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Endogenous wage regime selection: A general equilibrium model

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Abstract

This paper analyses the role of transaction costs in the context of incomplete collective bargaining coverage and endogenous wage regime selection. It is often assumed that firms oppose unions because they reduce profits. However, in many countries, union recognition is at the discretion of the employer and at the same time, collective bargaining is one of the main modes of wage-setting. In contrast to the previous literature, I assume that bargaining itself is no longer costless but rather involves additional resources. Based on a simple theoretical model, the results show that different wage regimes, unionized and non-unionized, co-exist in general equilibrium if cost structures between wage regimes are sufficiently different.

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1. Introduction

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. Unions are often perceived as monopolistic organizations that raise wages above the competitive level and create inefficiencies in resource allocations (Clark, 1984; Friedman, 2007). 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 paper takes a different perspective on collective wage bargaining and unions. On the one hand, it is commonly assumed that firms oppose unions because they reduce profits due to rent-seeking behavior. On the other hand, collective bargaining recognition is, especially in many European countries, at the discretion of the employer. This raises the question why firms should accept collective bargaining in the first place. There are two main explanations, from an economic perspective, why firms would agree to collective wage bargaining. First, firms face a trade-off 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, collective agreement contracts are complex and may cover more than wages. By dealing with one single entity, employers can realize gains form standardization and centralization. This transaction cost motive has received no attention in the theoretical literature so far.

Against this background, this paper 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 wage regimes is driven by differences in cost structures associated with a particular 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. Firms face a trade-off when deciding between wage regimes: The non-unionized wage regime is characterized by low fixed costs and high variable regime costs, whereas the opposite holds for the unionized regime. The wage regime decision is not irrevocable. Firms can enter or exit the market or switch the regime. The theoretical framework herein is tailored more towards the European system of industrial relations.[1] The basic idea, however, is more general and aims to complement existing research by focusing on the firm as unit of analysis.[2]

The contribution of the current paper is to offer an explanation for the empirically relevant and significant share of collective agreements, even if the recognition of the agreement is at the discretion of the employer. Simultaneous wage regimes exist even in narrowly defined industries, where some firms are subject to collective agreements, while others are not, and it has been shown that changes in firm behavior can better explain the evolution of collective

[1] In Germany, for instance, union recognition is at the discretion of the employer (Dustmann et al., 2009), whereas in the US, firms are legally obliged to bargain with a union once workers decided for union representation by majority vote (DiNardo and Lee, 2004).

[2] For instance, Card et al. (2018) emphasize the role of firms in wage determination, showing that firm-specific premiums account for 20% of the overall wage variation.

agreement coverage rates than changes in firm composition (Addison et al., 2013). The results show that different wage regimes co-exist in general equilibrium if cost structures between wage regimes are sufficiently different. Furthermore, the possibility for firms to recognize a collective agreement, or not, places a restriction on union actions. This gives rise to cooperation rather confrontation, which is a central feature of many European systems of industrial relations.

The paper contributes to the small literature on incomplete collective bargaining coverage and endogenous wage regime selection. In Lazear (1983), competitive firms face a national union and firms differ in their ability to fight off unionization. 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. Taschereau-Dumouchel (2017) 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 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.

The rest of the paper is organized as follows: Section 2 describes the model. Section 3 presents the general equilibrium result. Section 4 concludes.

2. The model

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. 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. Final output is also used as numéraire. Technology of final output producers follows

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

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.[3] Profit maximization of final output producers implies that demand for variety i follows

$$q_i = \frac{E}{PM}\left(\frac{p_i}{P}\right)^{-\sigma}, \tag{2}$$

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

$$P = \left[\frac{1}{M}\int_0^M p_i^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}. \tag{3}$$

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

$$q_i = \phi l_i, \tag{4}$$

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 $\pi_i = p_i(q_i)\, q_i - c_i(q_i/\phi) - P f_i$. With fixed costs being paid in units of final output. Maximizing profits subject to (2) gives the usual constant markup pricing rule over marginal cost,

$$p_i = \frac{\sigma}{\sigma - 1}\frac{c_i}{\phi}, \tag{5}$$

where $\sigma/(\sigma - 1)$ denotes the markup over marginal costs. Using the demand equation (2) and the constant markup rule (5), profits of firm i can be written as

$$\pi_i = \frac{1}{\sigma}\frac{E}{M}\left(\frac{p_i}{P}\right)^{1-\sigma} - P f_i. \tag{6}$$

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.[4] Additionally to general fixed costs of production f, regime specific fixed

[3] The first term on the right-hand side in (1) differs from the standard Dixit-Stiglitz model, as it eliminates external economies of scale effects (see for instance Blanchard and Giavazzi, 2003).

