOBIT estimator. Marginal eects reported only. Constant estimated but not reported.

Table 4.A.3: Detailed results of row 3 in Table 4.1

Dependent variable: Payment above union wage floor in percent						
	(1) OLS	**(2) OLS**	**(3) OLS**	**(4) IV**	**(5) IV**	**(6) IV**
Exports (percent of total sales)	0.018***	0.014**	0.006	0.118***	0.108**	0.115**
	(0.006)	(0.006)	(0.006)	(0.042)	(0.050)	(0.049)
Employment (ln)	–0.130	–0.043	–0.264**	–0.593***	–0.510*	–0.776***
	(0.138)	(0.134)	(0.131)	(0.221)	(0.273)	(0.262)
Capital (ln)	0.490***	0.361***	0.318***	0.297**	0.241**	0.184*
	(0.094)	(0.104)	(0.101)	(0.123)	(0.109)	(0.107)
Part-time workers (share)	2.975***	3.045***	–2.426**	3.355***	3.365***	–1.523
	(1.045)	(1.045)	(0.984)	(1.087)	(1.082)	(1.089)
Short-time workers (share)	–5.341**	–4.400*	–3.081	–4.252*	–3.816	–2.543
	(2.333)	(2.381)	(2.179)	(2.310)	(2.324)	(2.168)
Female workers (share)	–2.107***	–1.719***	–0.418	–1.724***	–1.540**	–0.340
	(0.581)	(0.605)	(0.572)	(0.599)	(0.608)	(0.595)
Labor productivity (ln)		0.868***	0.325		0.478	–0.067
		(0.241)	(0.248)		(0.405)	(0.391)
West-Germany (dummy)			4.342***			3.917***
			(0.236)			(0.268)
Observations	3,562	3,562	3,562	3,562	3,562	3,562
R^2	0.037	0.044	0.115	–0.045	–0.027	0.022
R^2 uncentered				0.379	0.389	0.418
Hansen J statistic				0.135	0.147	0.072
Kleibergen-Paap Wald F-statistic				44.576	37.919	38.298

Notes: Robust standard errors in parentheses. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. Observations collapsed to the establishment level. Export intensity is instrumented by transport expansion investment dummy, IT expansion investment dummy, and U.S. industry-level openness in (4) to (6) employing a 2sls IV estimator. Constant estimated but not reported.

Table 4.A.4: Detailed results of row 4 in Table 4.1

Dependent variable: Payment above union wage floor in percent						
	(1) TOBIT	(2) TOBIT	(3) TOBIT	(4) IV-TOBIT	(5) IV-TOBIT	(6) IV-TOBIT
Exports (percent of total sales)	0.016***	0.012**	0.002	0.100***	0.084*	0.095**
	(0.005)	(0.005)	(0.005)	(0.038)	(0.044)	(0.046)
Employment (ln)	–0.024	0.079	–0.216*	–0.413**	–0.279	–0.650***
	(0.134)	(0.131)	(0.128)	(0.203)	(0.240)	(0.247)
Capital (ln)	0.535***	0.380***	0.351***	0.367***	0.284***	0.232**
	(0.094)	(0.100)	(0.098)	(0.113)	(0.105)	(0.104)
Part-time workers (share)	3.750***	3.813***	–3.081***	4.062***	4.054***	–2.233*
	(1.190)	(1.188)	(1.125)	(1.226)	(1.225)	(1.183)
Short-time workers (share)	–6.826**	–5.903**	–4.639*	–5.818**	–5.370**	–4.066*
	(2.673)	(2.717)	(2.450)	(2.589)	(2.641)	(2.380)
Female workers (share)	–2.131***	–1.653***	0.013	–1.786***	–1.502**	0.083
	(0.613)	(0.625)	(0.590)	(0.628)	(0.631)	(0.604)
Labor productivity (ln)		1.068***	0.429**		0.761**	0.087
		(0.200)	(0.208)		(0.308)	(0.319)
West-Germany (dummy)			5.397***			4.965***
			(0.278)			(0.299)
Observations	3,562	3,562	3,562	3,562	3,562	3,562

Notes: Robust standard errors in parentheses. ***, **, and * denote signicance at the 1, 5, and 10 percent levels, respectively. Observations collapsed to the establishment level. Export intensity is instrumented by transport expansion investment dummy, IT expansion investment dummy, and U.S. industry-level openness in (4) to (6) employing a IV-TOBIT estimator. Marginal eects reported only. Constant estimated but not reported.

Chapter 5

Wages, competitiveness and exports

5.1 Introduction

The recent surge of German exports is surrounded by a heated debate on the causes and consequences of this so-called "export miracle".[1] Opponents argue that Germany has enforced a series of policy reforms that have led to wage moderation and thus increased international competitiveness at the expense of its trading partners, especially within the Eurozone (cf. Lagarde, 2010).[2] While the broader political debate focused on the role of diverging unit labor costs for growing current account imbalances, the "export miracle" also provokes questions about the driving forces of export activity. It is commonly acknowledged that exporting firms are distinctly different from their non-exporting competitors. Bernard, Jensen, and Lawrence (1995) and Bernard and Jensen (1999) documented for the US manufacturing industry that exporting firms are larger, more productive and pay higher wages than their national counterparts.[3] The seminal work by Melitz (2003) provides a tractable theoretical model that is able to explain these stylized facts by allowing for firm heterogeneity due to firm-specific productivity levels. While there is broad empirical support for this mechanism,[4] the economic profession is surprisingly quiet about the role of competitiveness for sorting into exporting.

It is the purpose of this paper to fill this gap by investigating the role of unit labor costs as a measure of competitiveness for the export activity of German plants. Therefore, we construct a proxy for competitiveness that comprises both productivity and labor costs. Higher productivity and/or lower labor costs make plants more efficient, indicated by a higher level of competitiveness. Moreover, we argue that the export promoting effect of competitiveness may be driven at two different margins. A rise in competitiveness may increase the probability of a plant to switch from the sole domestic supply regime to the exporter regime (extensive margin), or it may be associated with a surge in the export intensity of already exporting plants (intensive margin). In our view, German plants are highly interesting for analyzing these questions mainly for two reasons. First, German firms and plants have been particularly active in exporting in the recent past. In the period 2000–2010, the German export volume has increased by about 60% and surpassed the level of one trillion Euro for the first time in 2012 (cf. Statistisches

1 This chapter is joint work together with Daniel Etzel (University Bayreuth) and Hans-Jörg Schmerer (IAB Nuremberg), compare Etzel, Hauptmann, and Schmerer (2013).

2 During an interview with the Financial Times, Lagarde stated: "The issue at hand is really one of competitiveness. Clearly Germany has done an awfully good job in the last 10 years or so, improving competitiveness, putting a very high pressure on its labor costs. When you look at unit labor costs to Germany, they have done a tremendous job in that respect. I'm not sure it is a sustainable model for the long term and for the whole of the group."

3 Similar results were found for other countries, like Germany (cf. Bernard and Wagner, 1997) and Taiwan (cf. Aw and Hwang, 1995).

4 For an excellent survey on this topic see e.g. Bernard, Jensen, Redding, and Schott (2011).

Bundesamt, 2012). Secondly, at the same time, a number of structural reforms has been initiated on the German labor market. It is therefore often argued that these labor market reforms have increased the competitiveness of German firms and plants on international markets relative to their competitors from abroad.

