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# Multi-union Bargaining: Tariff Plurality and Tariff Competition\*

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## Abstract

We study sequential bargaining between two unions and a single firm. Parties bargain bilaterally and efficiently (over wage and employment). The unions' workforces can be substitutable ("tariff competition") or complementary ("tariff plurality" or "craft unionism"). If unions are substitutable, then too many workers from the first union are employed at the cost of employment from the second union (with overall overemployment). If unions are complementary, then employment of both unions is reduced (with overall underemployment). Unions merge when workers are substitutable but stay separate if complementary, so that the inefficiencies associated with craft unionism persist.

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# 1 Introduction

We study multi-union bargaining where a single employer must negotiate with two unions about working conditions. The groups of workers represented by the unions can be substitutable or complementary depending on the labor inputs they provide (we also allow for independency). In German labor law parlance, the former case is referred to as “tariff competition” and the latter case as “tariff plurality”.<sup>1</sup> The former type does not play a big role in the German collective bargaining system (as well as in other countries) because of the “tariff unity” and “representative” principles which force the some type of labor under a single tariff contract within a firm.<sup>2,3</sup> While there exist additional legal practices which aim at suppressing tariff competition (for instance, extension rules which make the collective wage contract of the dominant union generally binding), unions often

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<sup>1</sup>Taking a labor law perspective, Rieble (1996) surveys the German system of collective bargaining and the possibility of multi-union representation at the firm-level. See Haucap, Pauly, and Wey (2006) for an analysis of the stability of the German system of collective bargaining which has become recently under pressure. Since the end of the second world war, legal practice has been stabilizing the bilateral monopoly of union-employer association bargaining at the industry level. With the liberalization of former state monopolies, German reunification, and labor market liberalizations new unions have entered the market and multi-union bargaining has become a reality for many firms.

<sup>2</sup>According to Kissel (2002, p. 275), the tariff unity principle is deducted from the higher-ranked principles of legal certainty and legal clarity. If more than one collective contract exists (e.g., because of a firm merger), then legal practice and rulings of the Federal Labor Court prescribe that in those cases the more specific collective agreement is valid which covers the majority of employment relations (see Kissel, 2002, p. 276, and Haucap, Pauly, and Wey, 2006).

<sup>3</sup>In contrast to Germany (which was dominated by a unified labor movement under the roof of the *Deutscher Gewerkschaftsbund*, DGB), countries like France, Belgium, the Netherlands, and Italy have a long history of trade union pluralism with trade unions being divided along ideological and sometimes confessional lines. The most important direct legal consequence in pluralistic labor markets is the confining of certain rights to “most representative” unions, so that only the “most representative” union of the workforce in question is eligible for concluding enterprise-level collective agreements (see, Forde, 1984, for an account of the representative criterion in France).

merge when competition becomes an issues. Most prominently, when sector boundaries in services became more and more blurred because of technological changes, in March 2001 the biggest union merger ever took place to establish the German Trade Union (*Ver-einte Dienstleistungsgewerkschaft*; in short: *Verdi*) with almost 3 million members (see, Haucap, Pauly, and Wey, 2007, p. 125 f.).<sup>4</sup>

In Germany, legal practice vis-à-vis craft unionism changed dramatically with the decision of the Federal Labor Court (*Bundesarbeitsgericht*) of 23 June 2010 to give up the tariff unity principle of “one firm - one tariff contract.” Since that time more than one tariff contract can coexist in a single firm if each tariff agreement deals with different types of labor. An example are hospitals in which case hospital doctors are (mainly) represented by the *Marburger Bund* (a craft union), while the remaining workers are represented by the German Trade Union (*Verdi*). Such a situation is called “tariff plurality” (“Tarif-pluralität”). In contrast to “tariff competition,” tariff plurality is characterized by unions representing workers which provide complementary services. Typically one workforce (as hospital doctors) is represented by a fully specialized craft union (Haucap, 2012).<sup>5</sup>

In Germany, craft unionism and multi-union bargaining are on the rise in other industries as well (Bachmann and Schmidt, 2012). The *Deutsche Bahn* (the dominant railway operator) must bargain with the German Train Drivers Union (*Gewerkschaft Deutscher*

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<sup>4</sup>The merger consisted of the following unions: *Deutsche Angestellten Gewerkschaft* (German Employees Union), *Deutsche Postgewerkschaft* (German Postal Service Union), *Gewerkschaft Handel, Banken und Versicherungen* (Retailing, Banking and Insurance Union), *Industriegewerkschaft Medien, Druck und Papier* (Media, Printing, and Paper Union), *Industriegewerkschaft Publizistik und Kunst* (Publishing and Art Union), and *Gewerkschaft Öffentliche Dienste, Transport und Verkehr* (Public Utilities, Transport, and Traffic Union).

<sup>5</sup>In general, collective bargaining in Germany was dominated by industry unions which are organized in the German association of unions (*Deutscher Gewerkschaftsbund*; DGB). The newly established craft unions are not members of the German association of unions, so that firms must determine employment condition with two unions in those instances (the craft union and the traditional industry union of the DGB).

*Lokomotivführer*; GDL) and the Railway and Transport Union (*Eisenbahn- und Verkehrsgewerkschaft*; EVG).<sup>6</sup> Again, the GDL is a fully specialized craft union which is complementary to workers represented by the other union EVG. The former one takes care of the train drivers' employment conditions and the latter one represents the remaining railway workers' interests. Other examples include airlines (where pilots are represented by *Vereinigung Cockpit*) and airports (where air traffic controllers are organized in the *Gewerkschaft der Flugsicherung*). As a consequence, employers find themselves exposed to the demands of more than one union while each union represents complementary types of employees.

Behind this background, we explore the consequences of multi-union bargaining, where a single employer bargains with two unions, each one representing either substitutable or complementary workers.<sup>7</sup> We suppose an efficient contracting setting where the union and

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<sup>6</sup>The EVG was founded on 30 November 2010 as a merger of the unions *Transnet* and *GDBA* (see Haucap, Pauly, and Wey, 2007). It is member of the German association of unions (*Deutscher Gewerkschaftsbund*; DGB).