[4] The nature of this costs is deliberately kept general. In light of 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 time and resources. In this case, dealing with a single entity gives rise to economies of scale compared to a situation where the firm engages with each worker individually. The details of this assumption are discussed below.

costs a_j for $j \in \{N, U\}$ are assumed. Therefore, fixed costs of firm i in regime j are

$$f_{i(j)} = \left\{ \begin{array}{c} f_N \\ f_U \end{array} \right\} = f + \left\{ \begin{array}{ll} a_N & \text{if } j = N, \\ a_U & \text{if } j = U. \end{array} \right. \tag{7}$$

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

$$c_{i(j)} = \left\{ \begin{array}{ll} w_N + b_N & \text{if } j = N, \\ w_U + b_U & \text{if } j = U. \end{array} \right. \tag{8}$$

This difference in cost structures between wage regimes is crucial and one of the main features of this model is that firms are 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 at no cost. Switching between regimes continues until no firm can be made better off in the other regime.

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 we simply allow that differences in the wage formation process are also reflected in differences in the cost structure.

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 the product of each bargaining party's surplus from reaching an agreement $\left[\left(w_U - \tilde{w}\right) l_U\left(w_U\right)\right]^{\beta} \left[\pi_U\left(l_U\left(w_U\right)\right) - \pi_U\left(0\right)\right]^{1-\beta}$, 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

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

The bargained wage increases in the workers' fallback option ($\tilde{w}$), the bargaining power of the union (β) The fallback option serves as a lower bound for an agreement and determines the gains for the union from a successful negotiation for a given wage rate. β determines how much of the gains are allocated to the union. Put differently, the fallback option determines the size of the cake, which can be shared, and β the size of the slices of each party. If $b_U = 0$, equation (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 $\theta \equiv \left(\sigma - 1 + \beta\right) / \left(\sigma - 1\right)$ we can write the union wage equation as

$$w_U = \theta\tilde{w} + \left(\theta - 1\right) b_U. \tag{9}$$

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 equal total real revenues. It is easy to verify that this is equivalent with the price index equation in (3) to hold. Since firms are equal within each wage regime, the price index can be rewritten in terms of real prices such that

$$1 = (1 - \mu_U) \left(\frac{p_N}{P}\right)^{1-\sigma} + \mu_U \left(\frac{p_U}{P}\right)^{1-\sigma}, \tag{10}$$

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

$$\pi_N = \pi_U. \tag{11}$$

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 in one regime

$$\pi_U = 0. \tag{12}$$

By (11) this simultaneously holds in the other regime.

Fallback wage: The outside option of workers depends on wages outside the firm and unemployment benefits. The fallback wage is given by

$$\tilde{w} = (1 - u)\, \bar{w} + u w_0, \tag{13}$$

where $\bar{w}$ the average wage in the economy, u the unemployment rate and w_0 unemployment benefits.[5]

Labor market clearing: The labor market is cleared if the total mass of persons employed $L \equiv M\mu_N l_N + M\mu_U l_U$ is equal to the labor endowment N

$$L = N. \tag{14}$$

[5]In equilibrium, firms in the non-unionized regime pay the market-clearing wage and the fallback wage equals the average wage in the economy.

3. General equilibrium

Definition 1. *The equilibrium of the economy with simultaneous wage regimes, i.e.* $\mu_U \in (0,1)$*, is the duodecuple* $\left\{(q_j, l_j, w_j/P, p_j/P)_{j\in\{N,U\}}, \tilde{w}, E, M, \mu_U\right\}$ *satisfying (2), (4), (5) for* $j \in \{N,U\}$ *and (9)–(14).*

The reduced form solution to the system in Definition 1 is[6]

$$\frac{p_U}{P} = \left[\mu_U\left(1 - \frac{f_N}{f_U}\right) + \frac{f_N}{f_U}\right]^{\frac{1}{\sigma-1}}, \tag{RF1}$$

$$\frac{p_U}{P} = \frac{\sigma}{\sigma-1}\frac{\theta\left[\tilde{w} + b_U\right]}{P\phi}, \tag{RF2}$$

where

$$\tilde{w} + b_U = \frac{b_N - b_U}{\frac{\mu_U}{1-\mu_U}(\theta-1)\left(\frac{f_U}{f_N}\right)^{\frac{\sigma}{\sigma-1}} + \theta\left(\frac{f_U}{f_N}\right)^{\frac{1}{\sigma-1}} - 1}. \tag{15}$$

So far we only required (labor) cost structures to be different between wage regimes. For the remainder we make the following assumption.

