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Author
Matschke, Xenia

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LABOR MARKET RIGIDITIES AND THE POLITICAL ECONOMY OF TRADE PROTECTION

XENIA MATSCHKE

Abstract. Labor market rigidities are commonly believed to be a major reason for imposing trade impediments. In this paper, I introduce labor market rigidities (such as influential trade unions and high unemployment benefits), that are prevalent in continental European countries, into the well-known Grossman and Helpman (1994) protection for sale model, which has emerged as the leading model in the political economy of trade protection literature. I show that contrary to commonly held views, these labor market rigidities do not necessarily increase equilibrium trade protection. A testable equilibrium trade protection equation is also derived. The findings in this paper are hence particularly relevant for empirical tests of trade policy determinants in economies with more regulated labor markets.

1. Introduction

There are many reasons to believe that employment considerations are a major determinant of trade protection. The conventional wisdom is that labor market rigidities will increase the level of trade protection. Trade union influence, for instance, is usually believed to lead to higher import barriers. Since trade protection allows unions to demand higher wages and/or employment guarantees, unions are likely to favor the imposition of trade barriers. Not surprisingly then, U.S. trade unions led a determined public campaign against the ratification of NAFTA, and union contributions to U.S. congressmen were positively

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correlated with the likelihood that these representatives voted against trade liberalization.[1] Moreover, firms may also become less flexible in adapting to increased import competition when facing binding collective bargaining agreements, so they may lobby for compensating trade protection. Labor immobility seems similarly linked to higher trade protection: Sectorally immobile workers depend more strongly on the ups and downs of a particular industry and are thus more likely to be hurt by an increase in import competition. Hence, they are more likely to lobby for protection. And finally, inflexible wages, caused by trade union activity or by effective minimum wages, can cause unemployment when import competition increases. When labor is immobile and wages cannot adjust downward, it is well known that import barriers may be welfare-enhancing, so higher trade protection may result even without assuming any lobby influence. Not surprisingly, high unemployment rates, low employment growth rates, and high shares of unskilled labor have been found to go hand in hand with higher trade protection (Rodrik, 1995). The earlier empirical literature on the political economy of trade protection has essentially concluded that labor market considerations are a major determinant of trade protection, and this seems in accordance with common perception.

This paper examines the question of whether and how labor market considerations influence trade policy in the light of new theoretical advances in the trade protection literature. Thus far, the new political economy of trade protection literature downplays the influence of labor market considerations on trade protection. For instance, the preeminent model in the political economy of trade protection literature, the protection for sale model by Grossman and Helpman (1994)[2] is set up in such a way that no labor market variables enter the equilibrium protection equation. The GH model has been motivated by a perceived lack of theoretical underpinning of its predecessors. As Rodrik (1995) points out, the problem with the older political economy literature is that it suffers from a so-called "black box approach": From casual observation, we think we can identify the factors which account for higher rates of protection. Hence, the model is a priori set up in such a way as to assume that these factors lead to higher protection. For example, a stylized fact is that certain industries seem to enjoy higher protection than others. The political support function approach generates this outcome by assigning higher weights to the welfare of certain population groups in the governmental welfare function. However, it does not explain how the government obtains the welfare weights and what factors influence them. The GH model endogenizes these welfare weights using a principal-agent framework. The protection for sale approach has quickly become the leading model in the political economy of trade protection literature and has reinvigorated research in this area. In the GH model,

[1]See, e.g., Baldwin (1985), table 2.2 for 1973; Baldwin and Magee (2000) for more recent congressional votes such as on the Uruguay Round bills and NAFTA.

[2]Henceforth referred to as the GH model.

labor is the only mobile factor and earns a competitive wage which is independent of any protection influences. Lobbying is undertaken by the owners of specific capital in the different industries. They compete against each other by paying campaign contributions to buy protection. From first principles, GH derive a set of predictions about the determinants of protection levels. The number of relevant variables in their optimal tariff equation is very small. In particular, no employment-related variables appear. This is by design: Perfect labor mobility and the presence of a numeraire industry free of policy influences make wages independent of trade protection. Thus a tariff changes only the output prices and not the wages. There is always full employment since the numeraire sector absorbs any labor which might be set free in other industries. Furthermore, excluding labor unions ensures that capital owners capture all created rents.

The goal of this paper is twofold: First, it shows that labor market rigidities, such as union activity, labor immobility, and high unemployment benefits can be very naturally incorporated into the protection for sale model. Labor market variables then enter the equilibrium trade protection equation in an intuitive, but non-additive manner. This paper thus provides a theoretical foundation for testing the protection for sale model for countries with rigid labor markets, such as the continental European economies.[3] Secondly, this paper shows that the common wisdom that labor market rigidities always increase trade protection need not be correct. In particular, union influence has ambiguous effects on the level of trade distortions, so high union influence may actually lower European trade protection.

The modelling of labor market rigidities in this paper is motivated by continental European labor market characteristics since the major economies in this region, France and Germany, are commonly considered prime examples of industrialized countries with rigid labor markets.

Table 1 gives an idea of the considerable differences in the degree of labor market regulation within the industrialized world. The first two lines provide information on the generosity of unemployment benefits, both in terms of "depth" (i.e., how much income the unemployed are paid relative to what they earned before becoming unemployed), and "breadth" (i.e., percentage of the unemployed who actually received benefits). The depth of unemployment benefits is measured by the net of tax income replacement rate due to

[3]Although Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) conclude that the basic GH model predicts U.S. trade protection well, their estimates of the structural parameters (namely, the percentage of population represented by lobbies and the weight on domestic welfare in the governmental utility function relative to the weight on contributions) appear overly high. In another paper, Matschke and Sherlund (2003) reevaluate the influence of labor market considerations on U.S. trade policy using a modified version of the theory developed in this paper. In contrast to Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000), Matschke and Sherlund find that the introduction of labor market variables substantially improves the empirical model fit of the protection for sale model and leads to more reasonable estimates of its structural parameters for the U.S..

Table 1. Facts at a glance (Source: OECD 1994a, 1994b, 1997)

Variable	France	Germany	USA
income replacement in 1991	48	43	14
ratio beneficiaries in 1990/91	98	89	34
trade union density in 1990	10	33	16
bargaining coverage in 1990	92	90	18
inflow rate in 1991	1.45	1.15	12.25
share long-term unemployed in 1991	4.75	5.75	0.8

unemployment benefits, and the breadth by the ratio in percent of unemployed beneficiaries to unemployed. The third line shows that the trade union density (i.e., the percentage of workers organized in unions) is much higher in Germany than it is in the U.S. and France. In contrast, the percentage of employed workers covered by collective bargaining in line 4 is over 90% in the European countries, whereas collective bargaining coverage is far from extensive in the U.S. economy.[4] The emerging picture of considerable labor market differences becomes even starker when we compare labor mobility measures. Line 5 displays the inflow rate (i.e., the number of people unemployed for less than one month as a percentage of the working-age population minus the unemployed), and line 6 the share of long-term unemployed as a percentage of all unemployed. In the United States, the inflow rate is very high and the share of long-term unemployed low, while for the European countries the opposite is true. This points towards sizeable differences in labor mobility, the U.S. workforce being by far more mobile than the workforce in Europe.

The various labor market rigidities outlined above lead to separate effects that can be easily identified in the equilibrium trade protection equation. The first set of rigidities (namely, labor immobility and high unemployment benefits serving as effective minimum wage) creates unemployment. Under this scenario, there are two reasons why the equilibrium tariff is higher than that predicted by GH: First, in order to increase overall employment, the government would set strictly positive import tariffs even without lobbying. Second, unemployment benefits create a common interest for lobbies to demand trade protection for all industries in order to reduce unemployment and, consequently, unemployment tax payments. These two effects lead to a higher equilibrium tariff. Results from the introduction of the second set of rigidities (namely, union lobbying and collective bargaining) are also very intuitive. Collective bargaining causes rent sharing between capital owners and workers in an industry. If either group is not represented by a lobby, protection rents

[4]The numbers for trade union density and bargaining coverage are very close: The reported U.S. bargaining coverage number is probably overstated since the Bureau of Labor Statistics counts all union members as covered by collective bargaining.

are lost for lobbies and the resulting equilibrium tariff is lower than if all rents are captured by them. Moreover, if collective bargaining agreements also cover non-union workers who are not represented by any lobby, some protection rents are always dissipated, leading to a lower equilibrium tariff.

The remainder of the paper is organized as follows: In section 2, I set up the model. I use a simple GH model with industry-specific trade unions. Labor is immobile between industries in the short run, and high unemployment benefits serve as effective minimum wages. Workers may be covered by collective bargaining even if they are not union members. In section 3, I derive a convenient way of expressing the equilibrium tariffs as a weighted sum of tariffs that the players in the lobbying game would unilaterally set. This allows me to interpret the effects of labor market regulations on the equilibrium tariff structure as straightforward extensions of the effects on the utilities of the different players in the lobbying game. I discuss these unilateral changes in section 3 and then aggregate these effects in section 4 to see how the equilibrium tariffs are affected. It is shown that unemployment benefits, labor immobility, percentage of trade unionization, and coverage of non-union workers by collective bargaining influence equilibrium tariff levels in the GH model. However, it is not true that labor market rigidities necessarily increase trade protection. In particular, I demonstrate the following: High unemployment benefits and inter-industry labor immobility lead to higher tariffs, higher bargaining coverage lowers tariff rates, whereas the effect of a higher degree of unionization is ambiguous. Section 5 discusses several possible model extensions, and section 6 concludes. All proofs are in the appendix. A list of the symbols used in the paper can be found in table 3.

2. Model Description

2.1. **Basic setup.** In the following, I augment the Grossman and Helpman (1994) protection for sale model to allow for labor market considerations. In the first stage of the game, lobbies offer take-it-or-leave-it menus of contributions for different tariff vectors from which the domestic government can choose. In contrast to GH, however, it is assumed that both capital owners and industry-specific trade unions may lobby. In the second stage, employment and wages in the different industries are determined taking the tariff vector as given. This timing seems natural because wages and employment are more frequently adjusted than trade protection measures which are nationally set.