<sup>7</sup>We also examine “tariff competition” (when workforces are substitutable) as a theoretical possibility even though Germany's and other countries' labor institutions are protective against this constellation. However, after the liberalization of the law on employment agencies (*Arbeitnehmerüberlassungsgesetz*) in 2003, employment channelled through employment agencies has been steadily growing in Germany (the Federal Agency for Employment, BFA, 2013, reports 822,000 leased laborers as of December 2012, which is a threefold increase after the 2003 reform). A result of this trend is that some firms have now two collective contracts for the same type of labor; one concluded with the industry union and another one concluded with the union representing workers of employment agencies. If the latter union is not member of the monopoly union (*Deutscher Gewerkschaftsbund*; DGB) but of a competing union (in particular, *Christliche Gewerkschaft für Zeitarbeit*; Christian Union for Temporary Work), then the result is “tariff competition.” Needless to say that the monopoly union (DGB) is heavily lobbying for legal changes to stop this development (see Haucap, Pauly, and Wey, 2006, 2007). The DGB filed a lawsuit against competing tariff contracts with employment agencies and on 14 December 2010 the Federal Court of Labor denied that the Christian Union is a “tariff-enabled” union, so that all concluded “competing” tariff contracts since 2003 became void.

the employer bargain over both the employment level and the wage rate. If bargaining is simultaneous when unions are separated, then we replicate existing results of the literature which show merger incentives in case of substitutable unions and disintegration incentives in case of complementary workforces. At the same time, labor contracts are always efficient; i.e., the employment level maximizes the joint surplus of all workers and the firm. Our main findings relate to sequential multi-union bargaining, where one union contracts first with the firm and the other union following.<sup>8</sup> If unions are substitutable, then the first union employs more workers than the second union, while in case of complementary unions the opposite is true. Hence, “tariff competition” leads to overemployment (i.e., the joint surplus maximizing employment level would be smaller). Our overemployment result for the case of substitutable unions mirrors a similar result obtained in Stole and Zwiebel (1996) who use the Shapley value to calculate workers’ wages.

In contrast, when the unions are complementary, “tariff plurality” (or, craft unionism) leads to underemployment (i.e., the joint surplus maximizing employment level would be larger). The first union does not internalize the negative externality of reducing its employment level on the second union. At the same time, the second union benefits from a worsened disagreement payoff of the firm which allows it to settle on a larger employment level than the first union. As bilateral bargaining is efficient (i.e., about both wage and employment), it follows that there is a first-mover (second-mover) advantage when the workforces are substitutable (complementary). This follows from applying the (symmetric) Nash bargaining solution which requires to split the net surplus equally. A larger employment level of a union then mirrors a larger contribution to the (bilateral) surplus, so that a union’s wage bill must be larger the larger its employment level.

If the two workforces are substitutable, then both unions prefer to form a single union and bargain jointly. A union merger increases the union’s bargaining power and each

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<sup>8</sup>Assuming sequential contracting in the realm of organized labor is adequate as tariff contracts are observable and immune against renegotiation for the agreed upon contract duration.

workforce realizes a higher wage bill. If the workforces are complementary, then the total wage bill is lower under joint bargaining when compared with independent sequential bargaining. Interestingly, the unions' interests are not aligned in case of complementarity. The first union would be better off under joint bargaining (given an equal split of the total wage bill), while the second union would lose. This results mirrors the lobbying activities of the incumbent monopoly unions in Germany (organized within the DGB) against craft unionism, while the workers organized in craft unions have been able to raise their wage bills at the cost of the established unions' workers.

Unions' merger incentives under tariff competition eliminate the overemployment outcome of sequential bargaining. In contrast, in case of tariff plurality (i.e., workers are complementary) unions prefer to stay independent which implies that the underemployment result persists. Taking a total welfare perspective by including consumer surplus as well, it follows that the unions' merger decisions always stay in conflict with social welfare maximization; i.e., when unions merge in case of substitutable groups of workers, this reduces total welfare, while their preference for separate bargaining in case of complementary workforces leads also to a reduction in total welfare.<sup>9</sup>

Our model builds on Horn and Wolinsky (1988a) who analyze negotiations between two labor unions and an employer. They focus on bargaining over a wage rate while the efficient employment level is exogenously fixed.<sup>10</sup> By that they can highlight the rent-shifting aspects of multi-union bargaining when compared with a bilateral monopoly. It is shown that unions benefit from joint bargaining when their labor inputs are substitutable,

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<sup>9</sup>Note that our model assumes a symmetric setting (except for the sequential timing of bargaining). If unions were asymmetric (e.g., because of different outside options), then the merger results may change.

<sup>10</sup>The case of bargaining over linear contracts with an elastic labor demand function was analyzed in Horn and Wolinsky (1988b). While the results concerning unions' merger incentives remain valid, double marginalization problems provoke additional inefficiencies. Jun (1989) presents a fully specified extensive form game to solve the "two-unions one-firm" bargaining problem. It is shown that asymmetries among unions make separation more likely.

while unions prefer to bargain separately when their labor inputs are complementary.