Assumption 1. *Unionized firms face higher labor fixed cost and lower variable bargaining costs relative to non-unionized firms, i.e.* $a_U > a_N \Leftrightarrow f_U > f_N$ *and* $b_U < b_N$ *.*

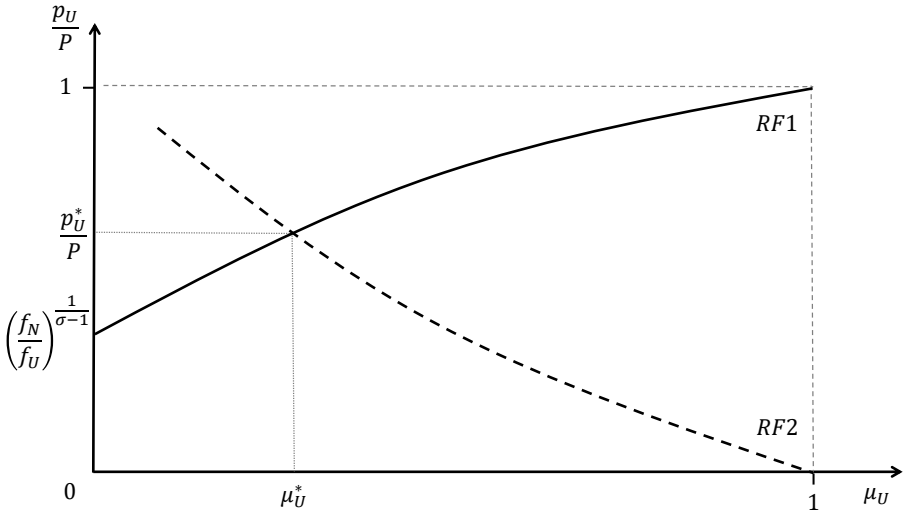
The assumption on differences in cost structures between wage regimes is not overly restrictive per se. However, whether these cost exist in the first place and are captured in Assumption 1 in a reasonably manner is indeed of pivotal importance and therefore merits more discussion. Assumption 1 rests on transaction cost motives. The reduction of transaction costs has long been identified as one major benefit of collective agreements (Williamson et al., 1975; Williamson, 1981; OECD, 2017) by employers (BDA, 2018; van het Kaar, 2004) and trade unions (DGB, 2018) alike.[7] More importantly, it is also in line with empirical evidence based on the German Job Vacancy Survey, which added questions in 2017 regarding hiring costs in terms of money and time. I only provide a summary here. The details are outlined in Appendix A. The results show that individual bargaining firms spent about 20% more time during the hiring process. They are 10%-points more likely to face additional costs in money terms and these costs are about 25% higher relative to firms not bargaining wages individually. These results are based on regressions controlling for the qualification level, atypical employment contracts, firm size, regional effects and industry affiliation. Furthermore, larger firms are less likely to bargain individually when covered by a collective agreement.

[6] See Appendix B.1 for details. Further note, that a closed form solution exits if variable regime cost are assumed to be proportional to wages instead of additive. But there is no obvious reason why this should be the case and the main conclusions remain unchanged.

[7] As an example, the Confederation of German Employers' Associations (BDA), the top body of representing private sector employer interests in Germany notes: *"Working conditions are therefore not negotiated individually by the employer with each employee. This saves the employer effort, time and money."* (BDA, 2018, own translation).

General equilibrium. (RF1) and (RF2) describe two distinct relations between the share of unionized firms μ_U and their price p_U, which is graphically represented in Figure 1.

Figure 1: Determination of equilibrium share of unionized firms (μ_U^*) and prices of unionized firms (p_U^*/P)



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

$$\frac{\sigma}{\sigma-1}\frac{\theta}{\phi}\frac{b_N-b_U}{P} > \theta - \left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}} \tag{16}$$

Proof. The proof is provided in Appendix B.2 □

Equation (16) shows that differences in cost structures between the two wage regimes is a necessary condition for simultaneous wage regimes with endogenous selection. And these differences need to be sufficiently large. 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. With perfect competition the mass of firms would be undetermined but the main properties implied by regime indifference 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 monopoly unions.