Consider a small country with $n + 1$ production sectors (henceforth called industries) which faces an exogenous vector of world prices. The country owns fixed amounts of industry-specific labor L_i, where $i = 0, \ldots, n$, and fixed amounts of industry-specific capital K_i, where $i = 1, \ldots, n$. Each industry produces a single good, with good 0 being the numeraire.

On the consumption side, it is assumed that all individuals have identical quasilinear preferences. The utility function for any individual is the sum of his good 0 consumption and strictly concave and increasing transformations of the consumption of each of the non-numeraire goods 1 to n.[5] Quasilinearity of preferences implies that the indirect utility function of any individual is additively separable into an income and a price component. Specifically, indirect utility can be written as the sum of income and consumer surplus V_i from consumption of good i where i goes from 1 to n. While utility functions are identical across agents, endowments are not. I divide the population into two groups: laborers and capitalists. Laborers own 1 unit of labor each, while capital owners possess 1 unit of specific capital per person which they supply inelastically.

Each non-numeraire industry $i = 1, \ldots, n$ consists of a unionized sector A and a non-unionized sector B which share an identical production function F^i. Capital employed in these sectors of industry i, namely, K_{iA} in sector A and $K_{iB} = K_i - K_{iA}$ in sector B, is immobile in the short run and is thus industry- as well as sector-specific. Industries $i = 1, \ldots, n$ and their sectors use labor and capital to produce output according to a linearly homogeneous and weakly concave production function F^i where $F^i_{LL} < 0$, $F^i_{KK} < 0$, and $F^i_{KL} > 0$. The numeraire industry ($i = 0$) only uses labor and is not divided into sectors. The world price of the numeraire good is fixed at 1, and one unit of labor produces one unit of output F^0 with a one-to-one production technology. Laborers in any non-numeraire industry $i = 1, \ldots, n$ are trained for work in their specific industry. The number of workers L_i in industry i is assumed to be constant; i.e., I am not considering a dynamic model in which workers can retrain for work in another industry. Hence industry i workers could potentially either work in the industry for which they possess training or in the numeraire industry where production does not require specific skills. For each non-numeraire industry, there exists an exogenously[6] given unemployment benefit u_i (e.g. in Germany, unemployment insurance benefits are linked to wages earned in earlier periods while the percentage of previous wages that are paid out as unemployment benefit is rarely changed, so u_i is exogenous in the short run). Since u_i in any non-numeraire industry is set above the wage in the numeraire industry, i.e., $u_i > 1$, workers in any industry $i = 1, \ldots, n$ prefer being unemployed to moving to industry 0 for work. Industry 0 workers are locked in

[5] It is assumed each individual has enough income to consume all goods; i.e., corner solutions are excluded.

[6] The exogeneity of the unemployment benefit is by no means crucial for the results. For example, we could let the percentage of the historical wage that is paid out as unemployment benefit be determined by political influences as well. To avoid corner solutions, this percentage should not be industry-specific which seems a reasonable assumption to make in practice. Due to the high linearity of the protection for sale model, we would obtain a separate equation for this unemployment benefit percentage, while the tariff equation would remain unchanged except that the unemployment benefit would now be a function of the equilibrium tariff t_i^*. Since many variables in the equilibrium tariff equation are functions of t_i^* as well, this should be considered only a minor change.

this industry because they are not qualified to work in any of the non-numeraire industries. Thus all labor is industry-specific.

2.2. **Stage 2: Wage and employment determination.** Sector A of industry $i = 1, \ldots, n$ is unionized[7], i.e., the capital owners in A bargain over wages and employment with their trade union, which has N_i members.[8] If firms and the union bargain over both employment and wages, it is a well-known theoretical result that the bargaining outcome will be efficient.[9] That is, the output produced will equal the output under perfect competition. The only effect bargaining has is to redistribute surplus from firms to workers via an increase in the union wage $\overline{w}_i$ above the competitive level. I assume that the union wage has to be uniformly applied to all employees in sector A. Employees can either come from the pool of union members N_i or from the pool of non-union members $L_i - N_i$. To introduce coverage of non-union workers by collective bargaining, I assume that if the unionized sector A hires $\alpha_i N_i$ union workers, it also employs $\delta_A \alpha_i (L_i - N_i)$ non-union workers.[10] $\delta_A \in [0, 1]$ is an anti-discrimination parameter assumed to be uniform across industries.[11] It takes on value 1 if there is nondiscriminatory hiring of union and non-union workers, i.e., the ratio of union to non-union workers employed in the unionized sector A matches the ratio of these worker

[7]The introduction of trade unions into the GH framework is not completely novel to the literature. Rama and Tabellini (1998) consider a two-sector model where in one sector, capital owners and trade union lobby the domestic government simultaneously for trade protection and minimum wages. Their model, however, is clearly tailored for developing countries and concentrates on investigating whether international agencies such as the World Bank should target labor market or trade distortions when imposing rules for restructuring the economy. Wages are fixed by the state, so there is no role for the trade union in collective bargaining, and all workers are assumed to be trade union members.

[8]The number of union workers is treated as exogenous here. For a discussion what happens when N_i is endogenized, the reader is referred to section 5.

[9]The efficient bargaining assumption reduces the effects of collective bargaining to redistributive issues. For more on this, see section 5.

[10]Even in the U.S., approximately 1.5% of non-union workers were covered by collective bargaining agreements in 2001. In many European countries, however, union wages apply to a much higher percentage of non-union workers. This is largely the result of laws against discriminatory treatment of workers based on union status and also of statutes that extend bargaining outcomes to firms that do not take part in collective bargaining. To keep things simple, I concentrate on the first explanation and assume that firms in the unionized sector A have to fill a certain quota for non-union worker employment. Notice that there exists a scope for discrimination: For given wage and employment, the union is interested in having as high a union member share as possible among the employees in sector A, while the firms do not care as all employees receive the same wage. Hence the union could successfully impose the requirement that union members be hired with priority. In particular, given that N_i is big enough, no non-union members would be hired at the union wage $\overline{w}_i$.

[11]This assumption is only made to drop the additional i subscript on the discrimination parameter. Assuming industry-specific parameters would lead to exactly the same results.

types in the labor market pool of industry i. If $\delta_A = 0$, the union succeeds in introducing a "closed shop".

In the non-unionized sector B, employment is chosen by the firms. I assume that labor supply L_i in any non-numeraire industry is relatively large such that the unemployment benefit u_i serves as an effective minimum wage for sector B of this industry. Similarly to sector A, both union and non-union members are employed in sector B, but the percentage of union workers is below their share in the workforce of industry i.[12] If sector B hires $\beta_i(L_i - N_i)$ non-union workers, then it also employs $\delta_B \beta_i N_i$ union members where $\delta_B \in [0, 1]$. The ratio of union workers to non-union workers hired in sector B is thus equal to this ratio in the labor market pool of industry i, multiplied by the anti-discrimination parameter δ_B. To avoid overemployment, I assume that in equilibrium $\alpha_i + \delta_B \beta_i \leq 1$ and $\beta_i + \delta_A \alpha_i \leq 1$ hold so that only interior solutions have to be considered. I do not explicitly discuss here why there are union workers employed in the non-unionized sector and why there are non-union workers employed in the unionized sector, but treat these employment shares as exogenously given. In some countries, $\delta_A, \delta_B > 0$ may be due to (only partially successful) anti-discrimination legislation, but even in the U.S., according to information obtained from the Bureau of Labor Statistics, approx. 15 % of union workers were not covered by collective bargaining, whereas 1.5 % of non-union workers were subject to such agreements.

At the production stage, it is assumed that firms maximize profits and the union maximizes the wage bill of union workers.[13]

In sector B, the firms choose the employment share β_i of non-union workers to maximize profits

$$p_i F^i(K_{iB}, \beta_i \left[\delta_B N_i + L_i - N_i\right]) - u_i \beta_i \left[\delta_B N_i + L_i - N_i\right],$$

where $\beta_i \left[\delta_B N_i + L_i - N_i\right]$ is the sum of union employment $\delta_B \beta_i N_i$ and non-union employment $\beta_i(L_i - N_i)$ in sector B. The corresponding FOC is

$$p_i F^i_L(K_{iB}, \beta_i \left[\delta_B N_i + L_i - N_i\right]) = u_i. \tag{2.1}$$

[12]There is certainly some scope for discrimination between workers according to whether or not they are union members. Just as an example in a dynamic setting, capitalists in sector B might want to reduce the hiring of union members for fear that union workers transform their firm into a bargaining unit, thus sharing in the profits. In the U.S. in 2001, only approximately 15% of union members were not covered by collective bargaining agreements according to information obtained from the Bureau of Labor Statistics. The vast majority of the labor force, however, worked in the non-unionized sector.

[13]A similar assumption is made in GH, where firms maximize profits in the second stage, but in the first (lobbying) stage they maximize utility of their shareholders.

It is straightforward to verify that β_i is strictly increasing in p_i, namely, after using the FOC (2.1) to substitute for F_L^{iB}

$$\frac{\partial \beta_i}{\partial p_i} = -\frac{u_i}{p_i^2 \left[L_i - N_i + \delta_B N_i\right] F_{LL}^{iB}} > 0. \tag{2.2}$$

Moreover, β_i is strictly decreasing in u_i and K_{iA}. Given price, minimum wage (i.e., unemployment benefit), and specific capital of sector B in i, the optimal labor input

$$\beta_i \left[\delta_B N_i + L_i - N_i\right]$$

is uniquely determined. It follows that an increase in union membership N_i (since L_i is constant, this means that the unionization degree of i's workforce increases) leads to a higher rate of employment β_i for $\delta_B < 1$ since union workers are underrepresented in the workforce of sector B (an increase in N_i decreases $\delta_B N_i + L_i - N_i$). A higher anti-discrimination parameter δ_B leads to lower β_i, because otherwise employment in sector B would rise above its optimal level (an increase in δ_B increases $\delta_B N_i + L_i - N_i$).