Our sequential bargaining model is related to Marx and Shaffer (1999) where two suppliers bargain sequentially with a single retailer over two-part tariff contracts. Sequential bargaining leads to “predatory accommodation” such that the first contract specifies a wholesale price below cost in order to shift rents from the second supplier to the first supplier. In contrast, we examine employment-wage contracts and we consider both substitutable and complementary (labor) inputs.<sup>11</sup>

Cai (2000) analyzes a model where a buyer bargains sequentially with two perfectly complementary sellers where the order of reaching an agreement is endogenously determined.<sup>12</sup> He shows the existence of a delay equilibrium which is driven by the fact that the “last” seller obtains a larger share of the joint surplus.<sup>13</sup>

## 2 The Model

We consider a firm (the employer) which has to reach agreements with two unions  $X$  and  $Y$  to produce two goods (or services). Production of good 1 requires only labor input

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<sup>11</sup>The idea of rent-shifting in sequential contracting goes back to Aghion and Bolton (1987) where the first contract is an exclusive contract which stipulates a costly exit clause. Related is also Marx and Shaffer (2007) who consider contingent two-part tariff contracts. Finally, von Schlippenbach and Wey (2011) and Caprice and von Schlippenbach (2013) consider demand complementarities resulting from one-stop shopping behavior. The latter work (which extends Marx and Shaffer, 1999) derives a slotting-fee equilibrium where the first supplier pays a slotting fee to the retailer and obtains a positive margin per each unit sold.

<sup>12</sup>Chongvilaivan, Hur, and Riyanto (2013) consider the case of a firm bargaining with a union and an input supplier over linear input prices, where the union and the supplier are perfectly complementary. Depending on the firm’s (exogenous Nash) bargaining power, it may prefer to bargain sequentially or simultaneously, or it may prefer to integrate with the supplier before bargaining with the union.

<sup>13</sup>In our sequential bargaining setting we assume a fixed order of negotiations. If the unions are complementary, the last union obtains a higher wage bill than the first union. According to Cai (2000) this ordering may lead to delays (strikes) which could be avoided by a union merger.



from union  $X$  with constant returns to labor input, i.e.;  $q_1 = x$ , where  $q_1$  is the output of good (service) 1 and  $x$  is the employment level of the workforce represented by union  $X$ . Similarly, production of good 2 requires only labor input from union  $Y$  with constant returns to labor input, i.e.,  $q_2 = y$ , where  $q_2$  is the output of good (service) 2 and  $y$  is the employment level of the workforce represented by union  $Y$ . The inverse demand for good  $i$  is assumed to be linear and given by  $p_i(q_i, q_j) = 1 - q_i - \gamma q_j$ , with  $i, j = 1, 2$  and  $i \neq j$ , where  $p_i$  is the price of good  $i$  and the parameter  $\gamma$  describes product differentiation with  $\gamma \in (\bar{\gamma}, 1]$  and  $\bar{\gamma} := -1/2$ .<sup>14</sup> The sign of the parameter  $\gamma$  determines whether the labor inputs of the two unions are substitutes ( $\gamma > 0$ ) or complements ( $\gamma < 0$ ) (products and labor inputs are independent for  $\gamma = 0$ ).

The parameter  $\gamma$  determines the relationship between the two workforces represented by unions  $X$  and  $Y$ , respectively. If the products (or, services) are substitutable ( $\gamma > 0$ ), then the workforces and their respective unions are also substitutable which mirrors the case of tariff competition. If, to the contrary, the products (or services) are complementary ( $\gamma < 0$ ), then the workforces and their unions are complementary which stands for the case of tariff plurality.<sup>15</sup>

We assume an efficient bargaining setting, so that the firm bargains with each union over both the wage and the employment level.<sup>16</sup> When unions operate independently, then

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<sup>14</sup>The upper bound  $\gamma = 1$  follows from noting that the two goods are homogenous at this value. The lower bound  $\bar{\gamma}$  ensures that the firm's profit function is strictly positive in the (unique) interior equilibrium. A qualitatively similar restriction on the complementarity of the unions' work forces is also invoked in Horn and Wolinsky (1988a). Otherwise, if complementarity becomes too strong, each union would get more than one-half of the joint surplus under separate bargaining which would lead to a negative profit level of the firm.

<sup>15</sup>We can also express the relationship between both workforces by the change of the marginal product of labor with respect to the labor input of the other workforce. Formally, we then get  $\frac{\partial^2((1-q_i-\gamma q_j))}{\partial l_i \partial l_j} = -\gamma$ , for  $i, j = 1, 2$  and  $i \neq j$ , which is positive (negative) if  $\gamma < 0$  ( $\gamma > 0$ ).

<sup>16</sup>The labor economics literature distinguishes between the right-to-manage model (bargaining only about wage) and the efficient bargaining model (bargaining about both wage and employment level).

bargaining proceeds bilaterally and simultaneously. The firm negotiates with union  $X$  (union  $Y$ ) over the employment level  $x$  ( $y$ ) and the wage rate  $w$  ( $r$ ). When negotiations are successful, then the firm produces quantities  $q_1$  and  $q_2$  and realizes profits  $\pi(x, w, y, r) = \sum_{i=1}^2 p_i(q_i, q_j)q_i - xw - yr$ .<sup>17</sup> Unions  $X$  and union  $Y$  maximize their wage bills given by  $xw$  and  $yr$ , respectively. We use the well-known Nash bargaining solution to solve for optimal contracts. We analyze firstly the bargaining problems in Section 2.1 (simultaneous and joint bargaining) and Section 2.2 (sequential bargaining). Secondly, in Section 3 we analyze unions' incentives to merge in an initial stage "0", with the bargaining game (either joint or sequential bargaining) following thereafter.

## 2.1 Simultaneous and Joint Bargaining Benchmarks

We start with the analysis of simultaneous and joint bargaining between the firm and the unions to provide benchmarks which allow us to highlight the effects of sequential bargaining. First, consider simultaneous bargaining when unions are separated. If the firm reaches an agreement with both unions, then its profit is  $\pi(x, w, y, r)$ . If the firm fails to reach an agreement with union  $X$  or union  $Y$ , then its profit is given by the disagreement points  $\pi^{DX} := \pi(0, 0, y, r) = (1 - y)y - ry$  or  $\pi^{DY} := \pi(x, w, 0, 0) = (1 - x)x - wx$ , respectively. Hence, the firm has a positive disagreement point when bargaining with each union, while the unions do not have a similar valuable outside option at hand. The

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See Oswald and Turnbull (1985) and Booth (1995) for surveys and Petrakis and Vlassis (2000) for an endogenous determination of the scope of union-firm bargaining.