In the first step of our analysis, we construct two measures of competitiveness. We compute unit labor costs per plant based on the information in the IAB establishment panel. Similarly, we derive a measure of competitiveness at the sectoral level by using OECD STAN data. Our analysis is closely linked to two recent studies by Davis and Harrigan (2011) and Harrigan and Reshef (2011), who extend the Melitz framework by modeling sorting into export according to productivity and labor costs, both drawn from a joint distribution. We regress the export share of German plants on our two measures of competitiveness. Since our endogenous variable is a fractional variable with a probability mass at zero it is not appropriate to model this variable by OLS or a variant of it. This issue is extensively discussed in Papke and Wooldridge (1996) and has been applied to international trade by Wagner (2001). These papers suggest using a fractional Logit/Probit model. On the other hand, the existence of a corner solution problem suggests the use of a Tobit model. We chose to follow both approaches and compare the results, which are remarkably similar. Irrespective of the choice of model, our results show a positive and significant relationship between plant-level competitiveness and export activity. Plants that are characterized by lower unit labor costs relative to their average foreign competitors export more. To the best of our knowledge, our paper provides the first plant-level evidence on the role of both productivity and average wages as export determinants. Moreover, we use Tobit regressions in the spirit of Felbermayr and Kohler (2006), which allow us to decompose the total effect into its component effects at the extensive and intensive margins of trade. The Tobit model has the crucial advantage that both effects can be estimated simultaneously. Of course, the Tobit model is appropriate only if we believe that the data generating process is the same at both margins. Put differently, we are postulating that the forces that drive firms' exporting behavior at both margins are identical. Following this approach we are able to report robust evidence on the export-promoting effects of competitiveness at both margins. Our results show that an increase of plant-competitiveness by two standard deviations is associated with an approximately 4% higher probability of being an exporter at the extensive margin and a one percentage point higher export intensity at the intensive margin. The results are robust to different estimators. Our industry-level competitiveness is insignificant in all specifications and models. Measuring competitiveness in terms of low labor costs reveals a negative relationship. Low-wage firms tend to export less. This result is in line with a huge literature that demonstrates that exporters pay higher wages. Schank, Schnabel, and Wagner (2007) were the first to use matched employer–employee data in order to show that the exporter wage premium is of the residual type. Controlling for observed and unobserved worker characteristics, ceteris paribus they find that German exporters in manufacturing industries pay higher wages than plants that solely serve the domestic market. Klein, Moser, and Urban (2010) further distinguish between low- and high-skilled workers and show that the positive premium is mainly driven by a premium paid to the high-skilled, whereas the low-skilled even suffer from a wage discount. Including both plant-level competitiveness measures reveals that ignoring the relative wage payments leads to lower point estimates of the competitiveness measures. We find a much stronger link between competitiveness and exports when controlling for the exporter wage premium through our labor cost competitiveness measure.

As an additional exercise, we separate regressions into the pre- and post- Euro era. Our results show that competitiveness was indeed important only after the Euro was introduced in the year 1999, which is in line with the critique by Lagarde and the accompanying hypothesis of wage moderation driving export activity. In this perspective, our paper can be related to a recent work by Hogrefe, Jung, and Kohler (2012), who argue that the introduction of the Euro gave rise to currency misalignments. In line with their study we find at least weak evidence for interaction between the introduction of a common currency union, competitiveness and trade.

Finally, random effects Tobit regressions are used as a robustness test. The findings further support the importance of wages in determining sorting into exporting. Competitiveness turns out to be insignificant, but the negative link between wage competitiveness and exports is not affected. However, higher plant competitiveness significantly increases exports at both margins when average wages are included in the regression.

The remainder of the paper is organized as follows. Section 5.2 describes the data source and provides first descriptive evidence. Section 5.3 introduces the empirical strategy. The results are presented in Section 5.4. Section 5.5 concludes.

5.2 Data and first descriptives

The IAB establishment panel. Our main data source is the IAB establishment panel, which is a stratified annual sample that surveys about 16,000 German plants with at least one employee subject to social security contributions. We focus on manufacturing industries, where trade in goods is much more important compared to the service sector. East German plants were first surveyed in the 1996 wave so that we focus on the period 1996–2008.[5]

5 The panel comprises newer data that reach to the year, 2010 and it would be very interesting to exploit these, especially from the background of the financial and economic crisis. However, due to a structural break in the data, many of our control variables cannot be computed after 2008. Therefore, we decided to use the dataset only up to the year 2008.

Within each wave we have information about the share of revenues generated through exports. Unfortunately, we have only very little information about the destination of exports. More precise information would allow us to run gravity-like regressions at the plant level by taking distance into account.[6] However, we argue that most German trade is within Europe, where distance is less important.[7] Beside export intensity there is a large set of additional information, such as establishment size, measured as the total number of employees, revenue, usage of intermediate inputs and investments. This dataset is based on the needs of the German Federal Employment Agency, so that in addition it comprises a large set of workforce characteristic controls. For instance, information about the recognition of a collective agreement, the share of female, part-time, short-term or qualified employees is available or can be constructed. See Felbermayr, Hauptmann, and Schmerer (2012a) for a detailed discussion on the data used. More comprehensive information on the IAB establishment can be found in Fischer, Janik, Müller, and Schmucker (2009) and Kölling (2000).

There is no capital information in the data. We apply the perpetual inventory method proposed by Müller (2008, 2010) as a proxy. Based on the information about the amount and type of expansion investments by plant we construct proxies for the plant's capital stocks by summing over all periods. Type-specific depreciation rates are used as discount factors.

The industry-level data on labor costs, total value, and bilateral trade flows are taken from the STAN-database of the OECD.

First glimpse at the data. Figure 5.1 graphs the variables of interest over time. The left panel compares the share of exporters (extensive margin), the export intensity of exporting plants (intensive margin) and the average level of competitiveness in German manufacturing industries.[8] The latter measures the competitiveness of Germany relative to its trading partners through production costs per unit of output.[9] Hence, a lower index for competitiveness implies that Germany has a relative cost advantage compared to its trading partners. To make this more illustrative and intuitive we decided to use the inverse of the index so that a higher measure corresponds to higher competitiveness.

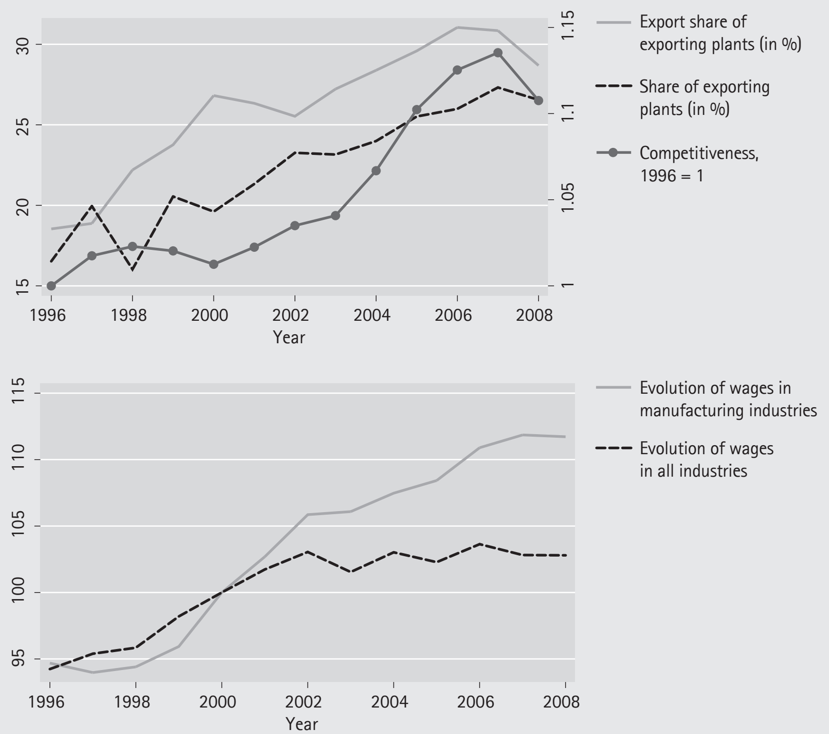
6 For some waves there is some limited information about export destinations. Schmillen (2011) shows how the broader information about two different areas can be used to construct distance proxies for the export destination for the IAB establishment panel. However, since it does not cover our whole sample period and consists of just three very broad regional categories, we do not utilize this measure.

7 The Federal Statistic Office of Germany reports that in 2012 almost 70% of exports of goods made in Germany were shipped to European countries. Asia and America rank second and third, far behind Europe.

8 All plant-level means are constructed using probability weights.

9 See the methodology section for more details on the construction of the index.

Figure 5.1: The evolution of exports, competitiveness, and wages



This first glimpse at the data reveals that the export intensity of German manufacturers and the relative cost advantage increased over time, as displayed in the left panel. Except for a short but sharp dip in the share of exporting plants in 1998, and a brief period of decreasing export intensity of exporting plants (2000–2002), both the extensive and intensive margins have risen in the period under consideration. The end of the timeline indicates a downturn in exports that is due to the beginning of the economic and financial crisis that sparked off in 2008. Despite the downturn, the export activity at both margins is still about 10 percentage points higher than in 1996. Our measure of competitiveness indicates no clear cost advantage for Germany until 2000. From then on, we first observe a moderate increase in competitiveness between 2000 and 2003 before German plants managed to push up their relative cost advantage more significantly. Interestingly, the emerging crisis seems to dampen the competitiveness of German plants relative to their foreign rivals.