In the unionized sector A, firms and union split the surplus according to the generalized Nash bargaining solution. If bargaining is successful, the wage bill for union workers equals

$$\alpha_i \overline{w}_i N_i + (1 - \alpha_i) u_i N_i.$$

$\alpha_i N_i$ union workers work in the unionized sector A and receive union wage $\overline{w}_i$, $\delta_B \beta_i N_i$ union workers work in the non-unionized sector B and receive wage u_i, and $(1 - \alpha_i - \delta_B \beta_i) N_i$ union workers become unemployed and receive unemployment benefit u_i. The profits that remain for capitalists in sector A amount to

$$p_i F^i(K_{iA}, \alpha_i \left[N_i + \delta_A (L_i - N_i)\right]) - \overline{w}_i \alpha_i \left[N_i + \delta_A (L_i - N_i)\right],$$

where the employment variable $\alpha_i \left[N_i + \delta_A (L_i - N_i)\right]$ is the sum of union worker employment $\alpha_i N_i$ and non-union worker employment $\delta_A \alpha_i (L_i - N_i)$ in sector A. Observe that all employees in sector A of industry i receive union wage $\overline{w}_i$. If bargaining fails, it is assumed that all workers either have to find employment in sector B or become unemployed, in which case the expected wage bill reduces to $u_i N_i$. The capitalists are even worse off because the union succeeds in interrupting production in sector A, so that their profit is reduced to 0. The generalized Nash bargaining solution thus maximizes

$$\left\{p_i F^i(K_{iA}, \alpha_i \left[N_i + \delta_A (L_i - N_i)\right]) - \alpha_i \overline{w}_i \left[N_i + \delta_A (L_i - N_i)\right]\right\}^{1-s_i} \times \left\{\alpha_i \left(\overline{w}_i - u_i\right) N_i\right\}^{s_i}, \tag{2.3}$$

where s_i denotes the relative bargaining strength of industry i's trade union. $s_i \in [0, 1]$ is assumed to be exogenously given.

Maximizing (2.3) with respect to α_i and $\overline{w}_i$ leads to two equations. The employment share α_i is determined by

$$p_i F_L^i(K_{iA}, \alpha_i \left[N_i + \delta_A(L_i - N_i)\right]) = u_i, \tag{2.4}$$

which defines the efficiency frontier. (2.4) shows that production will be efficient, given the minimum wage: The marginal value product of labor is set equal to u_i just as in the non-unionized sector B (compare (2.1)). Dividing both sides by p_i and using the linear homogeneity of F^i, we can rewrite (2.4) as common condition that has to hold across both sectors of industry i

$$F_L^i(1, \lambda_i) = \frac{u_i}{p_i},$$

where λ_i denotes the optimal labor-capital ratio in sectors A and B of industry i. Thus only changes in the unemployment benefit or the product price in industry i can influence λ_i. Going back to (2.4), straightforward comparative statics establish that α_i is increasing in K_{iA} and p_i and decreasing in u_i. For future reference, I provide the partial derivative of α_i with respect to p_i, using the FOC (2.4) once again:

$$\frac{\partial \alpha_i}{\partial p_i} = -\frac{u_i}{p_i^2 \left[N_i + \delta_A(L_i - N_i)\right] F_{LL}^{iA}} > 0. \tag{2.5}$$

Moreover, for given p_i, K_{iA}, and u_i, employment in sector A, just as in sector B, should be constant. Thus if the anti-discrimination parameter δ_A rises, α_i has to fall, and similarly, $\frac{\partial \alpha_i}{\partial N_i} < 0$. The second equation

$$\overline{w}_i = s_i \frac{p_i F^{iA}}{\alpha_i \left[N_i + \delta_A(L_i - N_i)\right]} + (1 - s_i) u_i \tag{2.6}$$

resulting from maximization of (2.3) describes how the union wage serves to distribute the bargaining surplus between the union and the capitalists. In particular, (2.6) shows that the union wage is a convex combination of the average value product of labor (weighted by the union bargaining power) and the minimum wage u_i (weighted by the capitalists' bargaining power). Clearly, the latter equals the marginal value product of labor since (2.4) holds simultaneously in equilibrium. As is common in union-firm bargaining games over employment and wage, the reaction of wage due to price changes is usually ambiguous in sign. But it can be established that the union wage is increasing in u_i and s_i and independent of changes in δ_A, K_{iA}, and N_i. In contrast, clear sign predictions can be given concerning $\frac{\partial(\alpha_i \overline{w}_i)}{\partial p_i}$, while $\frac{\partial(\alpha_i \overline{w}_i)}{\partial u_i}$ cannot be signed. In particular, we find that

$$\frac{\partial\left(\alpha_i \overline{w}_i\right)}{\partial p_i} = \frac{s_i F^{iA}}{N_i + \delta_A(L_i - N_i)} + \frac{\partial \alpha_i}{\partial p_i} u_i > 0. \tag{2.7}$$

For the reader's convenience, table 2 summarizes the characteristics of the wage and employment determination in sectors A and B.

2.3. **Stage 1: Lobbying.** In some of the industries, but not the numeraire industry 0, either capital owners or the trade union or both are active lobbyists that solicit trade protection from the domestic government. Each lobby offers the government a schedule that lists its contributions as a function of the domestic price vector p. p may differ from the world price p^* if the domestic government imposes a vector t of specific import or export tariffs or subsidies. Hence, if p_i^* denotes the world market price of good i, then the domestic price is $p_i = p_i^* + t_i$. Suppose good i is an import good. Then $t_i > 0$ ($t_i < 0$) means that an import tariff (import subsidy) is imposed. By contrast, if good i is an export good, then $t_i > 0$ ($t_i < 0$) implies an export subsidy (export tax). To facilitate the description, I will in the following focus on import goods when describing the determination of the equilibrium trade policy. The reader should note, though, that with the information given above, the interpretation can readily be changed to accommodate export goods as well. The tariff revenue (or the cost of subsidies) is rebated equally among (or collected costlessly from) the population. The government maximizes the weighted sum of total contributions and aggregate welfare where the weight on aggregate welfare is denoted by a. Contributions C receive a weight of 1. The solution to the lobbying game follows the findings in GH. The arising tariff structure is defined by the following set of conditions, where the number of conditions equals the number of lobbies plus one: First, the equilibrium tariff maximizes the government's utility function. This must be true because the domestic government chooses the tariff to maximize its own utility. Second, the equilibrium tariff maximizes the sum of governmental utility and the utility of any lobby. To understand this requirement, suppose this condition were not fulfilled for a certain lobby: Then the lobby could propose a different contribution schedule that left governmental welfare unchanged and assigned the surplus payoff to the lobby. This would clearly be better for the lobby and hence, the lobby would not have been utility-maximizing in the first place.

3. Group Interests and Tariff Determinants

3.1. **General relationship between equilibrium tariff and lobby group interests.** I first show that the equilibrium tariff "in its structure"[14] for any industry $i = 1, \dots, n$ can be expressed as the weighted sum of tariffs that the lobby groups and the government would set unilaterally. This is a very helpful result because it ties the equilibrium tariff vector directly to the interests of the different players in the lobbying game. Henceforth,

[14]The GH model does not yield a closed-form solution for the equilibrium tariff t_i^*. Instead, we obtain a structural equation that depends implicitly on t_i^*. The unilaterally optimal tariffs I derive for the different groups of the lobbying game are similarly implicitly defined structural forms. When I say that the equilibrium tariff "in its structure" is a weighted average of these tariffs, then I mean that t_i^* is a weighted average of the unilaterally optimal tariff forms which are themselves functions of t_i^*.

the percentage of the population organized into lobby groups is denoted by

$$\Theta = \sum_{K_i \in \Omega} \theta_{K_i} + \sum_{N_i \in \Omega} \theta_{N_i},$$

where Ω is the set of all organized lobby groups, consisting of trade unions and capital owner groups. θ_{K_i} (θ_{N_i}) stands for the population share of industry i capital owners (trade unionists). The summation in the formula of Θ is over all capital owner and trade union interest groups in all non-numeraire industries $i = 1, \ldots, n$, provided that these groups have formed a lobby. By definition, Θ only takes on values between 0 and 1. To cut down on notation, instead of introducing new symbols for capital owner and trade union groups, I refer to them by the number of their members, namely K_i and N_i. From the context, it should be clear which meaning the notation has.

Because every lobby member is assumed to consume each good and receive a tariff revenue share, I model tariff revenue and consumer surplus effects explicitly, while all other effects that may influence the choice of the tariff are lumped together in an "other effects" category (E). The symbol $E_i^{K_j}$ ($E_i^{N_j}$) denotes the other effects a tariff on industry i has for the utility of group K_j (N_j). These effects will be discussed in detail in section 3.2. The equilibrium tariff does not only reflect the interests of the lobby groups, but also the impact on domestic welfare. Here, I denote by t_i^G the welfare-maximizing tariff and by E_i^G the other effects (apart from consumer surplus and tariff revenue considerations) that a tariff has on domestic welfare. In the original (small open economy) GH setup, the welfare-maximizing tariff t_i^G equals zero and $E_i^G = F^i$. However, with labor market distortions, this is not necessarily the case. More precisely, $t_i^G = \frac{F^i - E_i^G}{M_i'}$, where $E_i^G = F^i + \sum_{j=0}^n \left[p_j F_L^{jA} \frac{dL_{jA}}{dp_i} + p_j F_L^{jB} \frac{dL_{jB}}{dp_i} \right]$, maximizes domestic welfare

$$W_G = \sum_{j=1}^n t_j M_j(p_j) + \sum_{j=0}^n p_j F^j + (L + \sum_{j=1}^n K_j) \sum_{j=1}^n V_j(p_j).$$

Domestic welfare W_G is the sum of tariff revenue, the value of domestic production, and consumer surplus. Then by the definition of "other effects", E_i^G equals the derivative of the domestic production value with respect to the tariff. The following lemma links the tariffs the players would unilaterally set to the equilibrium tariff of the lobbying game.