<sup>17</sup>In the following, we will write the firm's profit directly as a function of the employment levels as we assumed  $q_1 = x$  and  $q_2 = y$ .

Nash bargaining problem between the firm and union  $X$  can then be written as<sup>18</sup>

$$\begin{aligned} \max_{x,w} [\pi(x, w, y, r) - \pi^{DX}]wx & \quad (1) \\ = [(1 - x - \gamma y)x + (1 - y - \gamma x)y - wx - yr) - ((1 - y)y - ry)]xw, \end{aligned}$$

while the Nash bargaining problem between the firm and union  $Y$  can be stated similarly as

$$\begin{aligned} \max_{r,y} [\pi(x, w, y, r) - \pi^{DY}]yr & \quad (2) \\ = [(1 - x - \gamma y)x + (1 - y - \gamma x)y - wx - yr) - ((1 - x)x - wx)]yr. \end{aligned}$$

As the unions are symmetric, in equilibrium the optimal number of employed workers and their wages are the same for both unions. The following contract solves the simultaneous bargaining problems (1) and (2) (the superscript “*sim*” stands for simultaneous bargaining)

$$w^{sim} = r^{sim} = \frac{1}{4(1 + \gamma)} \text{ and } x^{sim} = y^{sim} = \frac{1}{2(1 + \gamma)}.$$

The equilibrium employment levels are efficient; i.e.,  $x^{sim} = y^{sim}$  maximize the joint surplus which is given by  $\Pi := \pi + wx + ry = \sum_{i=1}^2 p_i(q_i, q_j)q_i$ . Substituting the equilibrium values we get  $\Pi^{sim} = 1/[2(1 + \gamma)]$ . The firm’s equilibrium profit is given by

$$\pi^{sim} = \frac{1 + 2\gamma}{4(1 + \gamma)^2}.$$

To understand how the relationship between both unions’ workforces (as measured by the parameter  $\gamma$ ) affects the surplus sharing, it is instructive to calculate the share the firm

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<sup>18</sup>Each bargaining pair takes the wage-employment contract of the other bargaining pair as given when maximizing their Nash product. By that we solve for a Nash equilibrium of two simultaneous bargaining problems (see Chipty and Snyder, 1999, for a formalization). Inderst and Wey (2003) assume contracts which condition on the fact whether or not the other bargaining is successful. They show that this protocol gives rise to the Shapley value (see also Stole and Zwiebel, 1996). Our results are easily shown to be qualitatively robust in this regard.

gets from the joint surplus. We obtain

$$\frac{\pi^{sim}}{\Pi^{sim}} = \frac{2\gamma + 1}{2(1 + \gamma)}$$

from which it follows that the firm's share is monotonically increasing in  $\gamma$ . When goods are independent, then the firm gets exactly one-half of the joint surplus. Its share increases beyond one-half, when the unions' workforces become more and more substitutable (at  $\gamma = 1$ , the firm obtains 3/4 of the joint surplus). In contrast, the firm's share decreases when the two unions become less substitutable (for  $\gamma > 0$ ) or more complementary (for  $\gamma < 0$ ). In fact, for the case of complementary goods, as  $\gamma \rightarrow -1/2$  the firm's share goes to zero. Of course, the opposite relationship holds for the unions' wage bills which are monotonically decreasing in  $\gamma$ .

Those relationships are intuitive. When goods become more substitutable then each union's bargaining power decreases accordingly. For the case of complementary goods ( $\gamma < 0$ ), the unions exert their largest bargaining power. In the most complementary case (when  $\gamma \rightarrow -1/2$ ) the unions are able to pocket the entire joint surplus.

An intermediate result is that unions have incentives to form a single bargaining unit when goods are substitutes while they prefer to bargain separately when their workforces are complementary (see Horn and Wolinsky, 1988a). This follows directly from observing that the joint surplus is always shared equally when both workforces are represented by a single union which bargains with the firm. The firm's share must then be equal to one-half. As the firm's share under separate bargaining is larger (smaller) than one-half when goods are substitutes (complements), the unions want to merge (stay separate) when the workers are substitutable (complementary).

Formally, consider that unions  $X$  and  $Y$  join in a single encompassing union to negotiate with the firm. We consider the Nash bargaining problem between the firm and the encompassing union over wages and employment levels of worker groups  $X$  and  $Y$ . In the case of agreement over the contract  $(w, x, r, y)$ , the firm's profit is given by  $\pi(x, w, y, r) = \sum_{i=1}^2 p_i q_i - xw - yr$ , while the encompassing union receives  $wx + ry$ . In

case of disagreement, the firm must shut down and gets zero profit. The union does not have an outside option, i.e., its disagreement payoff is zero. The Nash bargaining problem, therefore, can be written as

$$\max_{w,x,r,y} \left[ \sum_{i=1}^2 p_i q_i - xw - yr \right] [xw + yr]. \quad (3)$$

The optimal levels of employment which solve this problem are (the superscript “ $joi$ ” indicates equilibrium values under joint bargaining)

$$x^{joi} = y^{joi} = \frac{1}{2(1 + \gamma)}$$

which are the same as under simultaneous bargaining. Obviously, under efficient bargaining the employment levels must maximize the parties’ joint surplus. The production quantities are then given by  $q_1^{joi} = x^{joi}$  and  $q_2^{joi} = y^{joi}$  for good 1 and good 2, respectively. The union’s wage bill which solves the Nash bargaining problem (3) is given by<sup>19</sup>

$$w^{joi} x^{joi} + r^{joi} y^{joi} = \frac{1}{4(1 + \gamma)}. \quad (4)$$

Accordingly, the firm’s total profit under contract  $(w^{joi}, x^{joi}, r^{joi}, y^{joi})$  is

$$\pi^{joi} = \frac{1}{4(1 + \gamma)}.$$

It follows that the encompassing union and the firm share the bargaining surplus equally for all possible values of  $\gamma$ ; i.e.,  $\pi^{joi} / \Pi^{joi} = 1/2$ , where  $\Pi^{joi} := \pi^{joi} + w^{joi} x^{joi} + r^{joi} y^{joi}$ . The following proposition summarizes our results which mirrors findings obtained in Horn and Wolinsky (1988a).<sup>20</sup>

**Proposition 1.** *Suppose union-firm bargaining determines both the employment level and the wage rate. Simultaneous bargaining as well as joint bargaining then lead to efficient*

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<sup>19</sup>The wage rate is given by  $w^{joi} = 1/4$ .