The right panel plots average wages over time. Without making the distinction between manufacturing and non-manufacturing sectors, we find the well-known picture that wage growth in Germany was stagnant after 2000, which is often associated with "wage moderation". If we focus on the manufacturing industries, which are characterized by their high degree of export participation, we find a considerable increase in wages since 1998. Therefore, the picture at least challenges the proposed nexus between wage moderation and export status. Moreover, it also provokes the question how rising wages and increasing competitiveness fit together. Two potential explanations consistent with these stylized facts are an increase in labor productivity and/or soaring labor costs of Germany's trading partners.

5.3 Empirical strategy

Our empirical strategy is twofold. In a first step we construct various measures of competitiveness for Germany. We then regress the plant's export intensity on the competitiveness measures. We try to put as many plant controls as possible in order to account for the omitted variable bias. Different estimators are used to address potential concerns about unobserved heterogeneity and to decompose the overall effect into its components at different margins.

Measuring plant competitiveness. We construct plant-level competitiveness measures that allow us to relate a plant's unit labor costs to its international engagement through the variable

$$C_{it} = V_{it}/W_{it}, \tag{5.1}$$

where V_{it}/W_{it} measures plant i's value added over its wage sum at time t. In this sense, our competitiveness measure mirrors the inverse of nominal unit labor costs. Higher competitiveness may be due to higher productivity and/or lower labor costs. Hence, we also shed light on the role of wages on unit labor costs as further plant-level evidence in order to assess the role of wage moderation on competitiveness by running all regressions including the average plant wage or/and the unit labor costs. Higher export intensity may be positively correlated with the average plant wage as long as unit labor costs are falling. Firms that become more productive can pay higher wages but still have relatively low unit labor costs. We expect a negative relationship between unit labor costs and plant exports. The effect of wages and exports may go in both directions.

Measuring industry-competitiveness. We use data from the OECD STAN database to construct a proxy for Germany's international competitiveness at the industry level as

$$C_{jt} = \frac{V_{Djt}/W_{Djt}}{\sum_k a_{kjt}V_{kjt}/W_{kjt}}, \tag{5.2}$$

where W_{Djt}/V_{Djt} denotes real unit labor costs in industry j at time t in Germany (indicated by subscript D) computed as labor cost (W_{Djt}) over value added (V_{Djt}). The denominator in (5.2) is a sum of unit labor costs of Germany's trading partners, weighted by each partner's trade share a_{kjt}.[10] Competitiveness increases if German unit labor costs increase (decrease) less (more) compared to its trading partners' average unit labor costs. For the estimations we use the predetermined trade share from the 1995 wave for all waves. Thus, the weights are constant over all waves included in our study (1996–2008).

To estimate the export intensity and competitiveness nexus we run the following model

$$EXP_{it} = \alpha + C_{it}\gamma_1 + C_{jt}\gamma_2 + X_{it}\beta + \theta_j + \theta_t + \theta_r + \varepsilon_{it}, \tag{5.3}$$

where EXP_{it} is the export share of plant i in year t. C_{it} denotes our plantlevel competitiveness measure, C_{jt} is the competitiveness of plant i's industry j at time t, and X_{it} is a vector of plant characteristics. Finally, ε_{it} represents a stochastic error term. We always include controls for year-specific fixed effects, θ_t, industry-specific fixed effects, θ_j, and regional-specific fixed-effects, θ_r.

As suggested in Wagner (2001) and Wagner (2011), the preferred model is a fractional Probit/Logit estimator as proposed by Papke and Wooldridge (1996). Their major contribution was to establish an estimator that fits a distribution that accounts for the proportions 0 and 1.

Our sample contains both single- and multi-plant firms, which may cause problems with the export variable. It may well be that part of the production is indirectly exported through the firm rather than the plant. We tackle this issue by including only single-plant firms in the sample, which are the majority.

Exploring the intensive and extensive margins of German export success. Felbermayr and Kohler (2006) use a corner solutions approach in order to decompose the effect of distance on bilateral trade into its component effects at

10 The weights are constructed such that $a_{kjt} = T_{kjt}/\sum_k T_{kjt}$, where T_{kjt}, denotes the trade between Germany and its partner country k in industry j. The weights therefore sum up to unity.

the intensive and extensive margins.[11] They propose a Tobit regression approach which allows them to estimate both effects simultaneously. We employ the same estimator

$$\begin{cases} EXP^* & = x'\beta + u, \\ EXP & = \max(0, EXP^*). \end{cases}$$

The dependent variable takes the value zero with a certain probability $p(EXP = 0|x)$. Certain values above zero, observations for exporters, happen with zero probability. Put differently, the export intensity is partly continuous over a certain interval. The model can be estimated using a consistent maximum likelihood estimator

$$L(\beta) = \prod_{i=1}^{n} \left[P(EXP_i = 0)^{1-w_i} f(EXP_i|x_i, EXP_i > 0)^{w_i} \right], \tag{5.4}$$

where w_i is an indicator variable that takes the value one if $EXP > 0$. The solution to the maximization problem yields the coefficients β with the following interpretation

$$\frac{\partial E(EXP^*|x)}{\partial x} = \beta. \tag{5.5}$$

However, besides the partial derivatives on the "latent" variable EXP^* the non-linear estimates obtained from the maximization of equation (5.4) can be used to compute the effects at the extensive and intensive margin through

$$\underbrace{\frac{\partial P(EXP > 0|x)}{\partial x}}_{\text{Extensive}}, \underbrace{\frac{\partial E(EXP|x, EXP > 0)}{\partial x}}_{\text{Intensive}}, \underbrace{\frac{\partial E(EXP|x)}{\partial x}}_{\text{Total}}, \tag{5.6}$$

which can be predicted based upon the estimates obtained from solving 5.4.[12] All marginal effects are evaluated at the sample means. The effects at the intensive margin can be interpreted as the marginal effect of variable x on the expected export intensity of firms that already export. The effect at the extensive margin is the change in probability of becoming an exporter if x changes.

11 Galiani (2008) provides a comprehensive overview over the corner solutions approach and its implementation into Stata.

12 We use the Stata commands mfx compute, predict(p(0,.)), mfx compute, predict(e(0,.)), mfx compute, predict(ys(0,.)) in order to predict the marginal effects in Equation (5.6). See Galiani (2008) for more information.

The two-step approach: Probit. There is also a heated discussion about whether to use a two-step approach to estimate the sorting into export using a Probit model. Hence, we also rerun the empirical specification presented in Equation (5.3) based on a Probit model. A plant's export performance is measured by a dummy that takes the value one if the plant has a positive export share. However, the export intensity itself is not taken into account, so that the marginal effect of competitiveness gives us the change in the probability of being an exporter.

5.4 Results

Table 5.1 reports coefficients obtained from estimating (5.3), where both plant- and industry-level competitiveness are included. Plant-level competitiveness is included in logs in order to account for the non-linear relationship between unit labor costs and exports.[13] Coefficients are reported in the first row of Table 5.1. Overall, we find that firms that are more competitive due to lower unit labor costs export more. However, the magnitude of the effect changes with different models and the level of significance varies systematically over different samples. All coefficients reported are marginal effects.

The role of unit labor costs. As a first step we distinguish between a Fractional Probit (column 1) and a Fractional Logit estimator (column 2). The coefficients measure the total effect of competitiveness on exports so that a further decomposition into the effects at the extensive and intensive margins is not possible based on the Fractional Probit/Logit model. The descriptives in the appendix show that the standard deviation of plant competitiveness is approximately 0.7. Exploiting this information helps us to evaluate the magnitude of the effects. Competitiveness is measured in logs so that the 0.7 standard deviation translates into a 70% standard deviation from the mean in both directions. A two-standard deviation increase in competitiveness is associated with a 1.12 to 0.98% higher export intensity, depending on whether we assume a Probit or Logit distribution, reported in columns (1) and (2) respectively.[14]

However, the results may be biased due to the presence of a corner solution problem that plagues our dependent variable. Zero export intensity is observed at a positive probability, whereas a certain export intensity above zero has zero mass in a continuous distribution. Linear models yield biased results, which can be addressed using a simple Tobit regression approach.

13 The standard deviation of plant competitiveness in logs is 0.7, the minimum is around -7.57 and the maximum is around 3.335.