Lemma 3.1. *The equilibrium tariff for industry i is given by*

$$t_i^* = \frac{F^i(t_i^*)}{M_i'(t_i^*)} - \frac{aE_i^G(t_i^*)}{a + \Theta} \frac{1}{M_i'(t_i^*)} - \frac{\sum_{N_j \in \Omega} E_i^{N_j}(t_i^*) + \sum_{K_j \in \Omega} E_i^{K_j}(t_i^*)}{a + \Theta} \frac{1}{M_i'(t_i^*)} \quad . \tag{3.1}$$

Alternatively, we can write the equilibrium tariff as an implicit solution to

$$t_i^* = \frac{a t_i^G(t_i^*)}{a + \Theta} + \sum_{K_j \in \Omega} \frac{\theta_{K_j} t_i^{K_j}(t_i^*)}{a + \Theta} + \sum_{N_j \in \Omega} \frac{\theta_{N_j} t_i^{N_j}(t_i^*)}{a + \Theta}, \tag{3.2}$$

where t_i^G is the welfare maximizing tariff on good i and $t_i^{K_j}$ ($t_i^{N_j}$) denotes the unilaterally optimal tariff for lobby group K_j (N_j).

Equation (3.1) shows that the interests of different lobby groups enter the optimal tariff equation additively. Changes in the equilibrium tariff cannot be caused by simple income redistribution among lobbies; i.e., if I increase the other effects for one lobby group and decrease the other effects of a different lobby group by the same amount, then (3.1) shows that t_i^* does not change. It can also be seen that neither the total number of lobbies nor the number of lobbies per industry affects the equilibrium tariff as long as the added marginal benefits or costs of a tariff as represented by the other effects stay the same[15].

Equation (3.2) is even more useful because it allows me to discuss the influence of labor market regulations on the tariffs each player group would set unilaterally and then add these effects to determine the equilibrium tariff.[16] The reader familiar with the original GH model will most likely recognize that Lemma 3.1 is closely linked to the claim established in Grossman and Helpman (1994) that the optimal tariff maximizes a weighted social welfare function and can thus be reinterpreted as the outcome of a political support function model with endogenized welfare weights. With the help of (3.2), it is now possible to make meaningful statements about how the labor market regulations affect the direction that lobbying takes. What does it mean that a certain group lobbies for or against a certain tariff, given that in the subgame-perfect Nash equilibrium all players ask for the same tariff vector? The answer to this question lies in the tariffs the lobby groups would set unilaterally if they could do so.

3.2. **Discussion of lobby group interests.** To see how the labor market influences the lobbying incentives, I discuss the form the unilateral tariffs take as well as how they are affected by changes in K_{iA} (capital bound in the unionized sector, keeping overall capital endowment fixed), N_i (number of union workers, keeping total number of workers fixed), δ_A (anti-discrimination parameter, higher δ_A indicates higher non-union worker share in the labor force of the unionized sector), s_i (union bargaining strength) and u_i (unemployment benefit). The possible players in the lobbying game are the government, lobby groups (capital owners and trade unions) outside industry i and capital owners and trade unions in industry i itself whose optimal unilateral tariffs as well as the corresponding comparative statics I derive next.

[15]This assumes that the share of lobbies in the population is fixed.

[16]The reader should note, though, that the unilaterally optimal tariffs are all functions of t_i^*, so the relationship between the equilibrium tariff and the unilaterally optimal tariffs is not as simple as it might appear. This is not surprising because GH also never obtain a closed form solution for the equilibrium tariff, but only derive the solution as an implicit function of t_i^* itself.

I start with the welfare-maximizing tariff t_i^G as the natural benchmark, i.e., the tariff that would be set if no interest group influences were present. Leaving out welfare components that are independent of the price of good i, t_i^G maximizes domestic welfare

$$W_G = p_i F^{iA} + p_i F^{iB} + t_i M_i + (L + \sum_{j=1}^{n} K_j) V_i,$$

where $p_i F^{iA} + p_i F^{iB}$ is the value of domestic production in industry i, $t_i M_i$ the tariff revenue from imports of good i, and $(L + \sum_{j=1}^{n} K_j) V_i$ the consumer surplus from consuming good i.

Proposition 3.1. *The tariff the government would set unilaterally is*

$$t_i^G = \frac{u_i^2}{p_i^2 M_i'} \frac{K_i}{F_{LL}^i(1, \lambda_i)} > 0. \tag{3.3}$$

The comparative statics are: $\frac{dt_i^G}{dK_{iA}} = \frac{dt_i^G}{dN_i} = \frac{dt_i^G}{ds_i} = \frac{dt_i^G}{d\delta_A} = 0$, *and the sign of* $\frac{dt_i^G}{du_i}$ *is ambiguous.*

The possibility of an employment increase in industry i and thus an overall employment increase leads to a strictly positive welfare-maximizing tariff for this industry. This is the well-known result (for example Hill, 1984) that when minimum wages are binding, a positive import tariff is optimal. Proposition 3.1 is also interesting because it shows that differences in unionization and bargaining coverage across countries do not influence the welfare-maximizing tariff. That is, without lobbying, the same tariff would be set. Inter-industry labor immobility leads to an additional tariff-increasing component in the formula for the equilibrium tariff, but without any further assumptions about the production structure, the conjecture that higher unemployment benefits (higher minimum wages) increase equilibrium tariffs, i.e., that higher distortions in the labor market lead to higher trade distortions, cannot be verified.

Next consider the interests of lobby groups g_j ($g_j \in \{N_j, K_j\}$, $j \neq i$) outside industry i. If g_j could set the tariff rate for industry i unilaterally, it would do so to maximize

$$W_{g_j} = \theta_{g_j} t_i M_i + \theta_{g_j} (L + \sum_{j=1}^{n} K_j) V_i - \theta_{g_j} u_i [(1 - \alpha_i - \beta_i \delta_B) N_i + (1 - \alpha_i \delta_A - \beta_i)(L_i - N_i)],$$

where the last term is the tax payment to finance the unemployment benefits. As before, all components that do not depend on t_i are omitted. Of the unemployed workers in industry i, $(1 - \alpha_i - \beta_i \delta_B) N_i$ are union workers and $(1 - \alpha_i \delta_A - \beta_i)(L_i - N_i)$ are non-union workers. Similarly to the tariff revenue, the costs from unemployment are assumed to be divided evenly among the population.

Proposition 3.2. *The tariff lobby groups g_j outside industry i would set unilaterally is*

$$t_i^{g_j} = \frac{1}{M_i'} \left[F^i + \frac{u_i^2}{p_i^2} \frac{K_i}{F_{LL}^i(1, \lambda_i)} \right] \text{ for } g_j \in \{N_j, K_j\}, \ j \neq i. \tag{3.4}$$

$\frac{F^i}{M_i'}$ is negative and $\frac{1}{M_i'}\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}$ is positive. The comparative statics are: $\frac{dt_i^{g_j}}{dK_{iA}} = \frac{dt_i^{g_j}}{dN_i} = \frac{dt_i^{g_j}}{d\delta_A} = \frac{dt_i^{g_j}}{ds_i} = 0$, and the sign of $\frac{dt_i^{g_j}}{du_i}$ is ambiguous.

In the original GH model, other industries lobby for an import subsidy equal to $\frac{F^i}{M_i'}$ for industry i as the consumer surplus effect is stronger than the tariff revenue effect. However, under labor market distortions, lobby g_j also takes into account that it has to pay for the unemployment benefits that go to laid-off workers in industry i. This creates a degree of common interest between the lobby groups of different industries which manifests itself in a positive tariff component $\frac{1}{M_i'}\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}$, and it is no longer clear that $t_i^{g_j}$ is negative.

Finally I turn to the interests of industry i lobby groups, starting with the capital owners. Contrary to the original GH model, the capital owners of sector A now have to share their profits with workers. This will necessarily decrease their interest in trade protection. On the other hand, the fact that they also have to finance the unemployment benefits has a positive influence on their desired tariff. If capital owners could set the tariff unilaterally, they would maximize the sum of profits $p_iF^{iA} - \alpha_i\overline{w}_i\left[N_i + \delta_A(L_i - N_i)\right]$ and $p_iF^{iB} - u_i\beta_i\left[\delta_B N_i + L_i - N_i\right]$ in sectors A and B, respectively, tariff revenue, and consumer surplus minus the unemployment tax payments, i.e.,

$$\begin{aligned} W_{K_i} = {} & p_iF^{iA} - \alpha_i\overline{w}_i\left[N_i + \delta_A(L_i - N_i)\right] + p_iF^{iB} - u_i\beta_i\left[\delta_B N_i + L_i - N_i\right] + \theta_{K_i}t_iM_i \\ & + \theta_{K_i}(L + \sum_{j=1}^{n} K_j)V_i - u_i\theta_{K_i}\left[(1-\alpha_i-\beta_i\delta_B)N_i + (1-\alpha_i\delta_A-\beta_i)(L_i - N_i)\right]. \end{aligned}$$

Proposition 3.3. *The tariff capital owners of industry i would set unilaterally is*

$$t_i^{K_i} = \frac{1}{\theta_{K_i}M_i'}\left[s_iF^{iA} - (1-\theta_{K_i})F^i + \theta_{K_i}\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}\right]. \tag{3.5}$$

$\frac{s_iF^{iA}}{\theta_{K_i}M_i'}$ is negative, while $-\frac{(1-\theta_{K_i})F^i}{\theta_{K_i}M_i'}$ and $\frac{1}{M_i'}\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}$ are positive. The comparative statics are: $\frac{dt_i^{K_i}}{dK_{iA}} < 0$, $\frac{dt_i^{K_i}}{ds_i} < 0$, $\frac{dt_i^{K_i}}{dN_i} = \frac{dt_i^{K_i}}{d\delta_A} = 0$, and the sign of $\frac{dt_i^{K_i}}{du_i}$ is ambiguous.