<sup>20</sup>One can quite easily introduce asymmetries between unions into the above setting. For instance, both unions may have positive but different payoffs in case of breakdown of bargaining. Under simultaneous bargaining, an increase of a union’s disagreement point will then increase its wage bill by the same amount. This also implies different wage bills for the unions when they have different disagreement

*employment levels. Under joint bargaining the entire surplus is shared equally between workers and the firm, while under simultaneous bargaining the firm's share of overall surplus is monotonically increasing in  $\gamma$ ; i.e., increases when the two workforces become more substitutable or less complementary. Workers are jointly better off under joint bargaining when the two workforces are substitutable, while they do better under separate bargaining when they are complementary.*

We now turn to sequential bargaining which reveals how bargaining externalities lead to inefficiencies depending on the nature of the two workforces. Those inefficiencies will have a pronounced effects on the overall employment level under separate bargaining and on the unions' incentives to integrate in the first place.

## 2.2 Sequential Bargaining

The firm bargains bilaterally and sequentially with the two unions. In the first stage, the firm negotiates a contract with union  $X$  over both the employment level,  $x$ , and the wage rate,  $w$ . In the second stage, the bargaining outcome of the first stage becomes public and the firm negotiates a contract with union  $Y$  which specifies employment level,  $y$ , and a wage rate,  $r$ . With that, the firm also determines its production quantities  $q_1$  and  $q_2$  and realizes its profit  $\pi(x, w, y, r) = \sum_{i=1}^2 p_i q_i - xw - yr$  if bargaining is successful. The unions receive their wage bills at the end of the game. The total wage bill for union  $X$  is  $wx$ , and for union  $Y$  it is  $yr$ . For each bargaining problem we use the Nash bargaining solution.<sup>21</sup> We solve the game by backward induction.

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points. It then also follows that two unions with different disagreement point may be unable to agree to merge their operations even if they organize substitutable workers. Such a constellation can be observed in Germany for the case of temporary workers where some kind of tariff competition exists where unions have been unable to merge so far.

<sup>21</sup>Our approach to sequential bargaining (in particular, the application of the Nash bargaining solution and the specification of the firm's disagreement points) builds on Marx and Shaffer (1991) where supplier-retailer bargaining over two-part tariffs is analyzed.

Suppose bargaining was successful in the first stage which resulted in a contract  $(w, x)$ . Then, in the second stage, the firm and union  $Y$  take the contract  $(w, x)$  as given when bargaining over the wage  $r$  and the employment level  $y$ . If the firm reaches an agreement with union  $Y$  over a contract  $(r, y)$ , then it gets the profit  $\pi(x, w, y, r)$ . In this case, union  $Y$  realizes the wage bill  $ry$ . In the case of disagreement, the firm can only produce good 1 and realizes the profit  $\pi^{DY} := \pi(x, w, 0, 0) = (1 - x)x - xw$  which defines the firm's disagreement point when bargaining with union  $Y$ . Again, we assume that union  $Y$ 's disagreement point is zero. The Nash bargaining problem between the firm and union  $Y$  is then given by

$$\begin{aligned} \max_{y,r} [\pi(x, w, y, r) - \pi^{DY}] yr & \quad (5) \\ = [(1 - x - \gamma y)x + (1 - y - \gamma x)y - xw - yr] - ((1 - x)x - xw) & \quad yr. \end{aligned}$$

The optimal contract  $(\hat{r}(x), \hat{y}(x))$  which depends on the employment level  $x$  the firm agreed upon with union  $X$ , follows from the first-order conditions of the Nash Bargaining problem (5). Straight forward calculations yield

$$\hat{r}(x) = \frac{1 - 2\gamma x}{4} \text{ and } \hat{y}(x) = \frac{1}{2} - \gamma x. \quad (6)$$

Unless the unions' workforces are independent, the optimal contract between the firm and the union  $Y$  depends on the quantity of workers employed from union  $X$ . If labor unions produce substitutable goods, i.e.,  $\gamma > 0$ , then both the employment level and the wage rate decrease in the employment level  $x$ . The opposite is true for complementary unions.

In the first stage, the firm and union  $X$  take the optimal strategies (6) as given when they bargain over employment  $x$  and the wage  $w$ . If the firm reaches an agreement with union  $X$  over the contract  $(w, x)$ , then its expected profit is  $\pi(x, w, \hat{y}(x), \hat{r}(x))$ . In this case, union  $X$  obtains the wage bill  $wx$ . In the case of disagreement with union  $X$ , the firm can only produce good 2 and realizes an expected profit of  $\pi^{DX} := \pi(0, 0, \hat{y}(0), \hat{r}(0))$  which gives  $\pi^{DX} = 1/8$  as  $\hat{y}(0) = 1/2$  and  $\hat{r}(0) = 1/4$  follow from (6). Hence,  $\pi^{DX} = 1/8$

is the firm's (fixed) disagreement point when bargaining with union  $X$ . Union  $X$  realizes a wage bill of zero when bargaining is not successful.