14 We compute the effect as $140 \times 0.007 = 0.98$.

The solution to the maximum likelihood function yields a one-step estimator for both the probability of being a corner solution (non-exporter) and the density of the export intensity conditional on our variables of interest. Co-efficients of the latent variable $EXP^* (\partial E(EXP^*|x)/\partial x = \beta)$ are omitted. The interpretation would be meaningless in our application.[15] The McDonald and Moffitt (1980) decomposition allows to compute the marginal effects for different regions of the non-linear Tobit regression results. At the extensive margin, we are interested in the effects of competitiveness on the probability of being an exporter, $\partial P(EXP > 0|x)/\partial x$, reported in column (3) as Tobit I. Coefficients are evaluated at the mean of all other regressors. At the intensive margin, we are mainly interested in the effects of competitiveness on the export intensity of plants that already export, $\partial E(EXP|x, EXP > 0)/\partial x$, reported in column (4) as Tobit II. Again, all marginal effects are evaluated at the sample means of all other regressors.

At the extensive margin we find that plants that increase their competitiveness relative to their "rival" by the same two standard deviations have a 4% higher probability of being an exporter. Conditional on already being an exporter, plants that increase their competitiveness by two standard deviations can increase their export intensity by one percentage point. The combined total effect at both margins (labeled TOBIT III) is reported in column (5). The same two standard deviation increase in plant-competitiveness is associated with an increase in exports of roughly 1.26 percentage points. This last coefficient is the counterpart to the coefficient reported in columns (1) and (2), where we used the Fractional Probit/Logit estimator to estimate the total effect of competitiveness on exports. It turns out that both the fractional models and the Tobit model yield results that are remarkably close to each other with coefficients between 0.008 and 0.01. Given the huge standard deviation of competitiveness, the difference between the coefficients is not significant.

The two-step Probit model results are reported in column (6). We basically obtain the same results as for the extensive margin results based on the Tobit regression which is reported in column (3). However, we still don't know whether this relationship is driven by wages or productivity. The effect is difficult to separate but we tackle this issue by comparing the effects with regression results that include additional wage measures.

15 Plants that report zero trade are non-exporters so that there is no latent trade variable as it is the case in the famous textbook example on expenditure and consumption.

Table 5.1: The extensive and intensive margin I

	(1) FRACP	(2) FRACL	(3) TOBIT I	(4) TOBIT II	(5) TOBIT III	(6) PROBIT
Plant-comp. (ln)	0.008*** (0.003)	0.007*** (0.002)	0.028*** (0.006)	0.007*** (0.001)	0.009*** (0.002)	0.027*** (0.010)
Industry-comp.	0.010 (0.025)	0.005 (0.023)	0.064 (0.081)	0.015 (0.019)	0.020 (0.025)	0.075 (0.095)
Employment (ln)	0.025*** (0.003)	0.022*** (0.003)	0.101*** (0.005)	0.024*** (0.001)	0.031*** (0.002)	0.137*** (0.012)
Capital (ln)	0.011*** (0.002)	0.010*** (0.002)	0.038*** (0.003)	0.009*** (0.001)	0.012*** (0.001)	0.040*** (0.007)
Female workers (share)	0.058*** (0.014)	0.054*** (0.013)	0.199*** (0.023)	0.047*** (0.005)	0.061*** (0.007)	0.234*** (0.050)
Part-time workers (share)	–0.082*** (0.020)	–0.086*** (0.018)	–0.239*** (0.031)	–0.056*** (0.007)	–0.073*** (0.010)	–0.224*** (0.063)
Short-term workers (share)	0.050** (0.024)	0.047** (0.021)	0.102* (0.052)	0.024* (0.012)	0.031* (0.016)	0.012 (0.080)
Apprentices (share)	–0.238*** (0.042)	–0.222*** (0.040)	–0.739*** (0.065)	–0.174*** (0.015)	–0.227*** (0.020)	–0.793*** (0.124)
Qualified tasks (share)	0.021** (0.010)	0.025*** (0.009)	0.045** (0.018)	0.011** (0.004)	0.014** (0.006)	–0.024 (0.035)
Multi-empl. barg. (dummy)	–0.024*** (0.005)	–0.021*** (0.004)	–0.097*** (0.009)	–0.023*** (0.002)	–0.029*** (0.003)	–0.127*** (0.018)
Single-empl. barg. (dummy)	–0.012** (0.006)	–0.010* (0.005)	–0.054*** (0.013)	–0.012*** (0.003)	–0.016*** (0.004)	–0.068*** (0.025)
Workers council (dummy)	0.028*** (0.007)	0.024*** (0.007)	0.099*** (0.011)	0.024*** (0.003)	0.032*** (0.004)	0.115*** (0.024)
West Germany (dummy)	0.012 (0.031)	0.010 (0.029)	0.026 (0.051)	0.006 (0.012)	0.008 (0.016)	–0.053 (0.088)
Foreign ownership (dummy)	0.094*** (0.013)	0.076*** (0.012)	0.251*** (0.016)	0.071*** (0.005)	0.098*** (0.008)	0.225*** (0.051)
Ownership n.a. (dummy)	0.019** (0.008)	0.016** (0.007)	0.081*** (0.017)	0.020*** (0.004)	0.026*** (0.006)	0.151*** (0.030)
Capital company (dummy)	0.025*** (0.006)	0.026*** (0.005)	0.098*** (0.011)	0.023*** (0.002)	0.029*** (0.003)	0.105*** (0.020)
Founded before 1990 (dummy)	–0.004 (0.006)	–0.002 (0.006)	–0.011 (0.009)	–0.003 (0.002)	–0.003 (0.003)	0.007 (0.022)
	18,620	18,620	18,620	18,620	18,620	18,620

Notes: Standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered at establishment-level in columns (1), (2) and (6). Bootstraped standard errors in columns (3)–(5) using 200 repetitions. Constant, year, industry, and regional dummies included in all models but not reported. All coefficients are marginal effects evaluated at the means of the other regressors. FRACP denotes fractional-probit, FRACL denotes fractional-logit estimator. TOBIT I reports $\partial P(T > 0|x)/\partial x$, TOBIT II reports $\partial E(T > 0|x)/\partial x$, TOBIT III reports $\partial E(T|x)/\partial x$. PROBIT denotes probit model with dependent variable equal to one if export share larger than zero. Only single plants included in the regressions.

The role of wages in determining competitiveness. As a second step, we analyze the role of wages for exports in Germany. Higher wages may reduce competitiveness through higher production costs. On the other hand, higher wages may be one of the crucial determinants of high quality. Both arguments have opposing effects on competitiveness but equally explain the observable surge in exports observed in Germany. We therefore analyze the role of wages and competitiveness separately by first including only the inverse average wage measure (Table 5.2) before we include both the wage and the unit labor costs variable into the same regression. The latter results are reported in Table 5.3. Note that we focus on the inverse wage rate, so that higher wages are associated with lower wage competitiveness. We compare the same models as before.

There is already a large literature on the exporter wage premium that states that exporting firms pay higher wages, which would be consistent with a negative sign of the competitiveness measure. The hypothesized wage moderation to export promotion effect would be validated by a positive sign of the wage competitiveness measure.

However, despite the higher labor costs, exporting firms may still be more efficient through their higher productivity. Our results confirm the hypothesized negative relationship. The export promoting effect of competitiveness reported in Table 5.1 hardly stems from the firms' low wage payments. On average, higher wages are associated with more intensified trade at both margins.