The requirement to pay unemployment tax introduces an additional positive tariff component just as in the case for lobbies outside industry i. Yet we can no longer be sure that $t_i^{K_i} > 0$. In the original GH model, the reason why capital owners lobby for a positive tariff is that the profit effect, i.e., the increase in profits caused by a marginal tariff increase, exceeds the net consumer surplus and tariff revenue effect. When unions are present, the profit effect is smaller by s_iF^{iA}, the share of profit increases that goes to workers in sector A. This reduction in the profit effect entails that the sign of $t_i^{K_i}$ is ambiguous, while in the original GH model, $t_i^{K_i} = -\frac{(1-\theta_{K_i})F^i}{\theta_{K_i}M_i'}$ is always positive. Due to union wage bargaining, a tariff also increases the wages that go to workers and creates a negative dispersion component $\frac{s_i F^{iA}}{\theta_{K_i} M_i'}$ in the optimal tariff equation for industry i capital owners. A higher percentage of production in unionized firms increases the percentage of profits affected by this dispersion and thus lowers the tariff. Similarly, an increase in union bargaining strength increases dispersion since the wage bill paid to workers rises. In contrast, the degree of unionization or the percentage of non-union workers covered by collective bargaining are immaterial for $t_i^{K_i}$ since they do not affect employment.

Union workers in industry i maximize the sum of wages and unemployment benefits $\alpha_i \overline{w}_i N_i + (1-\alpha_i) u_i N_i$, tariff revenue, and consumer surplus minus unemployment taxes

$$\begin{aligned} W_{N_i} &= \alpha_i \overline{w}_i N_i + (1-\alpha_i) u_i N_i + \theta_{N_i} t_i M_i + \theta_{N_i} (L + \sum_{j=1}^{n} K_j) V_i \\ &\quad - u_i \theta_{N_i} \left[(1-\alpha_i - \beta_i \delta_B) N_i + (1 - \alpha_i \delta_A - \beta_i)(L_i - N_i) \right]. \end{aligned}$$

Proposition 3.4. *The tariff the trade union of industry i would set unilaterally is*

$$t_i^{N_i} = \frac{1}{\theta_{N_i} M_i'} \left(\theta_{N_i} F^i - s_i \frac{N_i F^{iA}}{N_i + \delta_A (L_i - N_i)} + \theta_{N_i} \frac{u_i^2}{p_i^2} \frac{K_i}{F_{LL}^i (1, \lambda_i)} \right), \quad \text{where} \tag{3.6}$$

$\frac{F^i}{M_i'} < 0$, $-\frac{s_i}{\theta_{N_i} M_i'} \frac{N_i F^{iA}}{N_i + \delta_A (L_i - N_i)} > 0$, *and* $\frac{1}{M_i'} \frac{u_i^2}{p_i^2} \frac{K_i}{F_{LL}^i (1, \lambda_i)} > 0$. *The comparative statics are:* $\frac{dt_i^{N_i}}{dK_{iA}} > 0$, $\frac{dt_i^{N_i}}{dN_i} > 0$ *(holding θ_{N_i} constant),* $\frac{dt_i^{N_i}}{d\delta_A} < 0$, $\frac{dt_i^{N_i}}{ds_i} > 0$. *The sign of* $\frac{dt_i^{N_i}}{du_i}$ *is ambiguous.*

As for $t_i^{K_i}$, the sign of $t_i^{N_i}$ is unclear. The first component appearing in the formulae for the optimal unilateral tariffs of all lobbies, $\frac{F^i}{M_i'}$, is the import subsidy that would be favored by union members if they only considered consumer surplus and tariff revenue effect. The third component $\frac{1}{M_i'} \frac{u_i^2}{p_i^2} \frac{K_i}{F_{LL}^i (1, \lambda_i)} > 0$ arises because a tariff decreases the funds necessary to finance unemployment benefits. This component is common in the formulae for all lobbies' optimal unilateral tariffs since everybody has to pay unemployment tax. Compared to the previously determined optimal tariffs, the new component $-\frac{s_i}{\theta_{N_i} M_i'} \frac{N_i F^{iA}}{N_i + \delta_A (L_i - N_i)}$ contained in $t_i^{N_i}$ is a collection component: The trade union is interested in protection since this increases the wage bill paid to its members. All parameters associated with unionization have an impact on this collection component: For example, the extent to which non-union members are covered by collective bargaining is immaterial for the capital owners in i, but is important to the union since more coverage of non-union workers decreases the number of union workers who are paid the union wage. For the future derivation of the equilibrium tariff of the lobbying game, this also means that the wage bill effect for the trade union (i.e., the increase in the wage bill paid to union workers due to a marginal tariff increase) and the profit effect for the capital owners do not add up to F^i, the profit effect in the original GH model. The reason is that the union wage is also paid to non-union members as long as $\delta_A > 0$, i.e., the benefits of trade protection are partly dispersed to a population group that does not lobby.

In general, we cannot say whether the trade union and the capital owners even agree on a positive import tariff. This is a consequence of the consumer surplus and tariff revenue effects. If we only considered the wage bill and profit effect of industry i lobbyists as is often done in partial equilibrium studies, we would indeed find that both lobbies want a tariff as claimed in Matsuyama (1990). Similarly, the unemployment tax effect works towards an import tariff. But it is well possible that trade unions would lobby for protection ($t_i^{N_i} > 0$) whereas capital owners would lobby against it ($t_i^{K_i} < 0$) as found in Baldwin and Magee (2000). This outcome is especially likely since labor rents seem to be substantially higher than capital rents (Katz and Summers, 1989). The reader should also note that even if the lobbies agreed on the sign of t_i, it would be sheer coincidence if they happened to lobby for the same tariff rate.

4. Equilibrium Tariff Structure

Using Lemma 3.1 and the unilaterally optimal tariffs for the different player groups (3.3), (3.4), (3.5), and (3.6), the optimal tariff of the lobbying game is easily determined.

Proposition 4.1. *Define*

$$t_i^G = -\frac{u_i}{M_i'}\left[[N_i + \delta_A(L_i - N_i)]\frac{\partial \alpha_i}{\partial p_i} + [L_i - N_i + \delta_B N_i]\frac{\partial \beta_i}{\partial p_i}\right].$$

Alternatively, t_i^G can be written as

$$t_i^G = \frac{1}{M_i'}\left[\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1, \lambda_i)}\right].$$

Note that t_i^G is the welfare-maximizing tariff if M_i', p_i and F_{LL}^i are evaluated at t_i^G. Furthermore, let Θ, the percentage of population represented by lobbies, be fixed. Then the equilibrium tariff t_i^* in industry i can be characterized as follows:

(*a*) *If both labor and capital in i lobby, i.e., if $N_i \in \Omega$ and $K_i \in \Omega$, then*

$$t_i^* = -\frac{1-\Theta}{\Theta + a}\frac{F^i(t_i^*)}{M_i'(t_i^*)} + \frac{s_i}{\Theta + a}\frac{F^{iA}(t_i^*)}{M_i'(t_i^*)}\frac{\delta_A(L_i - N_i)}{N_i + \delta_A(L_i - N_i)} + t_i^G(t_i^*).$$

(*b*) *If nobody in i lobbies, i.e., if $N_i \notin \Omega$ and $K_i \notin \Omega$, then*

$$t_i^* = \frac{\Theta}{\Theta + a}\frac{F^i(t_i^*)}{M_i'(t_i^*)} + t_i^G(t_i^*).$$

(*c*) *If only labor in i lobbies, i.e., if $N_i \in \Omega$ and $K_i \notin \Omega$, then*

$$t_i^* = \frac{\Theta}{\Theta + a}\frac{F^i(t_i^*)}{M_i'(t_i^*)} - \frac{s_i}{\Theta + a}\frac{F^{iA}(t_i^*)}{M_i'(t_i^*)}\frac{N_i}{N_i + \delta_A(L_i - N_i)} + t_i^G(t_i^*).$$

(*d*) *Finally, if only capital in i lobbies, i.e., if* $N_i \notin \Omega$ *and* $K_i \in \Omega$, *then*

$$t_i^* = -\frac{1-\Theta}{\Theta+a}\frac{F^i(t_i^*)}{M_i'(t_i^*)} + \frac{s_i}{\Theta+a}\frac{F^{iA}(t_i^*)}{M_i'(t_i^*)} + t_i^G(t_i^*).$$

Furthermore, the following comparative statics results hold:

Proposition 4.2. *For the equilibrium tariff* t_i^*, *the following is true:*

(*a*) *If* $N_i \in \Omega$ *and* $K_i \in \Omega$, *then* $\frac{dt_i^*}{d\delta_A} < 0$, $\frac{dt_i^*}{dN_i} > 0$, $\frac{dt_i^*}{dK_{iA}} < 0$, $\frac{dt_i^*}{ds_i} < 0$.
(*b*) *If* $N_i \notin \Omega$ *and* $K_i \notin \Omega$, *then* $\frac{dt_i^*}{d\delta_A} = 0$, $\frac{dt_i^*}{dN_i} = 0$, $\frac{dt_i^*}{dK_{iA}} = 0$, $\frac{dt_i^*}{ds_i} = 0$.
(*c*) *If* $N_i \in \Omega$ *and* $K_i \notin \Omega$, *then* $\frac{dt_i^*}{d\delta_A} < 0$, $\frac{dt_i^*}{dN_i} > 0$, $\frac{dt_i^*}{dK_{iA}} > 0$, $\frac{dt_i^*}{ds_i} > 0$.
(*d*) *Finally, if* $N_i \notin \Omega$ *and* $K_i \in \Omega$, *then* $\frac{dt_i^*}{d\delta_A} = 0$, $\frac{dt_i^*}{dN_i} = 0$, $\frac{dt_i^*}{dK_{iA}} < 0$, $\frac{dt_i^*}{ds_i} < 0$.

I now discuss how the different equilibrium tariffs compare to the original GH findings as well as to each other. Throughout this analysis, it is important to remember that the formulae for t_i^* given on the right-hand side are functions of the tariff itself, i.e., they are not reduced form solutions. This rules out comparisons of the form "tariff x is higher than tariff y" by just looking at the formulae. Comparisons of the equilibrium tariff structure, in contrast, are very easy. So when I say "tariff x is structurally higher than tariff y", I mean that tariff x has an additional positive component compared to y (or tariff y has an additional negative component compared to x). This kind of comparison is useful to evaluate how union lobbying, unemployment benefits, and coverage of non-union workers by collective bargaining change the protection for sale predictions and how these new predictions would have to be evaluated econometrically as in Goldberg and Maggi (1999).