4. Conclusion

This paper analyses the role of transaction costs in the context of incomplete collective bargaining coverage and endogenous wage regime selection. Based on a simple theoretical model, the results show that different wage regimes, unionized and non-unionized, co-exist in general equilibrium if cost structures between wage regimes are sufficiently different. This questions the view that firm oppose unions per se, because they reduce profits due to higher wages. Allowing firms to decide over recognizing a collective agreement also places a restriction on union wage demands. This approach aims to complement existing research by focusing on the firm as unit of decision-making. More generally, it emphasizes the importance of endogenous wage regime selection on wage formation processes. If there is more than one option to choose from (for firms or workers or unions), the conclusions of standard economic models may change. This would need to be addressed by further research.

Acknowledgments

This paper is based on a chapter of my dissertation (cf. Hauptmann, 2015). I would like to express my gratitude to my supervisor Prof. Klaus Wälde. I am also grateful to Herbert Brücker, Hans-Jörg Schmerer, Ignat Stepanok as well as the participants of the Brownbag Seminar at the University of Mainz, the CRD at Chair of macroeconomics, the GradAB Colloquium in Nürnberg, and the 3rd Joint Workshop of Aarhus University and the IAB for valuable comments and suggestions.

Appendix A. Empirical evidence on cost differences

There exists little empirical evidence on cost differences between wage bargaining regimes during the hiring process. To address this issue, I use the German Job Vacancy Survey 2017, an annual representative survey of about 14,000 establishments conducted by the Institute for Employment Research (IAB) (for further details see Bossler et al., 2019). The survey includes information on various plant characteristics, such as size, industry affiliation and region. More importantly it also contains information on whether a collective wage agreement is in place and further questions on the most recent hired worker. There are two topics of particular interest here. First, there is information on whether the firm and worker have bargained over the wage. Second, in 2017 two questions regarding the hiring costs in terms of time and money have been added.[1] I restrict the sample to those establishment with an actual recruitment during the last 12 months.

The left panel of Figure A.1 shows the distribution of collective agreement recognition by establishment size. The share of collective agreements increases monotonically in size with about 30% for the smalles and almost 70% for the largest establishments. The right panel of Figure A.1 displays the share of employers who have bargained the wage individually by establishment size and collective agreement status.[2] Two findings emerge. First, employers not subject to collective agreements are always more likely to engage in individual bargaining. Second, whereas the bargaining share remains almost constant for firms not recognizing a collective agreement, it decreases systematically in size for employers subject to one if their workforce comprises ten employees or more.

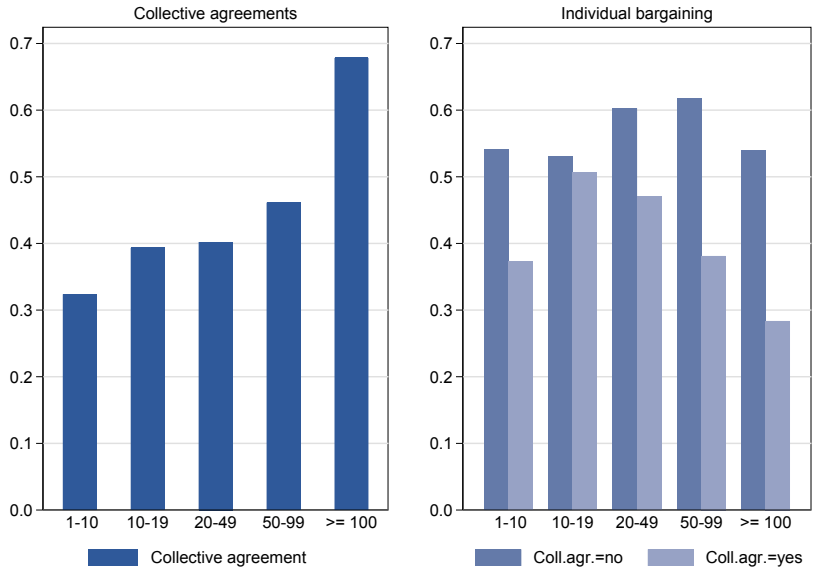
Table A.I summarizes the results on hiring costs with respect to individual bargaining and collective agreements using ordinary least squares (OLS). Since hiring costs may depend on other factors, I additionally control in all specifications for the required qualification, atypical employment contracts, firm size as well as industry and regional fixed effects. Column 1 starts with measuring hiring costs in terms of time, i.e. how many hours were spent on filling the position. The results suggest firms who bargained individually spend almost 20% more time during the hiring process. Since almost 50% of the respondents reported no extra monetary cost, I report results on the extensive margin, i.e. whether they faced any cost at all or not, in column 2 and on the intensive margin, if they reported positive hiring costs, in column 3. Again, individually bargaining firms are 10 %-points more likely, to face additional pecuniary costs, and if so, these costs are about 25% higher. Furthermore, the coefficient on collective agreement recognition is statistically not significant in columns 1 and 3, and much smaller and measured with less precision in column 2.