Table 5.2: The extensive and intensive margin II

	(1) FRACP	(2) FRACL	(3) TOBIT I	(4) TOBIT II	(5) TOBIT III	(6) PROBIT
Plant-comp. wage (ln)	–0.048*** (0.008)	–0.046*** (0.007)	–0.153*** (0.014)	–0.036*** (0.003)	–0.046*** (0.004)	–0.134*** (0.023)
Industry-comp.	0.007 (0.025)	–0.001 (0.022)	0.059 (0.072)	0.014 (0.017)	0.018 (0.022)	0.081 (0.095)
Employment (ln)	0.024*** (0.003)	0.020*** (0.003)	0.096*** (0.005)	0.022*** (0.001)	0.029*** (0.001)	0.131*** (0.012)
Capital (ln)	0.010*** (0.002)	0.008*** (0.002)	0.035*** (0.003)	0.008*** (0.001)	0.011*** (0.001)	0.036*** (0.007)
Female workers (share)	0.066*** (0.014)	0.063*** (0.013)	0.225*** (0.022)	0.053*** (0.005)	0.068*** (0.007)	0.256*** (0.050)
Part-time workers (share)	–0.050** (0.020)	–0.056*** (0.019)	–0.135*** (0.035)	–0.032*** (0.008)	–0.041*** (0.011)	–0.127** (0.063)
Short-term workers (share)	0.051** (0.023)	0.050** (0.020)	0.111** (0.053)	0.026** (0.012)	0.034** (0.016)	0.012 (0.082)
Apprentices (share)	–0.205*** (0.041)	–0.185*** (0.040)	–0.642*** (0.070)	–0.150*** (0.016)	–0.195*** (0.021)	–0.709*** (0.125)
Qualified tasks (share)	0.006 (0.010)	0.011 (0.009)	–0.004 (0.019)	–0.001 (0.004)	–0.001 (0.006)	–0.068 (0.035)
Multi-empl. barg. (dummy)	–0.026*** (0.005)	–0.022*** (0.004)	–0.104*** (0.009)	–0.024*** (0.002)	–0.031*** (0.003)	–0.135*** (0.018)
Single-empl. barg. (dummy)	–0.013** (0.006)	–0.011** (0.005)	–0.058*** (0.011)	–0.013*** (0.003)	–0.017*** (0.003)	–0.072*** (0.024)
Workers council (dummy)	0.025*** (0.007)	0.020*** (0.006)	0.091*** (0.011)	0.022*** (0.003)	0.029*** (0.003)	0.110*** (0.024)
West Germany (dummy)	0.007 (0.031)	0.004 (0.028)	0.010 (0.044)	0.002 (0.044)	0.003 (0.013)	–0.066 (0.089)
Foreign ownership (dummy)	0.090*** (0.013)	0.071*** (0.011)	0.249*** (0.013)	0.069*** (0.005)	0.096*** (0.007)	0.223*** (0.052)
Ownership n.a. (dummy)	0.018** (0.008)	0.016** (0.007)	0.080*** (0.016)	0.020*** (0.004)	0.026*** (0.005)	0.148*** (0.030)
Capital company (dummy)	0.017*** (0.006)	0.019*** (0.005)	0.071*** (0.011)	0.016*** (0.002)	0.021*** (0.003)	0.078*** (0.021)
Founded before 1990 (dummy)	–0.004 (0.006)	–0.002 (0.005)	–0.013 (0.009)	–0.003 (0.002)	–0.004 (0.003)	0.006 (0.022)
Observations	18,620	18,620	18,620	18,620	18,620	18,620

Notes: Standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered at establishment-level in columns (1), (2) and (6). Bootstraped standard errors in columns (3)–(5) using 200 repetitions. Constant, year, industry, and regional dummies included in all models but not reported. All coefficients are marginal effects evaluated at the means of the other regressors. FRACP denotes fractional-probit, FRACL denotes fractional-logit estimator. TOBIT I reports $\partial P(T > 0|x)/\partial x$, TOBIT II reports $\partial E(T > 0|x)/\partial x$, TOBIT III reports $\partial E(T|x)/\partial x$. PROBIT denotes probit model with dependent variable equal to one if export share larger than zero. Only single plants included in the regressions.

Table 5.3: The extensive and intensive margin III

	(1) FRACP	(2) FRACL	(3) TOBIT I	(4) TOBIT II	(5) TOBIT III	(6) PROBIT
Plant-comp. (ln)	0.014*** (0.003)	0.012*** (0.003)	0.048*** (0.006)	0.011*** (0.001)	0.015*** (0.002)	0.046*** (0.010)
Plant-comp. wage (ln)	–0.055*** (0.008)	–0.052*** (0.007)	–0.177*** (0.015)	–0.041*** (0.003)	–0.054*** (0.004)	–0.157*** (0.024)
Industry-comp.	0.006 (0.025)	–0.001 (0.023)	0.052 (0.068)	0.012 (0.016)	0.016 (0.021)	0.070 (0.095)
Employment (ln)	0.025*** (0.003)	0.021*** (0.003)	0.100*** (0.005)	0.023*** (0.001)	0.030*** (0.001)	0.135*** (0.012)
Capital (ln)	0.008*** (0.002)	0.007*** (0.002)	0.030*** (0.003)	0.007*** (0.001)	0.009*** (0.001)	0.032*** (0.007)
Female workers (share)	0.069*** (0.014)	0.065*** (0.013)	0.236*** (0.023)	0.055*** (0.005)	0.071*** (0.007)	0.267*** (0.050)
Part-time workers (share)	–0.044** (0.020)	–0.050*** (0.019)	–0.114*** (0.037)	–0.027*** (0.009)	–0.035*** (0.011)	–0.107 (0.062)
Short-term workers (share)	0.058** (0.023)	0.056*** (0.020)	0.135** (0.058)	0.032** (0.014)	0.041** (0.014)	0.037 (0.081)
Apprentices (share)	–0.193*** (0.041)	–0.175*** (0.039)	–0.606*** (0.069)	–0.141*** (0.016)	–0.183*** (0.021)	–0.674*** (0.125)
Qualified tasks (share)	0.005 (0.010)	0.010 (0.009)	–0.009 (0.018)	–0.002 (0.004)	–0.003 (0.005)	–0.072** (0.035)
Multi-empl. barg. (dummy)	–0.026*** (0.005)	–0.022*** (0.004)	–0.106*** (0.008)	–0.025*** (0.002)	–0.031*** (0.002)	–0.137*** (0.018)
Single-empl. barg. (dummy)	–0.012** (0.006)	–0.010** (0.005)	–0.056*** (0.012)	–0.013*** (0.003)	–0.016*** (0.003)	–0.070*** (0.024)
Workers council (dummy)	0.024*** (0.007)	0.019*** (0.006)	0.087*** (0.011)	0.021*** (0.003)	0.027*** (0.003)	0.106*** (0.024)
West Germany (dummy)	0.004 (0.031)	0.002 (0.028)	0.000 (0.043)	0.000 (0.010)	0.000 (0.013)	–0.075 (0.088)
Foreign ownership (dummy)	0.088*** (0.218)	0.069*** (0.011)	0.244*** (0.015)	0.067*** (0.005)	0.093*** (0.007)	0.218*** (0.052)
Ownership n.a. (dummy)	0.016** (0.008)	0.014** (0.007)	0.075*** (0.018)	0.018*** (0.005)	0.024*** (0.006)	0.144*** (0.030)
Capital company (dummy)	0.017*** (0.006)	0.018*** (0.005)	0.068*** (0.010)	0.016*** (0.002)	0.020*** (0.003)	0.076*** (0.021)
Founded before 1990 (dummy)	–0.004 (0.006)	–0.002 (0.005)	–0.012 (0.009)	–0.003 (0.002)	–0.004 (0.003)	0.007 (0.022)
Observations	18,620	18,620	18,620	18,620	18,620	18,620

Notes: Standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered at establishment-level in columns (1), (2) and (6). Bootstraped standard errors in columns (3)–(5) using 200 repetitions. Constant, year, industry, and regional dummies included in all models but not reported. All coefficients are marginal effects evaluated at the means of the other regressors. FRACP denotes fractional-probit, FRACL denotes fractional-logit estimator. TOBIT I reports $\partial P(T > 0|x)/\partial x$, TOBIT II reports $\partial E(T > 0|x)/\partial x$, TOBIT III reports $\partial E(T|x)/\partial x$. PROBIT denotes probit model with dependent variable equal to one if export share larger than zero. Only single plants included in the regressions.

Dividing the sample into a pre- and a post-Euro era. Tables 5.4–5.6 report the results obtained from the post-Euro sample that starts from 1996 (the earliest wave that covers all regions in Germany) and 1999, the year the exchange rates were officially fixed within the Euro area. Again, we compare fractional Probit, Tobit and Probit models. Except for the Tobit model results, competitiveness is insignificant before the year the common currency was introduced in 1999. We compare these results to the estimates obtained from regressions based on the post-Euro sample, which are reported in Tables 5.5 and 5.6, where we divide the post-Euro sample into a pre- and post-Hartz 4 sample. The advantage of dividing the post-Euro period into two sub-periods is that the different samples are roughly comparable in time length. However, the results have to be treated cautiously, at least for the Tobit estimators. There is a discussion that nonlinear estimators yield results that are not comparable across different samples. Nevertheless, we are mainly interested in the inference of statistical significance. The magnitude of the effects can be compared based on the outcomes of the linear models. We obtain significant estimates for the period after the Euro was introduced.

Estimates for the period 2005–2008 are significant only for the Tobit model. Competitiveness is insignificant for the Probit model. For Fractional-Probit/Logit we obtain coefficients that are significant only at the 10 and 5% level. This supports the hypothesized link between the establishment of a common currency union and competitiveness.