Rewriting t_i^* when none of the players in industry i lobby as

$$t_i^* = \overbrace{\frac{\Theta}{\Theta+a}\frac{F^i}{M_i'}}^{\text{GH}} + \overbrace{\frac{1}{M_i'}\left[\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}\right]}^{\text{unemployment}},$$

we can see that the equilibrium tariff consists of two components. The first one (GH component) is the familiar optimal tariff from the original GH model. It is negative when capital owners of industry i do not lobby. Compared to the simple GH model without labor market rigidities, the possibility of unemployment causes a second, positive component. Domestic welfare can be increased by trade protection because employment can be increased. This possibility does not exist in the original GH model since perfect labor mobility always ensures full employment. It should be noted that the unemployment component stems from two different sources. It is true that with immobile labor the domestic government would set a strictly positive tariff $t_i^G = \frac{1}{M_i'}\left[\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}\right]$ to increase domestic welfare. This would only increase t_i^* by $\frac{a}{\Theta+a}t_i^G$, however. Instead, we see that the unemployment component is equal to t_i^G. This difference arises because all lobbies are interested in an increase in industry i employment in order to reduce the levied unemployment tax. These lobby interests add to the government interests in the formation of the unemployment component. None of the t_i^* components is affected by changes in the parameters δ_A, N_i, s_i, and K_{iA}.[17]

Next consider the case when capital owners of industry i lobby, but the trade union does not. The equilibrium tariff contains three different parts as shown below:

$$t_i^* = \overbrace{-\frac{1-\Theta}{\Theta+a}\frac{F^i}{M_i'}}^{\text{GH}} \overbrace{+\frac{s_i}{\Theta+a}\frac{F^{iA}}{M_i'}}^{\text{dispersion to workers}} \overbrace{+\frac{1}{M_i'}\left[\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}\right]}^{\text{unemployment}}.$$

The first and the third part are once again the GH component (now adjusted for the fact that capital owners lobby) and t_i^G. The second component arises because collective bargaining leads to profit sharing between capital owners and workers. More precisely, industry i workers obtain an additional share $s_i F^{iA}$ as increase in union wages when the tariff on good i is increased. To the extent of this profit dispersion, the capital owners' interest in trade protection is diminished, which is reflected in a negative, the equilibrium tariff lowering, structural component. The dispersion component is independent of δ_A and N_i since the capital owners do not care whether the higher wages go to union or non-union workers. A higher capital share in the unionized sector or higher union bargaining power, however, increase the overall wage bill paid to workers, hence t_i^* is decreasing in K_{iA} and s_i.

I now turn to the case when only the trade union of industry i lobbies. In this case, the optimal tariff will be structurally higher than in the case when no industry i players lobby. The optimal tariff consists of three components, of which the second one is new:

$$t_i^* = \overbrace{\frac{\Theta}{\Theta+a}\frac{F^i}{M_i'}}^{\text{GH}} \overbrace{-\frac{s_i}{\Theta+a}\frac{F^{iA}}{M_i'}\frac{N_i}{N_i+\delta_A(L_i-N_i)}}^{\text{collection by union workers}} \overbrace{+\frac{1}{M_i'}\left[\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}\right]}^{\text{unemployment}}.$$

The collection component is in a sense the opposite of the dispersion component encountered earlier. If capital owners do not lobby, their special interests are not taken into account in the lobbying game (apart from their impact on domestic welfare). With union bargaining, however, the union workers capture part of the protection rents that would accrue to capital owners in the original GH model. And since they take part in the lobbying game, their interests in protection are reflected in a structurally higher tariff. Notice that for a given tariff, the collection component would be absolutely smaller than the dispersion component when $N_i \notin \Omega$, $K_i \in \Omega$ because the union workers, whose special interests are reflected in t_i^*, only partially capture the higher wages in sector A. A higher N_i increases the collection component since the share of union wages that goes to union workers increases, while a

[17] For this claim to be true, the percentage of lobbyists Θ in the population must be constant. Except for changes in N_i, this is no problem. An increase in N_i, however, would also raise Θ. To keep Θ constant when increasing the number of union members in industry i, I have to decrease union membership in a different industry where trade unionists also lobby. Otherwise an increase in N_i will also have an impact on the GH component, namely a negative one. In the following discussion, I assume that Θ is fixed.

higher δ_A decreases it because this share goes down. Higher K_{iA} or higher s_i increase the overall wage bill and thus also the collection component.

Finally, the equilibrium tariff when both the union and the capital owners of industry i lobby consists of three distinct parts as labelled below:

$$t_i^* = \overbrace{-\frac{1-\Theta}{\Theta+a}\frac{F^i}{M_i'}}^{\text{GH}} \overbrace{+\frac{s_i}{\Theta+a}\frac{F^{iA}}{M_i'}\frac{\delta_A(L_i-N_i)}{N_i+\delta_A(L_i-N_i)}}^{\text{dispersion to non-union workers}} \overbrace{+\frac{1}{M_i'}\left[\frac{u_i^2}{p_i^2}\frac{K_i}{F_{LL}^i(1,\lambda_i)}\right]}^{\text{unemployment}}.$$

The first part is once again the GH component, and the third part is the unemployment component. The second part is new. As in the case when $N_i \notin \Omega$, $K_i \in \Omega$, this part is a dispersion component. It exists because the union does not capture all the excess surplus extracted from the capital owners. Of the wage bill paid in sector A, the union receives only a share $\frac{N_i}{N_i+\delta_A(L_i-N_i)} < 1$. If $\delta_A(L_i - N_i)$ were zero (i.e., if no non-unionized workers received the higher union wage), the dispersion component would disappear because the sum of the profit effect of capital owners and the wage bill effect of trade unionists would equal the profit effect in the original GH model. However, as long as part of the benefits from trade protection is dispersed to a population group that does not lobby, the overall interest of lobbies in trade protection is diminished. The dispersion component thus structurally lowers the optimal tariff in equilibrium. How does t_i^* for $N_i \in \Omega$, $K_i \in \Omega$ change when the parameters are altered? An increase in the anti-discrimination parameter δ_A raises the percentage of the union wage bill that goes to non-union members. The absolute increase in the dispersion component thus lowers the optimal tariff. The opposite is true when the number of union members increases. The dispersion effect is diminished, and the optimal tariff increases. If the amount of capital K_{iA} in the unionized sector or the union bargaining power s_i increase, it is once again the dispersion component that is directly affected. This time, the overall wage bill increases. Keeping everything else constant, this means that more wages go to non-union workers, i.e., the dispersion effect rises and the optimal tariff falls.

In summary, labor market rigidities lead to additional components in the equilibrium tariff equation compared to the basic protection for sale framework. Binding minimum wages paired with labor immobility induce an additional, tariff-raising component, whereas trade union activity can either lead to a positive or negative additional component in the equilibrium tariff equation, depending on who in an industry is lobbying. Labor market variables (such as employment size and unionization rates) are shown to influence the equilibrium trade policy in an intuitive way, but they do so in a non-additive manner.

5. Extensions

A common view is that the existence of union lobbies increases trade protection. After all, trade union rhetoric against unfair imports and for the protection of domestic worker interests is widespread, and union activists can be found among the protesters against free trade at WTO meetings and the like. What we have found so far, however, is that the introduction of trade unions – taken by itself – into the protection for sale framework only increases the equilibrium tariff if capital owners do not lobby. The natural question to ask is thus whether it is possible to reverse this finding by changing some model assumptions. In the following, I sketch some possibilities that may lead to higher trade protection under unionization.

The first possibility is to allow workers to choose whether or not they want to become union members and to let this decision be influenced by trade policy considerations. Union membership can be endogenized by introducing an additional stage between wage and employment determination and the lobbying stage. In this stage, individual workers decide whether they want to join a trade union. Suppose workers have to incur a fixed cost f_i to join a union, for example a membership fee.[18] If the expected benefits of union membership $\alpha_i \overline{w}_i + (1-\alpha_i)u_i - f_i$ exceed the expected benefits $\alpha_i \delta_A \overline{w}_i + (1-\alpha_i \delta_A)u_i$ of not being a union member, a worker joins the union, if the inequality is reversed, he chooses not to join.

In an interior equilibrium, the number N_i of union workers in industry i will be determined by the equality of fixed cost and the net benefits of union membership, i.e.,

$$f_i = \alpha_i(1-\delta_A)(\overline{w}_i - u_i). \tag{5.1}$$

Whereas the left-hand side of (5.1) is independent of N_i, α_i and thus the right-hand side is a decreasing (and strictly convex) function of N_i by (2.4). Assuming $\alpha_i(1-\delta_A)(\overline{w}_i - u_i) > f_i$ for $N_i = 0$ and $\alpha_i(1-\delta_A)(\overline{w}_i - u_i) < f_i$ for $N_i = L_i$, we have an interior, stable membership equilibrium since the net benefits curve of union membership intersects the fixed cost line from above. An increase in p_i, for example caused by a higher tariff, shifts the net benefit curve out because $\alpha_i(\overline{w}_i - u_i)$ is increasing in p_i by (2.7). The equilibrium union member number is therefore higher. It can also easily be established that N_i is increasing in K_{iA} and s_i. The former follows since employment in the unionized sector is greater the bigger this sector, while the latter follows since the union wage increases with the bargaining power of the union. Finally, an increase in δ_A has a direct negative effect on the net benefit of union membership via the factor $(1-\delta_A)$ and an additional indirect negative effect via the decrease in the employment parameter α_i. Therefore the net benefit curve shifts in and $\frac{\partial N_i}{d\delta_A} < 0$.