The empirical evidence presented above supports the cost structure described in Assumption 1. It shows that bargaining indeed is costly, and individually bargaining firms face higher hiring cost in time and money terms. Furthermore, larger firms are less likely to bargain individually when covered by a collective agreement.

[1] The questions asked were: "How many hours in total were spent on filling this position?" and "Apart from the hours: Which other costs have been incurred for filling the position (e.g. for advertisements, headhunters, reimbursement of travel expenses)?".

[2] In the theoretical model firms bargain either individually or collectively. In practice, however, a collective agreement sets a legally binding wage floor but the employer is free to pay more or engage in further negotiations.

Figure A.1: Collective agreement and individual bargain shares



Note: This figure shows on the left panel the share of establishments with collective agreements by different employment size categories. The right panel shows the share of establishments reporting to have bargained individually with the worker most recently hired by employment size categories and collective agreement status. Source: German Job Vacancy Survey 2017, weighted results.

Table A.I: Hiring costs, individual bargain and collective agreements

	(1)	(2)	(3)
Dependent variable	Hours	Euros	Euros
Hiring costs in terms of...	(ln)	(y/n)	(ln)
Individual bargainig (dummy)	0.190***	0.105***	0.262***
	(0.026)	(0.014)	(0.055)
Collective agreement (dummy)	0.046	0.048**	0.025
	(0.034)	(0.021)	(0.071)
Qualification: medium	0.288***	0.090***	0.495***
	(0.037)	(0.024)	(0.089)
Qualification: high	0.589***	0.139***	0.967***
	(0.056)	(0.038)	(0.121)
Fixed-term contract (dummy)	-0.064**	-0.081***	-0.215***
	(0.031)	(0.014)	(0.060)
Part-time contract (dummy)	-0.199***	-0.061**	-0.493***
	(0.034)	(0.023)	(0.091)
Employment (ln)	0.072***	0.034***	0.214***
	(0.010)	(0.008)	(0.023)
Observations	7,522	6,131	3,189
R^2	0.095	0.067	0.219

Note: All specifications include industry and federal state fixed effects. Robust standard errors clustered at the industry-level in parentheses. $^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$. Qualification classification "low" without vocational training (reference category), "medium" with vocational training, "high" with college or university degree.

Appendix B. Derivations and proofs

B.1 Derivation of reduced form solution (RF1), (RF2) and (15)

Equation (RF1) is derived by combining the product market clearing condition (10), the regime indifference condition (11), and the free entry condition (12).

Equation (RF2) is derived from using the optimal pricing condition in (5), together with (8) and (9).

In equilibrium, the unemployment rate is zero and the fallback wage equals the average wage

$$\tilde{w} = (1 - \lambda_U)\, w_N + \lambda_U w_U, \tag{B.1}$$

where λ_U denotes the share of workers employed in unionized firms. By using (2), (4), (11), and (12) this can be written as

$$\lambda_U = \frac{M_U l_U}{M_U l_U + M_N l_N} = \frac{1}{1 + \rho\left(\mu_U\right)}, \tag{B.2}$$

where we defined $\rho\left(\mu_U\right) \equiv \frac{1-\mu_U}{\mu_U} \left(\frac{f_N}{f_U}\right)^{\frac{\sigma}{\sigma-1}}$. Furthermore, using (5), (9), (11), and (12), the wage of non-unionized firms can be written as

$$w_N = \theta \left[\tilde{w} + b_U\right] \left(\frac{f_N}{f_U}\right)^{\frac{1}{1-\sigma}} - b_N. \tag{B.3}$$

Using (9) together with (B.1)-(B.3) yields (15) after some rearrangements.

B.2 Proof of Proposition 1

It is easy to verify that (RF1) is strictly increasing and (RF2) strictly decreasing in μ_U, given Assumption 1. Since $p_U|^{RF1}_{\mu_U=1} > p_U|^{RF2}_{\mu_U=1} \Leftrightarrow 1 > 0$, an equilibrium exists and is unique if $p_U|^{RF1}_{\mu_U=0} < p_U|^{RF2}_{\mu_U=0} \Leftrightarrow \frac{\sigma}{\sigma-1}\frac{\theta}{\phi}\frac{b_N - b_U}{P} > \theta - \left(\frac{f_N}{f_U}\right)^{\frac{1}{\sigma-1}}$.