The random effects Tobit model. Including factor variables when estimating Tobit regressions is not appropriate due to the nonlinearity of the Tobit model. We therefore use a random-effects estimator in order to purge the regressions from unobserved heterogeneity at the plant level. Table 5.7 reports the results. The coefficient indicates a rather low relationship between unit labor costs and exports once we control for the random effects. Moreover, the unit labor costs measure is insignificant in columns (1) to (3). Thus, the exporting promoting effects seem to be driven by some unobservable factors omitted in the regressions above. Columns (4) to (6) report regression results where only wage competitiveness is included. Again, we find a significant relationship between higher wages and higher exports. Most interestingly, columns (7) to (9) report regression results where we include both plant-competitiveness measures. Finally, plant-competitiveness is significantly associated with exports at both margins.

Table 5.4: The extensive and intensive margin 1996–1999

	(1) FRACP	(2) FRACL	(3) TOBIT I	(4) TOBIT II	(5) TOBIT III	(6) PROBIT
Plant-comp. (ln)	0.006 (0.004)	0.004 (0.003)	0.029** (0.015)	0.006** (0.003)	0.007** (0.003)	0.025 (0.020)
Industry-comp.	–0.064 (0.056)	–0.057 (0.047)	–0.028 (0.268)	–0.005 (0.052)	–0.007 (0.064)	0.045 (0.331)
Employment (ln)	0.014*** (0.004)	0.011*** (0.004)	0.077*** (0.013)	0.015*** (0.002)	0.018*** (0.003)	0.119*** (0.021)
Capital (ln)	0.012*** (0.003)	0.010*** (0.003)	0.054*** (0.009)	0.011*** (0.002)	0.013*** (0.002)	0.050*** (0.012)
Female workers (share)	0.032* (0.017)	0.026* (0.015)	0.173*** (0.053)	0.034*** (0.010)	0.041*** (0.013)	0.245*** (0.085)
Part-time workers (share)	–0.088*** (0.026)	–0.082*** (0.023)	–0.444*** (0.086)	–0.086*** (0.017)	–0.105*** (0.020)	–0.538*** (0.119)
Short-term workers (share)	0.028 (0.031)	0.026 (0.026)	0.026 (0.116)	0.005 (0.023)	0.006 (0.027)	–0.165 (0.168)
Apprentices (share)	–0.289*** (0.053)	–0.275*** (0.050)	–1.045*** (0.173)	–0.203*** (0.035)	–0.248*** (0.041)	–1.096*** (0.244)
Qualified tasks (share)	0.015 (0.013)	0.016 (0.011)	0.038 (0.042)	0.007 (0.008)	0.009 (0.010)	0.002 (0.066)
Multi-empl. barg. (dummy)	–0.014* (0.007)	–0.012** (0.006)	–0.072*** (0.024)	–0.014*** (0.005)	–0.017*** (0.006)	–0.096*** (0.035)
Single-empl. barg. (dummy)	–0.006 (0.008)	–0.007 (0.006)	–0.040 (0.030)	–0.008 (0.006)	–0.009 (0.007)	–0.064 (0.042)
Workers council (dummy)	0.017* (0.009)	0.015* (0.008)	0.085*** (0.025)	0.017*** (0.005)	0.021*** (0.006)	0.106** (0.042)
West Germany (dummy)	0.053 (0.042)	0.063 (0.042)	0.140 (0.117)	0.028 (0.024)	0.034 (0.030)	–0.029 (0.149)
Foreign ownership (dummy)	0.101*** (0.030)	0.082*** (0.026)	0.347*** (0.054)	0.085*** (0.019)	0.117*** (0.027)	0.328*** (0.098)
Ownership n.a. (dummy)	–0.022 (0.018)	–0.028 (0.017)	–0.036 (0.069)	–0.007 (0.013)	–0.009 (0.016)	0.022 (0.082)
Capital company (dummy)	0.015* (0.008)	0.016** (0.007)	0.077*** (0.024)	0.015*** (0.005)	0.018*** (0.005)	0.059 (0.037)
Founded before 1990 (dummy)	–0.007 (0.008)	–0.005 (0.007)	–0.031 (0.023)	–0.006 (0.005)	–0.007 (0.006)	–0.012 (0.037)
Observations	3,150	3,150	3,150	3,150	3,150	3,150

Notes: Standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered at establishment-level in columns (1), (2) and (6). Bootstraped standard errors in columns (3)–(5) using 200 repetitions. Constant, year, industry, and regional dummies included in all models but not reported. All coefficients are marginal effects evaluated at the means of the other regressors. FRACP denotes fractional-probit, FRACL denotes fractional-logit estimator. TOBIT I reports $\partial P(T > 0|x)/\partial x$, TOBIT II reports $\partial E(T > 0|x)/\partial x$, TOBIT III reports $\partial E(T|x)/\partial x$. PROBIT denotes probit model with dependent variable equal to one if export share larger than zero. Only single plants included in the regressions.

Table 5.5: The extensive and intensive margin 2000–2004

	(1) FRACP	(2) FRACL	(3) TOBIT I	(4) TOBIT II	(5) TOBIT III	(6) PROBIT
Plant-comp. (ln)	0.008** (0.003)	0.007** (0.003)	0.031*** (0.008)	0.007*** (0.002)	0.010*** (0.003)	0.038*** (0.012)
Industry-comp.	0.006 (0.052)	–0.007 (0.047)	–0.096 (0.220)	–0.023 (0.052)	0.030 (0.068)	0.204 (0.224)
Employment (ln)	0.027*** (0.004)	0.023*** (0.004)	0.108*** (0.007)	0.026*** (0.002)	0.033*** (0.002)	0.144*** (0.015)
Capital (ln)	0.013*** (0.003)	0.011*** (0.002)	0.039*** (0.005)	0.009*** (0.001)	0.012*** (0.001)	0.036*** (0.008)
Female workers (share)	0.058*** (0.018)	0.056*** (0.016)	0.178*** (0.037)	0.042*** (0.009)	0.055*** (0.011)	0.185*** (0.059)
Part-time workers (share)	–0.067*** (0.024)	–0.069*** (0.022)	–0.153*** (0.045)	–0.036*** (0.011)	–0.048*** (0.014)	–0.102 (0.081)
Short-term workers (share)	0.020 (0.033)	0.017 (0.029)	0.020 (0.084)	0.005 (0.020)	0.006 (0.026)	–0.021 (0.105)
Apprentices (share)	–0.255*** (0.054)	–0.244*** (0.051)	–0.715*** (0.101)	–0.170*** (0.024)	–0.222*** (0.031)	–0.668*** (0.161)
Qualified tasks (share)	0.007 (0.013)	0.012 (0.011)	0.002 (0.025)	0.001 (0.006)	0.001 (0.008)	–0.065 (0.043)
Multi-empl. barg. (dummy)	–0.024*** (0.006)	–0.020*** (0.005)	–0.101*** (0.013)	–0.024*** (0.003)	–0.031*** (0.004)	–0.138*** (0.023)
Single-empl. barg. (dummy)	–0.010 (0.009)	–0.007 (0.008)	–0.054*** (0.019)	–0.012*** (0.004)	–0.016*** (0.005)	–0.071** (0.031)
Workers council (dummy)	0.024*** (0.009)	0.019** (0.008)	0.089*** (0.015)	0.021*** (0.004)	0.028*** (0.005)	0.117*** (0.029)
West Germany (dummy)	0.028 (0.037)	0.023 (0.034)	0.082 (0.061)	0.020 (0.015)	0.026 (0.019)	0.015 (0.113)
Foreign ownership (dummy)	0.075*** (0.014)	0.061*** (0.012)	0.212*** (0.021)	0.058*** (0.007)	0.080*** (0.010)	0.228*** (0.059)
Ownership n.a. (dummy)	0.021 (0.017)	0.018 (0.015)	0.098*** (0.038)	0.025** (0.010)	0.033** (0.014)	0.173** (0.078)
Capital company (dummy)	0.024*** (0.007)	0.024*** (0.007)	0.098*** (0.013)	0.023*** (0.003)	0.030*** (0.004)	0.113*** (0.025)
Founded before 1990 (dummy)	–0.003 (0.008)	–0.002 (0.007)	–0.005 (0.012)	–0.001 (0.003)	–0.001 (0.004)	0.023 (0.026)
Observations	8,586	8,586	8,586	8,586	8,586	8,586

Notes: Standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered at establishment-level in columns (1), (2) and (6). Bootstraped standard errors in columns (3)–(5) using 200 repetitions. Constant, year, industry, and regional dummies included in all models but not reported. All coefficients are marginal effects evaluated at the means of the other regressors. FRACP denotes fractional-probit, FRACL denotes fractional-logit estimator. TOBIT I reports $\partial P(T > 0|x)/\partial x$, TOBIT II reports $\partial E(T > 0|x)/\partial x$, TOBIT III reports $\partial E(T|x)/\partial x$. PROBIT denotes probit model with dependent variable equal to one if export share larger than zero. Only single plants included in the regressions.