Endogenizing N_i does not change the conclusions about the unilaterally optimal tariffs for the government, lobbies outside industry i, or capital owners in i. The reason is that the determination of employment in sectors A and B is unaffected by the endogeneity

[18] It is convenient to assume that the unions collect the membership fees and then redistribute them lump-sum to their members. In this way, the fixed cost of joining a union is neutralized in the welfare functions of the unions and the government.

of N_i. The unilaterally optimal tariff for the trade union changes, however. An increase in p_i causes a greater number of workers to join the trade union of industry i. Therefore, two additional components appear in the formula for $t_i^{N_i}$. First, the increase in the number of union members increases their percentage in the population. The resulting effect in the FOC for $t_i^{N_i}$ is equal to $\frac{\partial N_i}{\partial p_i}$ times the sum (per worker in industry i) of consumer surplus, tariff revenue, and unemployment tax, thus sharing its sign with this sum. Secondly, the expected wage bill for union members is affected because the increase in p_i also increases the number of union workers employed in the unionized sector. Assuming that consumer surplus plus tariff revenue minus unemployment tax payment is positive, the finding is thus that both effects created by the endogeneity of union membership introduce additional positive components into the formula for $t_i^{N_i}$ and thus also into t_i^* in case that the trade union of industry i lobbies. A new result is that now wage bill effect and profit effect sum to more than F^i, the profit effect in the original GH model. Whereas the conclusion for exogenous N_i is that wage dissipation to non-union members reduces the joint interest of capital owners and union in protection, the conclusion is opposite once N_i is endogenized. Although wage dissipation still exists, it is more than offset by the increase in the union member wage bill as more workers join the union. What we see here is that if both union and capital owners in industry i lobby, then unionization increases the equilibrium tariff once union membership is endogenous.

A second possibility arises if we drop the efficient bargaining assumption. After all, firms and unions often bargain only over wages, not employment.[19] Once we consider a model setup in which firms unilaterally decide on employment, taking the union wage, which is determined via collective bargaining, as given, employment will no longer be efficient. More specifically, there are two major changes that impact the equilibrium tariff predictions. First, the marginal value product of labor in the unionized sector A equals the union wage and thus exceeds the wage in the non-unionized sector. Consequently, ceteris paribus employment in the unionized sector will be lower. Secondly, employment in sector A is no longer independent of the union wage, that is we have now $\alpha_i = \alpha_i(\overline{w}_i, p_i)$ instead of $\alpha_i = \alpha_i(p_i)$. Sign predictions thus become harder, in particular it may or may not be true that employment in the unionized sector of industry i rises when a tariff on good i is imposed. Yet, it is certainly possible to calculate the equilibrium tariff levels, and moreover, the major conclusions (namely, that the existence of rigid wages and labor immobility lead to an unemployment component and unionization leads to redistribution effects) remain

[19]It should be noted, however, that in Europe agreements that also include job guarantees are quite common. Moreover, for the U.S. empirical tests of the efficient bargaining model vs. the competing right-to-manage model have led to inconclusive results or even a rejection of the right-to-manage model, thus offering (albeit weak) support for the efficient bargaining model (see MaCurdy and Pencavel, 1986).

valid. Define

$$\widetilde{t}_i^G = -\frac{1}{M_i'}\left[\overline{w}_i\left[N_i+\delta_A(L_i-N_i)\right]\left(\frac{\partial\alpha_i}{\partial\overline{w}_i}\frac{d\overline{w}_i}{dp_i}+\frac{\partial\alpha_i}{\partial p_i}\right)+u_i\left[L_i-N_i+\delta_B N_i\right]\frac{\partial\beta_i}{\partial p_i}\right].$$

The equilibrium tariff predictions for the right-to-manage union model look as follows:

Proposition 5.1. (a) *If both labor and capital in i lobby, i.e., if $N_i \in \Omega$ and $K_i \in \Omega$, then*

$$t_i^* = -\frac{1-\Theta}{\Theta+a}\frac{F^i}{M_i'}+\frac{1}{\Theta+a}\left[\frac{\delta_A\alpha_i(L_i-N_i)}{M_i'}\frac{d\overline{w}_i}{dp_i}-\frac{(\overline{w}_i-u_i)N_i}{M_i'}\left(\frac{\partial\alpha_i}{\partial\overline{w}_i}\frac{d\overline{w}_i}{dp_i}+\frac{\partial\alpha_i}{\partial p_i}\right)\right]+\widetilde{t}_i^G.$$

(b) *If nobody in i lobbies, i.e., if $N_i \notin \Omega$ and $K_i \notin \Omega$, then*

$$t_i^* = \frac{\Theta}{\Theta+a}\frac{F^i}{M_i'}+\widetilde{t}_i^G.$$

(c) *If only labor in i lobbies, i.e., if $N_i \in \Omega$ and $K_i \notin \Omega$, then*

$$t_i^* = \frac{\Theta}{\Theta+a}\frac{F^i}{M_i'}-\frac{1}{\Theta+a}\left[\frac{\alpha_i N_i}{M_i'}\frac{d\overline{w}_i}{dp_i}+\frac{(\overline{w}_i-u_i)N_i}{M_i'}\left(\frac{\partial\alpha_i}{\partial\overline{w}_i}\frac{d\overline{w}_i}{dp_i}+\frac{\partial\alpha_i}{\partial p_i}\right)\right]+\widetilde{t}_i^G.$$

(d) *Finally, if only capital in i lobbies, i.e., if $N_i \notin \Omega$ and $K_i \in \Omega$, then*

$$t_i^* = -\frac{1-\Theta}{\Theta+a}\frac{F^i}{M_i'}+\frac{1}{\Theta+a}\frac{L_{iA}}{M_i'}\frac{d\overline{w}_i}{dp_i}+\widetilde{t}_i^G.$$

In case that both union wage and employment in sector A depend positively on the tariff, it is still true that the unemployment component increases the equilibrium tariff prediction, whereas redistribution considerations lead to a structurally higher t_i^* if $N_i \in \Omega$ and $K_i \notin \Omega$ and a structurally lower t_i^* if $N_i \notin \Omega$ and $K_i \in \Omega$. However, the reader should note two major deviations from the predictions compared to the efficient bargaining model: The unemployment component no longer equals t_i^G because the government values more employment in sector A more highly (namely, by $\overline{w}_i$) than the lobbies (namely, by u_i). In addition, even if both the union and the capital owners of industry i lobby and only union workers are covered by collective bargaining, the equilibrium tariff still does not coincide with the original GH predictions, but will be structurally higher. This difference occurs because the marginal value product of labor in sector A is higher than in the non-unionized sector B. Hence, assuming that employment indeed rises with the tariff, the right-to-manage model of unionization gives comparable results to the efficient bargaining model, but there are some additional positive elements that structurally increase the equilibrium tariff prediction.

Finally, a third possibility to argue that unionization increases trade protection is to say that unions, once they are founded on an industry-wide basis to bargain with firms, have already accomplished a substantial degree of organization and thus can also function more easily as active trade policy lobbies. While in Europe the negotiating partners of trade unions are typically firm associations, the negotiating partners in the U.S. are usually single firms. In order to speak with one voice as an industry lobby for trade policy, they still have to form a working lobby association. In order to explain why the existence of unions usually increases trade protection, one might argue at least for the U.S. that the case where capital owners do not lobby while trade unions do is the most common situation.

6. Conclusion

In this paper, I show that augmenting the GH model by trade union activity and unemployment due to labor immobility and high unemployment benefits introduces labor market variables into the equilibrium tariff equation in a natural way. The employment-related variables enter the tariff equation non-additively. The results in this paper suggest that the simple GH model may do a poor job in explaining trade protection in countries where unionized labor is influential, such as continental Europe, and where labor markets do not clear. This paper provides a more appropriate framework for testing the protection for sale model in such countries.

One might expect that higher labor market distortions, commonly assumed to be a distinguishing factor between the United States and the continental European labor market, increase trade protection. In this paper, however, I show that this is only partly true. Labor immobility, high unemployment benefits, and resulting sectoral unemployment increase the equilibrium tariff level. Tariffs increase employment in the protected industry as well as overall employment. Since the increase in production is beneficial for the domestic country, the government (even without lobbying) would levy a strictly positive tariff on imports and subsidize exports. Moreover, higher employment reduces taxes to finance unemployment benefits. Tax reduction considerations create some common interest between lobbies to increase employment in industries other than their own.

In contrast, the effect of trade union activity differs depending on whether or not capital owners of an industry take part in the lobbying game. Suppose first that the trade union, but not capital owners of an industry lobby. The trade union captures part of the protection rents from the firms via collective bargaining. Moreover, these protectionist interests are represented in the lobbying game. Compared to the case when trade unions and capital owners of industry i do not lobby, the equilibrium tariff in this industry thus rises. The opposite is true, however, when capital owners lobby but the trade union does not. Since part of the protection benefits goes to workers via collective bargaining, the capital owners' interest in protection (and thus the equilibrium tariff) is reduced as compared to a model where no profit sharing between capital owners and workers occurs. A similar result holds if both the trade union and capital owners of industry i lobby. In this case, capital owners and workers share the rents accruing from trade protection. But coverage of non-union workers by collective bargaining outcomes, which is substantial in many European countries, dissipates part of the rents to workers who are not represented by lobbies. The reduction of rents that go to lobbies caused by this dissipation effect decreases the equilibrium tariff compared to the original GH model when capital owners lobby.