References

Addison, J. T., P. Teixeira, A. Bryson, and A. Pahnke (2013): "Collective Agreement Status and Survivability: Change and Persistence in the German Model," *LABOUR*, 27(3), 288–309.

BDA (2018): "Vorteile des Tarifvertrags erkennen und nutzen," Bundesvereinigung der Deutschen Arbeitgeberverbände (BDA) [Confederation of German Employers' Associations (BDA)] https://www.arbeitgeber.de/www/arbeitgeber.nsf/res/Vorteile-Tarifvertrag.pdf/$file/Vorteile-Tarifvertrag.pdf, accessed: 16.10.2019.

Blanchard, O. and F. Giavazzi (2003): "Macroeconomic Effects Of Regulation And Deregulation In Goods And Labor Markets," *The Quarterly Journal of Economics*, 118(3), 879–907.

Bossler, M., H. Gartner, A. Kubis, B. Küfner, and T. Rothe (2019): "The IAB Job Vacancy Survey: Establishment survey on labour demand and recruitment processes, Waves 2000 to 2016 and subsequent quarters 2006 to 2017," Fdz-datenreport, 03/2019 (en), Institut für Arbeitsmarkt- und Berufsforschung (IAB), Nürnberg [Institute for Employment Research (IAB)].

Card, D., A. R. Cardoso, J. Heining, and P. Kline (2018): "Firms and Labor Market Inequality: Evidence and Some Theory," *Journal of Labor Economics*, 36(S1), 13–70.

Clark, K. B. (1984): "Unionization and Firm Performance: The Impact on Profits, Growth, and Productivity," *The American Economic Review*, 74(5), pp. 893–919.

DGB (2018): "Tarifbindung stärken," Deutscher Gewerkschaftsbund (DGB) [German Trade Union Confederation (DGB)] https://www.dgb.de/themen/++co++6a527eaa-dc4e-11e8-b4c3-52540088cada, accessed: 17.10.2019.

DiNardo, J. and D. S. Lee (2004): "Economic Impacts of New Unionization On Private Sector Employers: 1984-2001," *The Quarterly Journal of Economics*, 119(4), 1383–1441.

Donado, A. and K. Wälde (2012): "How trade unions increase welfare," *Economic Journal*, 122(563), 990–1009.

Dustmann, C., J. Ludsteck, and U. Schönberg (2009): "Revisiting the German Wage Structure," *The Quarterly Journal of Economics*, 124(2), 843–881.

Freeman, R. B. (1976): "Individual Mobility and Union Voice in the Labor Market," *American Economic Review*, 66(2), 361–68.

Freeman, R. B. and J. L. Medoff (1984): *What do Unions do?*, New York: Basic Books.

Friedman, M. (2007): *Price Theory*, New Brunswick, NJ: Transaction Publishers.

Hauptmann, A. (2015): *Essays on wage formation and globalization*, IAB-Bibliothek, 356, Bielefeld: Bertelsmann.

Lazear, E. P. (1983): "A Competitive Theory of Monopoly Unionism," *The American Economic Review*, 73(4), pp. 631–643.

Nickell, S. J. and M. Andrews (1983): "Unions, Real Wages and Employment in Britain 1951-79," *Oxford Economic Papers*, 35(0), 183–206.

OECD (2017): "Collective bargaining in a changing world of work," in *OECD employment outlook 2017*, OECD, Paris, Chapter 4, 125–186.

Pissarides, C. A. (2009): "The Unemployment Volatility Puzzle: Is Wage Stickiness the Answer?" *Econometrica*, 77(5), 1339–1369.

Taschereau-Dumouchel, M. (2017): "The Union Threat," unpublished manuscript, available at https://www.mathtd.info/files/papers/The%20Union%20Threat/paper.pdf.

van het Kaar, R. (2004): "Most employers positive about extension of collective agreements," EIROnline: European industrial relations observatory on-line.

Williamson, O. E. (1981): "The Economics of Organization: The Transaction Cost Approach," *American Journal of Sociology*, 87(3), 548–577.

Williamson, O. E., M. L. Wachter, and J. E. Harris (1975): "Understanding the Employment Relation: The Analysis of Idiosyncratic Exchange," *Bell Journal of Economics*, 6(1), 250–278.