Table 5.6: **The extensive and intensive margin 2005–2008**

	(1) FRACP	(2) FRACL	(3) TOBIT I	(4) TOBIT II	(5) TOBIT III	(6) PROBIT
Plant-comp. (ln)	0.009* (0.005)	0.009** (0.004)	0.023** (0.010)	0.006** (0.002)	0.008** (0.003)	0.008 (0.015)
Industry-comp.	0.001 (0.032)	–0.002 (0.031)	0.020 (0.123)	0.005 (0.031)	0.007 (0.041)	0.103 (0.105
Employment (ln)	0.030*** (0.005)	0.026*** (0.004)	0.107*** (0.009)	0.027*** (0.002)	0.035*** (0.003)	0.141*** (0.016)
Capital (ln)	0.008*** (0.003)	0.007*** (0.003)	0.029*** (0.005)	0.007*** (0.001)	0.010*** (0.002)	0.037*** (0.010)
Female workers (share)	0.068*** (0.020)	0.063*** (0.018)	0.224*** (0.037)	0.056*** (0.009)	0.074*** (0.012)	0.279*** (0.068)
Part-time workers (share)	–0.098*** (0.030)	–0.107*** (0.028)	–0.276*** (0.058)	–0.069*** (0.014)	–0.091*** (0.019)	–0.286*** (0.084)
Short-term workers (share)	0.084** (0.038)	0.077** (0.033)	0.211** (0.087)	0.053** (0.022)	0.069** (0.029)	0.151 (0.112)
Apprentices (share)	–0.186*** (0.057)	–0.161*** (0.054)	–0.638*** (0.101)	–0.159*** (0.025)	–0.210*** (0.034)	–0.786*** (0.162)
Qualified tasks (share)	0.044*** (0.015)	0.046*** (0.014)	0.103*** (0.029)	0.026*** (0.007)	0.034*** (0.010)	0.017 (0.051)
Multi-empl. barg. (dummy)	–0.029*** (0.006)	–0.026*** (0.006)	–0.108*** (0.014)	–0.026*** (0.003)	–0.034*** (0.004)	–0.137*** (0.026)
Single-empl. barg. (dummy)	–0.017** (0.008)	–0.014* (0.007)	–0.062*** (0.019)	–0.015*** (0.005)	–0.019*** (0.006)	–0.067* (0.037)
Workers council (dummy)	0.039*** (0.010)	0.031*** (0.009)	0.111*** (0.015)	0.029*** (0.004)	0.038*** (0.006)	0.108*** (0.033)
West Germany (dummy)	–0.022 (0.039)	–0.020 (0.035)	–0.060 (0.100)	–0.015 (0.025)	–0.020 (0.033)	–0.085 (0.128)
Foreign ownership (dummy)	0.121*** (0.020)	0.100*** (0.018)	0.276*** (0.024)	0.085*** (0.010)	0.119*** (0.014)	0.195*** (0.065)
Ownership n.a. (dummy)	0.016 (0.019)	0.012 (0.016)	0.077* (0.040)	0.020* (0.011)	0.027* (0.015)	0.140* (0.079)
Capital company (dummy)	0.032*** (0.010)	0.036*** (0.009)	0.111*** (0.019)	0.027*** (0.005)	0.035*** (0.006)	0.117*** (0.030)
Founded before 1990 (dummy)	–0.002 (0.008)	0.001 (0.007)	–0.011 (0.016)	–0.003 (0.004)	–0.004 (0.005)	–0.003 (0.028)
Observations	6,873	6,873	6,873	6,873	6,873	6,873

Notes: Standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered at establishment-level in columns (1), (2) and (6). Bootstraped standard errors in columns (3)–(5) using 200 repetitions. Constant, year, industry, and regional dummies included in all models but not reported. All coefficients are marginal effects evaluated at the means of the other regressors. FRACP denotes fractional-probit, FRACL denotes fractional-logit estimator. TOBIT I reports $\partial P(T > 0|x)/\partial x$, TOBIT II reports $\partial E(T > 0|x)/\partial x$, TOBIT III reports $\partial E(T|x)/\partial x$. PROBIT denotes probit model with dependent variable equal to one if export share larger than zero. Only single plants included in the regressions.

Table 5.7: Robustness checks

Dependent variable: Export intensity (share)	(1) XTTOBIT Ext. mar.	(2) XTTOBIT Int. mar.	(3) XTTOBIT Both mar.	(4) XTTOBIT Ext. mar.	(5) XTTOBIT Int. mar.	(6) XTTOBIT Both mar.	(7) XTTOBIT Ext. mar.	(8) XTTOBIT Int. mar.	(9) XTTOBIT Both mar.
Plant-comp. (ln)	0.002	0.001	0.001				0.009**	0.002**	0.003**
	(0.005)	(0.001)	(0.001)				(0.004)	(0.001)	(0.001)
Wage Comp. wage (ln)				–0.037***	–0.009***	–0.012***	–0.044***	–0.011***	–0.014***
				(0.010)	(0.003)	(0.003)	(0.010)	(0.002)	(0.003)

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Bootstraped standard errors computed based on 200 repetitions. Included controls identical to those in Table (1)–(6) but coefficients are not reported. All coefficients are marginal effects evaluated at the means of the other regressors. Only single plants included in the regressions.

5.5 Conclusion

Our paper contributes to the discussion of potential explanations for Germany's recent export success. We are able to show that higher plant-level competitiveness due to higher productivity and/or lower wages is positively correlated with export intensity at the intensive and extensive margins. Moreover, this effect is not driven by lower wage payments, as exports are associated with higher wages. There are two explanations: Firms are more efficient in producing goods, or real exchange rate movements in the Euro area led to higher export demand for relatively cheaper German products. The latter affects all industries equally. Moreover, both arguments are consistent with the higher wage payments in exporting plants. Our regressions support this latter view in so far that separate regressions for the pre- and post-Euro periods reveal that the export promoting effect of competitiveness is strongest shortly after the Euro was introduced. Some of the models yield insignificant coefficients of competitiveness before 1999 or after 2004. Future research has to be done in quantifying the effects at work based on a structural estimation of a macro-economic model. However, this is beyond the scope of our paper.

Appendix

5.A IAB establishment panel

Table 5.A.1: Description of variables and summary statistics

Variable	Description	Mean	S.D.
Exports (share)	Share of sales abroad relative to total sales.	0.137	0.224
Plant-comp. (ln)	Plant-level competitiveness in logs, measured as inverse unit labor cost, as defined in (5.1).	0.630	0.704
Plant-comp. wage (ln)	Plant-level wage competitiveness in logs, measured as inverse average wages. Average wages are calculated as total wage sum over total employment.	-7.367	0.527
Industry-comp.	Industry-level competitiveness index, measured as inverse unit labor cost relative to inverse unit labor cost of trading partners as defined in (5.2). Data source: OECD STAN data base.	0.875	0.095
Employment (ln)	Total employment in logs.	3.509	1.566
Capital (ln)	Capital in logs. Capital is proxied by applying the perpetual inventory method by Müller (2008, 2010).	13.744	2.314
Female workers (share)	Number female employees relative to total number of employees.	0.280	0.227
Part-time workers (share)	Number employees with part-time contracts relative to total number of employees.	0.099	0.148
Short-term workers (share)	Number of employees with short-term contracts relative to total number of employees.	0.030	0.076
Apprentices (share)	Number of apprentices relative to total number of employees.	0.056	0.080
Qualified tasks (share)	Number of workers with qualified tasks relative to total number of employees. Qualified tasks are defined as requiring either a completed apprenticeship or a university degree.	0.670	0.244
Multi-empl. barg. (dummy)	1 if establishment is subject to multi-employer collective agreements (*Flächentarifvertrag*). 0 if not subject to collective agreements.	0.360	0.480
Single-empl. barg. (dummy)	1 if establishment is subject to single-employer collective agreements (*Firmentarifvertrag*). 0 if not subject to collective agreements.	0.086	0.280
Workers council (dummy)	1 if workers council is present, 0 otherwise.	0.324	0.468

(continued)

Variable	Description	Mean	S.D.
West Germany (dummy)	1 if establishment is located in West Germany. 0 if otherwise.	0.456	0.498
Foreign ownership (dummy)	1 if establishment is mainly property of a foreign owner, 0 if establishment is mainly property of domestic owners.	0.047	0.213
Ownership n.a. (dummy)	1 if establishment majority ownership is not known or missing. 0 if otherwise.	0.085	0.279
Capital company (dummy)	1 if establishment's legal form is a limited liability company or a company limited by shares, 0 if otherwise.	0.679	0.467
Founded before 1990 (dummy)	1 if establishment is founded before 1990, 0 if founded 1990 or later.	0.576	0.494

Source: IAB establishment panel, 1996–2008. 4,683 establishments, 18,620 observations.