The Nash bargaining problem between the firm and union  $X$  can be stated as

$$\begin{aligned} \max_{x,w} [\pi(x, w, \hat{y}(x), \hat{r}(x)) - \pi^{DX}] xw & \quad (7) \\ &= [(1 - x - \gamma \hat{y}(x))x + (1 - \hat{y}(x) - \gamma x)\hat{y}(x) - wx - \hat{r}(x)\hat{y}(x) - 1/8] xw \\ &= \left[ -\frac{1}{2}\gamma x + \frac{1}{2}\gamma^2 x^2 + x - x^2 - xw \right] xw, \end{aligned}$$

where the last equality follows from substituting (6) into (7). The contract  $(w^*, x^*)$  which solves the Nash bargaining problem (7) is given by (asterisks indicate equilibrium values)

$$w^* = \frac{2 - \gamma}{8} \text{ and } x^* = \frac{2 - \gamma}{2(2 - \gamma^2)}. \quad (8)$$

Substituting (8) into (6) we obtain the equilibrium contract for union  $Y$  which is given by

$$r^* = \frac{1 - \gamma}{2(2 - \gamma^2)} \text{ and } y^* = \frac{1 - \gamma}{2 - \gamma^2}. \quad (9)$$

The equilibrium quantities of the goods 1 and 2 are then  $q_1^* = x^*$  and  $q_2^* = y^*$ , respectively.

The firm's equilibrium profit then becomes

$$\pi^* = \frac{8 - 4\gamma - \gamma^2}{16(2 - \gamma^2)},$$

while union  $X$ 's wage bill is

$$w^* x^* = \frac{(2 - \gamma)^2}{16(2 - \gamma^2)}, \quad (10)$$

and union  $Y$ 's wage bill is

$$r^* y^* = \frac{(1 - \gamma)^2}{2(2 - \gamma^2)^2}. \quad (11)$$

The firm's share of total surplus which follows from  $\pi^*/\Pi^*$ , with  $\Pi^* := \pi^* + w^* x^* + r^* y^* = (2\gamma^3 - \gamma^2 - 8\gamma + 8)/(4(2 - \gamma^2)^2)$ , is monotonically increasing in  $\gamma$ . It reaches one-half at  $\gamma = 0$  and  $3/4$  at  $\gamma = 1$ . However, when products are complementary and  $\gamma \rightarrow -1/2$ , then the firm's share of total surplus is roughly 37% which reveals a sharp difference



to the cases of simultaneous bargaining and joint bargaining. Before we fully compare the different bargaining regimes, the next lemma summarizes the orderings of wages, employment levels, and wage bills under sequential bargaining.<sup>22</sup>

**Lemma 1.** *Consider sequential multi-union bargaining (union  $X$  bargains first and union  $Y$  secondly). Then the following orderings hold:*

- i)  $w^* > r^*$  ( $w^* < r^*$ ) if  $\gamma > 0$  ( $\gamma < 0$ ), with equality holding for  $\gamma = 0$ .*
- ii)  $x^* > y^*$  ( $x^* < y^*$ ) if  $\gamma > 0$  ( $\gamma < 0$ ), with equality holding for  $\gamma = 0$ .*
- iii)  $w^*x^* > r^*y^*$  ( $w^*x^* < r^*y^*$ ) if  $\gamma > 0$  ( $\gamma < 0$ ), with equality holding for  $\gamma = 0$ .*

Sequential bargaining creates externalities between the two union-firm bargaining pairs which affect the unions' wage bills differently. The sign of the externality of the first contract  $(x, w)$  on the second contract  $(y, r)$  can be seen immediately from the optimal bargaining outcome with union  $Y$  (namely, (6)). Of course, the externality is negative (positive) if both workforces are substitutable (complementary). Now note that each bargaining pair maximizes the joint surplus over the firm's disagreement point. As bargaining is about both the wage rate and the employment level, this outcome is always bilaterally efficient if successful; i.e., the *net* surplus is maximized and split equally. Note next that the firm's disagreement point when bargaining with the first union  $X$  is fixed at  $\pi^{DX^*} = 1/8$  which follows from the optimal contract (6) which the will firm agree upon with union  $Y$  in case of a settlement. To the contrary, the firm's (equilibrium) disagreement point when bargaining with the second union  $Y$  is given by  $\pi^{DY^*} := \pi(x^*, w^*, 0, 0) = (1-x^*)x^* - x^*w^*$ . Substituting the equilibrium values (8) yields

$$\pi^{DY^*} = (\gamma^4 + 4\gamma^3 - 18\gamma^2 + 8\gamma + 8) / [16(2 - \gamma^2)^2].$$

Inspection of the difference  $\pi^{DY^*} - \pi^{DX^*}$  gives that

$$\frac{\partial(\pi^{DY^*} - \pi^{DX^*})}{\partial\gamma} > 0 \text{ with } \text{sign}[\pi^{DY^*} - \pi^{DX^*}] = \text{sign}[\gamma],$$

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<sup>22</sup>The proof follows directly from inspecting the respective equilibrium values.

and  $\pi^{DY^*} - \pi^{DX^*} = 0$  for  $\gamma = 0$ . Hence, the firm enjoys a better disagreement point when bargaining with union  $Y$  if the unions are substitutable (i.e.,  $\pi^{DY^*} > \pi^{DX^*}$  for  $\gamma > 0$ ). Because of the symmetry of the bargaining problems, it follows immediately that union  $Y$  obtains a smaller wage bill than union  $X$ . This wage bill reduction is caused by a negative externality the first union  $X$  exerts on the second union  $Y$ . It also implies a first-mover advantage for unions when workforces are substitutable.

In the case of complementary unions (“craft unionism”), the opposite is true; i.e., the firm’s disagreement point is better when bargaining with the first union  $X$  (i.e.,  $\pi^{DX^*} > \pi^{DY^*}$  for  $\gamma < 0$ ). The first union  $X$  creates a positive externality on the second union  $Y$ , if it reaches an agreement with the firm. This implies that union  $X$ ’s wage bill must be smaller than union  $Y$ ’s wage bill which mirrors the second-mover advantage under craft unionism.<sup>23</sup>

### 3 Joint versus Separate Bargaining

We examine the incentives of the unions  $X$  and  $Y$  to form a single union before bargaining starts. If unions merge, then the bargaining outcome is given by  $(w^{joi}, x^{joi}, r^{joi}, y^{joi})$ . If the unions do not merge, then bargaining is assumed to be sequential with union  $X$  bargaining first with the firm followed by union  $Y$  (the solutions given by (8) and (9)). Before solving the entire game, it is instructive to perform some comparisons between the joint bargaining outcome and the sequential bargaining equilibrium.

Sequential bargaining has the following impact on employment levels when compared with joint bargaining.

**Lemma 2.** *Consider sequential multi-union bargaining (union  $X$  first and union  $Y$  second). Comparison of the employment levels of both unions under joint bargaining and*

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<sup>23</sup>This result is in line with Cai’s (2000) finding that equilibrium delay is possible when two sellers are complementary as each one prefers to be the last bargaining partner.

*sequential bargaining gives rise to the following orderings:*

- i)  $x^* > x^{joi}$  ( $x^* < x^{joi}$ ) if  $\gamma > 0$  ( $\gamma < 0$ ), with equality holding for  $\gamma = 0$ .*
- ii)  $y^* < y^{joi}$  for all  $\gamma \neq 0$ , with equality holding for  $\gamma = 0$ .*
- iii)  $x^* + y^* > x^{joi} + y^{joi}$  ( $x^* + y^* < x^{joi} + y^{joi}$ ) if  $\gamma > 0$  ( $\gamma < 0$ ), with equality holding for  $\gamma = 0$  and  $\gamma = 1$ .*

If the workforces are substitutable, then the firm hires more workers from the first union than the efficient level. The second union  $Y$  optimally responds by reducing its employment level below the efficient level. The overall effect on employment by the firm is positive and overemployment is the outcome (part *iii*) of Lemma 2). If both workforces are complementary, then the first union  $X$  reduces its employment level below the efficient level which induces the second union  $Y$  to reduce its employment level also below the efficient level. Part *iii*) of Lemma 2 shows that these changes lead to an inefficiently low employment level when workers are complementary. In fact, both unions reduce their employment levels below the efficient level so that underemployment occurs unambiguously under tariff plurality (craft unionism).

We next compare the wage rates under joint bargaining and under sequential bargaining.

**Lemma 3.** *Consider sequential multi-union bargaining (union  $X$  first and union  $Y$  second). Comparison of the wage rates of both unions under joint bargaining and sequential bargaining gives rise to the following orderings:*

- i)  $w^* < w^{joi}$  ( $w^* > w^{joi}$ ) if  $\gamma > 0$  ( $\gamma < 0$ ), with equality holding for  $\gamma = 0$ .*
- ii)  $r^* < w^{joi}$  ( $r^* > w^{joi}$ ) if  $\gamma > 0$  ( $\gamma < 0$ ), with equality holding for  $\gamma = 0$ .*
- iii)  $\partial(w^{joi} - w^*)/\partial\gamma > 0$  and  $\partial(w^{joi} - r^*)/\partial\gamma > 0$  for all  $\gamma \in (\bar{\gamma}, 1]$ .*

Both unions' wage rates are lower under sequential bargaining than under joint bargaining when workers are substitutable ( $\gamma > 0$ ). The opposite holds, when workers are complementary ( $\gamma < 0$ ). Part *iii*) of Lemma 3 shows that the relationships between the wages under sequential bargaining when compared with the wage under joint bargaining

are positively monotone; i.e., the differences  $w^{joi} - w^*$  and  $w^{joi} - r^*$  are strictly increasing over the range of admissible values of  $\gamma$ .

The following proposition summarizes both unions' merger decision in the initial stage "0" and the subgame perfect equilibrium outcomes for all values of  $\gamma$ .

**Proposition 2.** *Unions X and Y have strict incentives to merge if workers are substitutable ( $\gamma > 0$ ) while they have strict incentives to stay independent when workers are complementary ( $\gamma < 0$ ), with indifference holding for  $\gamma = 0$ . The following contracts are then implemented in equilibrium:*

- i) If  $\gamma \geq 0$ , then wages and employment levels are given by  $(w^{joi}, x^{joi}, r^{joi}, y^{joi})$ .*
- ii) If  $\gamma < 0$ , then wages and employment levels are given by  $(w^*, x^*, r^*, y^*)$ .*

The proof of Proposition 2 follows directly from comparing the wage bill under joint bargaining (4) with the sum of the wage bills under sequential bargaining (10) and (11). If the goods are substitutes ( $\gamma > 0$ ), the total wage bill is larger under joint bargaining than the sum of both unions' wage bills under sequential bargaining. The opposite is true if both workforces are complementary ( $\gamma < 0$ ) in which case unions prefer to bargain independently.

When workforces are substitutable, then there is no conflict of interest between the unions even if they split the surplus equally under joint bargaining; i.e.,

$$\frac{w^{joi}x^{joi} + r^{joi}y^{joi}}{2} - r^*y^* > \frac{w^{joi}x^{joi} + r^{joi}y^{joi}}{2} - w^*x^* > 0, \text{ for } \gamma > 0.$$

It follows that both unions agree to merge when being substitutable, so that the efficient outcome is achieved. Bargaining independently would lead to negative externalities (in particular, overemployment) with an overall lower wage bill.