Chapter 6

Concluding remarks

The aim of this thesis is to study wage formation processes in the context of globalization and different institutional settings. In particular, three research questions are formulated to address different aspects on that topic: First, how does collective bargaining coverage evolve in modern economies if firms are free to opt for alternative modes of wage-setting? Second, how does the increasing international exposure of firms affect wages in the context of different institutional settings? Third, how do wages and competitiveness affect the export participation of firms?

Chapter 2 addresses the first question by modeling the evolution of collective bargaining coverage rates. In contrast to the existing literature, firms are allowed to decide about joining the collective bargaining regime. This approach is consistent with the system of industrial relations in many European countries and challenges the view, that firms are generally opposed to collective wage bargaining. Beyond wages, regimes differ in their cost structures. The results show that these differences are sufficient to describe incomplete collective bargaining coverage with endogenous selection as a stable equilibrium outcome. Furthermore, the results are in line with the related literature emphasizing the role of technical progress and product market deregulations.

Chapter 3 and Chapter 4 investigate the second research question by studying the exporter wage premium of firms subject to collective agreements. Both chapters are based on recent theoretical findings. In particular, Chapter 3 investigates empirically, whether wages in exporting firms are systematically different if they are subject to collective agreements. Several theoretical contributions in the current literature predict a lower exporter wage premium if firms are subject to collective agreements due to stronger competition on foreign markets. The results indeed show that rent-sharing is less pronounced in firms with more export exposure.

Chapter 4 supplements the literature on the exporter wage premium by using differences in payments above the binding wage floor in firms subject to collective agreements. The empirical identification of the exporter wage premium is commonly based on the within variation of the data. This raises concerns if the variation over time is low. Chapter 4 offers a new identification strategy of the exporter fair wage premium. Collective wage agreements constitute a legally binding wage floor. Nevertheless, firms are allowed to pay more if they choose so. We use this above wage floor payments to proxy for fair wage considerations. The results show that the firm's export intensity is associated with these payments, supporting the fair-wage hypothesis.

Chapter 5 addresses the third question, i.e. the link between wages, competitiveness and the international participation of firms. In particular, the chapter contributes to the expanding literature on the German export success during the last years. The results confirm that higher competitiveness of firms due to higher productivity or lower wages increases the export intensity of firms. Nevertheless, lower wage payments alone are not associated with more export participation which is consistent with the literature on the exporter wage premium.

This thesis addresses the process of wage formation from different perspectives. The results show that wages, globalization and institutions are highly interconnected. These processes are central to answer some of the big questions. I cannot give one clear cut answer, but I hope I have added some smaller ones. It is of course just one step towards a more general understanding of how wages are set in modern economies. But I think it is a challenging and rewarding field of research.

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Kurzlebenslauf

Andreas Hauptmann, studied economics at the University of Würzburg and completed his studies in 2007. He has been a doctoral candidate at the Universities of Glasgow and Mainz under the supervision of Prof. Dr. Klaus Wälde. Between 2009 and 2012 he received a scholarship at the joint graduate program of the Institute of Employment Research (IAB) and the University of Erlangen-Nürnberg. Since 2008 Andreas Hauptmann is working as a researcher at the IAB in Nürnberg.

Abstract

Wage formation processes form an important element in many economic and social discussions, especially in the context of increasing globalization during the past decades. Against this background, this dissertation addresses different aspects of wage formation in modern economies. It consists of four independent essays. Chapter 2 investigates why some firms pay collectively agreed wages rather than to negotiate wages individually. The analysis is carried out in a theoretical general equilibrium framework with endogenous self-selection of firms into two different wage regimes. The results show that different cost structures are sufficient to explain incomplete collective agreement coverage rates as an equilibrium outcome. Furthermore, the results show that the decrease in collective bargaining coverage rates can be attributed to technological progress and product market deregulations. Chapter 3 studies wage formation in international firms. Based on recent theoretical considerations, the chapter investigates empirically whether international trade exposure reduces the so called exporter wage premium in firms subject to collective agreements. The results show that rent-sharing is less pronounced in more export-intensive firms or in more open industries. Chapter 4 provides new empirical evidence on the fair-wage hypothesis in exporting firms. Among other things, fair-wage considerations depend also on whether the firm is able to pay certain wage rates. In the German system of industrial relations, the collectively agreed wage constitutes a binding wage floor, but employers are allowed to pay higher wage rates. We employ this setting to investigate the implications of the fair-wage-hypothesis. In contrast to previous literature, identification does not rely on the within variation of the data. The results show that payments above the collectively agreed wage floor are systematically related to the firm's export intensity. Chapter 5 studies also empirically the determinants of a firm's export participation. The findings indicate that higher plant-level competitiveness, measured by lower unit labor costs, is positively associated with the firm's export participation.

Kurzfassung

Lohnbildungsprozesse bilden einen wichtigen Bestandteil in vielen ökonomischen und gesellschaftlichen Debatten, besonders im Kontext der zunehmenden Globalisierung während der vergangenen Dekaden. Vor diesem Hintergrund adressiert diese Dissertation unterschiedliche Aspekte der Lohnbildung in modernen Volkswirtschaften. Sie besteht aus vier voneinander unabhängigen Aufsätzen. Kapitel 2 untersucht, warum einige Firmen nach Tarif zahlen, statt die Löhne individuell auszuhandeln. Die Analyse wird in einem theoretischen allgemeinen Gleichgewichtsmodell mit endogener Lohnregimeselektion durchgeführt, wobei Firmen sich in eines von zwei Lohnregimen selektieren. Die Ergebnisse zeigen, dass unterschiedliche Kostenstrukturen ausreichend sind, um unvollständige Tarifvertragsabdeckung im Gleichgewicht zu erklären. Darüber hinaus zeigen die Ergebnisse, dass der Rückgang der Tarifbindung durch technischen Fortschritt und Produktmarktderegulierungen erklärt werden kann. Kapitel 3 betrachtet die Lohnbildung in internationalen Firmen. Basierend auf den jüngsten theoretischen Überlegungen untersucht dieses Kapitel empirisch, ob Außenhandelsaktivitäten von Firmen die sogenannte Exportlohnprämie reduziert, wenn sie gleichzeitig an Tarifverträge gebunden sind. Die Ergebnisse zeigen, dass die Aufteilung von ökonomischen Renten – in exportintensiven Firmen oder offeneren Sektoren weniger ausgeprägt ist. Kapitel 4 liefert neue empirische Belege zur sogenannten „Fair-Wage-Hypothese" in exportierenden Unternehmen. Angemessene Lohnzahlungen hängen, unter anderem, von der Leistungsfähigkeit der Firma ab. In Deutschland stellt der Tariflohn eine verbindliche Lohnuntergrenze dar, von der der Arbeitgeber allerdings nach oben abweichen kann. Wir verwenden dies, um die Implikationen der „Fair-Wage-Hypothese" zu untersuchen. Im Gegensatz zu bisherigen Ansätzen basiert die Identifikationsstrategie nicht auf der Variabilität der Daten über die Zeit. Die Ergebnisse zeigen, dass Zahlungen oberhalb des geltenden Tariflohns systematisch mit der Exportintensität der Firma assoziiert sind. Kapitel 5 untersucht, ebenfalls empirisch, die Determinanten der Exportpartizipation einer Firma. Es zeigt sich, dass eine höhere Wettbewerbsfähigkeit, gemessen durch geringere Lohnstückkosten, positiv mit der Exportaktivitäten einer Firma korreliert ist.

Why do some firms pay collectively agreed wages rather than to negotiate wages individually? Do exporting firms pay higher wages than non-exporting firms, and to what extent this is determined by institutional frameworks? What are the connections between the labor unit costs and a strong export performance of companies? These and other questions are addressed in this book by Andreas Hauptmann. In several chapters the author shows a variety of interactions between wages, globalization and institutional factors.

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