In contrast, if workers are complementary, then the unions do not find it jointly attractive to integrate both workforces into a single union even though joint bargaining would increase the entire surplus available for the workers and the firm. However, interests are not as cleanly aligned as in the case of substitutes. To see this, suppose that both work-

forces share the wage bill equally under joint bargaining. It is then true that union  $X$  would benefit from integration while union  $Y$  would be worse off; i.e.,

$$\frac{w^{joi}x^{joi} + r^{joi}y^{joi}}{2} - w^*x^* > 0 > \frac{w^{joi}x^{joi} + r^{joi}y^{joi}}{2} - r^*y^* \text{ for } \gamma < 0.$$

Union  $X$  (which bargains first) prefers one-half of the total wage bill realized under joint bargaining. In contrast, union  $Y$ 's wage bill is higher under sequential bargaining when compared with one-half of the overall wage bill under joint bargaining. Both unions, therefore, must disagree about the question whether or not to integrate their workers into a single union.<sup>24</sup> In total, unions realize a higher wage bill under sequential bargaining when compared with the wage bill realized under joint bargaining. It follows that the possibility of a union merger does not eliminate the underemployment inefficiency associated with craft unionism.

Until now we have focused on the joint surplus of the bargaining parties as our measure of efficiency (i.e., the sum of the firm's profit and both unions' wage bills). If we consider also consumer surplus to take a total welfare perspective, we obtain the following result.

**Corollary 1.** *Consider the entire game where the unions can first decide to merge and then either bargain jointly with the firm or independently and sequentially. It is then always true that the unions' merger decision is in conflict with total welfare maximization; i.e., the unions' decision to merge when workers are substitutable reduces total welfare which is also true for the unions' decision to stay separated when workers are complementary.*

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<sup>24</sup>In fact, the incumbent monopoly unions (organized in the *Deutscher Gewerkschaftsbund*; DGB) heavily lobby against craft unionism so as to re-integrate "renegade" workers. In contrast, of course, craft unions as the *Marburger Bund* or the *Gewerkschaft Deutscher Lokomotivführer* (GDL) have been fighting for recognition in the last years. In our model, union  $X$  (which is disadvantaged as a first-mover) would have an incentive to lobby for integration while union  $Y$  (which benefits from the second-mover advantage) would oppose such demands. In that sense, newly formed craft unions may benefit from a second-mover advantage which allows them to obtain a large wage bill at the cost of the wage bill of the incumbent union's workers.

The proof of Corollary 1 follows from observing that total welfare is given by the sum of consumer surplus and the sum of the firm's profit plus workers' wage bills. Of course, this welfare measure is monotonically increasing in the employment levels of both workforces in the relevant range. As the unions' decisions to merge under substitutable workforces and not to merge under complementary workforces both reduce the employment levels both decisions must also reduce social welfare. We conclude that Corollary 1, therefore, mirrors the often mentioned assessment that (powerful) unionism in general (and not only craft unionism) is a challenge to a society's well-being (see, e.g., Simon, 1944).

## 4 Conclusion

We have analyzed multi-union bargaining which is an issue in countries with a fragmented labor movement. In countries like France, Italy, or Belgium, and also more recently, in Germany trade union pluralism is a fact which has not been much analyzed in the existing literature on union-firm bargaining. Even if unions can merge freely their businesses such an outcome is not likely in the presence of craft unionism. When unions' workforces are complementary (tariff plurality), then they can achieve a higher surplus when bargaining separately. As union-firm bargaining is characterized by an observable (and not renegotiable) tariff agreement, multi-union bargaining is adequately modelled as a sequential procedure.<sup>25</sup> Sequential bargaining leads to overemployment under substitutable unions which then have strong incentives to form a single union. In contrast, under craft unionism the sequential bargaining outcome is characterized by underemployment. As unions prefer to stay independent when workers are complementary, the underemployment inefficiency can be expected to persist.

The relevance of our model is underlined by the recent bargaining between the *Deutsche Bahn* (the dominant railway operator in Germany) and the German Train Drivers Union

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<sup>25</sup>Note the difference to negotiations in non-labor input markets which are typically not observable, rather complex and not protected against re-negotiations.

(*Gewerkschaft Deutscher Lokomotivführer*; GDL) and the Railway and Transport Union (*Eisenbahn- und Verkehrsgewerkschaft*; EVG). While the latter union (which is part of the DGB) reached an agreement with the Deutsche Bahn in 2013 over employment security issues, the craft union GDL delayed negotiations until today to obtain a better contract for the train drivers by ripping off its second-mover advantage.<sup>26</sup>

Unions' merger incentives are exactly opposite to the social welfare maximizing union structure. If the represented workforces are substitutable, then "tariff competition" would be socially desirable, but unions' incentive to monopolize the labor market prevail. If, to the contrary, the workforces of the unions are complementary, then "tariff plurality" is socially inferior to joint bargaining, but unions' rent-shifting incentive back union plurality.

Many labor laws are extremely defensive against a fragmented union structure at the firm level. In Germany, for instance, tariff competition at the firm-level is directly fought by several instruments as the tariff-unity principle and entry-detering strategies which assign the privilege of collective bargaining exclusively to a single union and (last but not least) extension rules which make the dominant tariff contract generally binding for all workers of a particular type in a certain industry. While those measures have been quite successful in the past, they mainly help to monopolize the labor supply and to protect it against competition.

Interestingly, tariff pluralism (or, craft unionism) is on the rise as labor institutions are less restrictive in this regard. Recently legal practice in Germany has been reassuring that tariff pluralism cannot be eliminated by the tariff-unity principle, so that firms must come to terms with powerful craft unions. A fragmented union structure is likely to persist as craft unions have strong incentives to stay independent. From a social point of view that trend is likely to induce underemployment which harms social welfare.

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<sup>26</sup>See the newspaper article "*Von Mitte Januar an drohen Zugausfälle - Lokführergewerkschaft stellt nach gescheiterten Tarifverhandlungen Streiks in Aussicht*" published in the *Frankfurter Allgemeine Zeitung*, 3 January 2014, p. 11.

Our analysis can be extended in several directions. First, asymmetries between unions may change bargaining outcomes and union merger incentives. It would be interesting to analyze both the different sources for union asymmetries and their consequences on equilibrium outcomes. Second, labor institutions may treat unions differently (for instance, depending on their “representativeness” of a firm’s employees) which may force unions to merge even when they are complementary.

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