Appendix A. Proofs

Proof of Lemma 3.1. Let $g_j \in \{N_j, K_j\}$ denote a lobby group in industry j. From Grossman and Helpman (1994), we know that the equilibrium tariff for any industry i fulfills the following conditions: (i) It maximizes the governmental welfare function

$$\sum_{g_j \in \Omega} C_{g_j} + a\left[\sum_{j=1}^{n} t_j M_j(p_j) + \sum_{j=0}^{n} p_j F^j + (L + \sum_{j=1}^{n} K_j)\sum_{j=1}^{n} V_j(p_j)\right].$$

This implies the FOC (after multiplying by $(\ell - 1)$, where ℓ is the number of lobbies)

$$(\ell - 1)\sum_{g_j \in \Omega} \frac{\partial C_{g_j}}{\partial p_i} + (\ell - 1)\, aE_i^G - (\ell - 1)\, aF^i + (\ell - 1)\, at_i M_i^{'} = 0, \tag{A.1}$$

where E_i^G denotes the sum of changes in the value of domestic production caused by a tariff on good i. (ii) For all $g_k \in \Omega$, the equilibrium tariff also maximizes the sum of lobby g_k's and the government's welfare

$$\sum_{g_j \in \Omega, g_j \neq g_k} C_{g_j} + a\left[\sum_{j=1}^{n} t_j M_j(p_j) + \sum_{j=0}^{n} p_j F^j + (L + \sum_{j=1}^{n} K_j)\sum_{j=1}^{n} V_j(p_j)\right] + W_{g_k},$$

where W_{g_k} denotes lobby g_k's welfare before the contribution is subtracted. This implies the FOC

$$\sum_{g_j \in \Omega, g_j \neq g_k} \frac{\partial C_{g_j}}{\partial p_i} = -\left(a + \theta_{g_k}\right) t_i M_i^{'} + \left(a + \theta_{g_k}\right) F^i - aE_i^G - E_i^{g_k}.$$

Summing over the g_k, we obtain

$$(\ell - 1)\sum_{g_j \in \Omega} \frac{\partial C_{g_j}}{\partial p_i} = -(\ell a + \sum_{g_j \in \Omega} \theta_{g_j}) t_i M_i^{'} + (\ell a + \sum_{g_j \in \Omega} \theta_{g_j}) F^i - \ell a E_i^G - \sum_{g_j \in \Omega} E_i^{g_j}.$$

Substituting the previous expression into (A.1) yields (3.1) as expression for the equilibrium tariff t_i^*. To verify (3.2), note that the unilateral tariff that lobby g_j would want to impose on industry i is determined by $\theta_{g_j} t_i M_i^{'} - \theta_{g_j} F^i + E_i^{g_j} = 0$, which yields

$$t_i^{g_j} = \frac{F^i}{M_i^{'}} - \frac{E_i^{g_j}}{\theta_{g_j} M_i^{'}}.$$

The structural form of $E_i^{g_j}$ is the same as in the previous equation, except that it is here a function of $t_i^{g_j}$ instead of t_i^*. It is possible to substitute from this equation for $E_i^{g_j}$ if we keep in mind that then $t_i^{g_j}$ will be a function of the equilibrium tariff t_i^* and as such, in general, does no longer solve the original maximization problem of population group g_j. The desired result follows. □

Proof of Proposition 3.1. Maximizing domestic welfare W_G leads to the FOC

$$u_i\left[N_i+\delta_A(L_i-N_i)\right]\frac{\partial \alpha_i}{\partial p_i}+u_i\left[L_i-N_i+\delta_B N_i\right]\frac{\partial \beta_i}{\partial p_i}+t_i M_i'=0.$$

If it were not for the labor market distortions, employment would not change and consequently t_i^G would be zero. But since employment increases with the tariff, we find that

$$t_i^G=-\frac{u_i}{M_i'}\left[\left[N_i+\delta_A(L_i-N_i)\right]\frac{\partial \alpha_i}{\partial p_i}+\left[L_i-N_i+\delta_B N_i\right]\frac{\partial \beta_i}{\partial p_i}\right]>0.$$

Substituting from (2.5) and (2.2), the FOC can be simplified to

$$-\left[\frac{1}{F_{LL}^{iA}}+\frac{1}{F_{LL}^{iB}}\right]\frac{u_i^2}{p_i^2}+t_i M_i'=0.$$

By linear homogeneity of F^i, it is also true that $\frac{1}{F_{LL}^{iA}}+\frac{1}{F_{LL}^{iB}}=\frac{K_i}{F_{LL}^i(1,\lambda_i)}$. To see this, notice that F_{LL}^{iA} and F_{LL}^{iB} are homogeneous of degree -1 because F^i is homogeneous of degree 1. Furthermore, it was established previously that the optimal labor-capital ratio λ_i is the same across the sectors of industry i. Hence we can write $\frac{1}{F_{LL}^{iA}}+\frac{1}{F_{LL}^{iB}}=\frac{K_{iA}}{F_{LL}^i(1,\lambda_i)}+\frac{K_{iB}}{F_{LL}^i(1,\lambda_i)}=\frac{K_i}{F_{LL}^i(1,\lambda_i)}$. The formula for t_i^G can thus be rewritten as

$$t_i^G=\frac{u_i^2}{p_i^2 M_i'}\frac{K_i}{F_{LL}^i(1,\lambda_i)},\quad \text{where}\quad M_i'=\frac{dD_i}{dp_i}+\frac{u_i^2}{p_i^3}\frac{K_i}{F_{LL}^i(1,\lambda_i)}.$$

Since $\frac{dD_i}{dp_i}$ does not depend on K_{iA}, M_i' proves to be independent of changes in K_{iA} as well.

To find out how changes in the parameters affect the welfare-maximizing tariff t_i^G, notice that for any player g_j and any parameter $x\in\{K_{iA},N_i,\delta_A,s_i,u_i\}$, we have

$$\frac{dt_i^{g_j}}{dx}=-\frac{\partial LHS}{\partial x}\Big/\frac{\partial LHS}{\partial t_i^{g_j}},$$

where LHS denotes the left-hand side of g_j's FOC. Assuming that the second-order condition holds, this means that $sign(\frac{dt_i^{g_j}}{dx})=sign(\frac{\partial LHS}{\partial x})$. Since the LHS of the FOC for t_i^G is independent of simple redistributions of capital between sectors A and B by linear homogeneity of F^i, we find that $\frac{dt_i^G}{dK_{iA}}=0$. Similarly, it is true that $\frac{dt_i^G}{dN_i}=\frac{dt_i^G}{d\delta_A}=0$ because the employment parameters α and β always adjust such as to hold employment in sectors A and B constant. Union bargaining power s_i does not enter the formula for t_i^G at all, hence $\frac{dt_i^G}{ds_i}=0$. Hardest to determine are the effects of an increase in u_i. In order to determine $sign(\frac{dt_i^G}{du_i})$, knowledge of the sign of the third derivative of F^i with respect to labor would be necessary. Whereas we do know that employment and output in industry i decrease and consumer surplus is not affected by a change in u_i, we cannot determine how tariff revenue and unemployment tax payments change. □

Proof of Proposition 3.2. Calculating the FOC for maximization of W_{g_j} and simplifying (substituting from (2.5) and (2.2) and using linear homogeneity of F^i) yields

$$-\theta_{g_j}\frac{u_i^2}{p_i^2}\frac{K_i}{F^i_{LL}(1,\lambda_i)} - \theta_{g_j}F_i + \theta_{g_j}t_i M_i' = 0.$$

That $\frac{dt_i^{g_j}}{dK_{iA}} = \frac{dt_i^{g_j}}{dN_i} = \frac{dt_i^{g_j}}{d\delta_A} = 0$ follows from the same arguments as the corresponding comparative statics for t_i^G. s_i does not enter the formula for $t_i^{g_j}$ at all, hence $\frac{dt_i^{g_j}}{ds_i} = 0$. To see that the sign of $\frac{dt_i^{g_j}}{du_i}$ is ambiguous, notice that once again we would need information about the sign of F^i_{LLL}. □

Proof of Proposition 3.3. Maximizing W_{K_i} by choice of t_i leads to the FOC

$$F^i - s_i F^{iA} - \theta_{K_i}F_i + \theta_{K_i}t_i M_i^{'} - \theta_{K_i}\frac{u_i^2}{p_i^2}\frac{K_i}{F^i_{LL}(1,\lambda_i)} = 0.$$

Compared to the original GH model, the profit effect is smaller by $s_i F^{iA}$, the share of profit increases that goes to workers in sector A. Solving for $t_i^{K_i}$ leads to the expression given in the proposition. High union bargaining power s_i, a high percentage θ_{K_i} of industry i capital owners in the population, and a high percentage of unionized sector A production in industry i work in favor of capital owners' opting for an import subsidy. An increase in K_{iA} or s_i decreases the profit effect for firms in i since they have to pay more to workers, $t_i^{K_i}$ is thus diminished. Changes in δ_A and N_i are absorbed by changes in α_i and β_i so that output and its derivatives are not affected, hence $\frac{dt_i^{K_i}}{dN_i} = \frac{dt_i^{K_i}}{d\delta_A} = 0$. The sign ambiguity of $\frac{dt_i^G}{du_i}$ arises for similar reasons as mentioned in the discussion of $\frac{dt_i^G}{du_i}$ and $\frac{dt_i^{g_j}}{du_i}$. □

Proof of Proposition 3.4. Maximization of W_{N_i} yields the FOC (using (2.7) and (2.5))

$$s_i\frac{N_i}{N_i + \delta_A(L_i - N_i)}F^{iA} - \theta_{N_i}F_i + \theta_{N_i}t_i M_i^{'} - \theta_{N_i}\frac{u_i^2}{p_i^2}\frac{K_i}{F^i_{LL}(1,\lambda_i)} = 0,$$

which can be easily solved for $t_i^{N_i}$ given in proposition 3.4. Similarly to $t_i^{K_i}$, the sign of $t_i^{N_i}$ is unclear. The first component $\frac{F^i}{M_i'}$, appearing in the formulae for the optimal unilateral tariffs of all lobbies, is the import subsidy that would be favored by union members if they only considered consumer surplus and tariff revenue effect. The third component $\frac{1}{M_i'}\frac{u_i^2}{p_i^2}\frac{K_i}{F^i_{LL}(1,\lambda_i)} > 0$ is present because a tariff decreases the funds necessary to finance unemployment benefits. This component is common in the formulae for all lobbies' optimal unilateral tariffs since everybody has to pay unemployment tax. The second component $-\frac{s_i}{\theta_{N_i}M_i'}\frac{N_i F^{iA}}{N_i + \delta_A(L_i - N_i)}$ is positive and appears because an increase in the tariff increases the wage bill for union members. An increase in K_{iA} or an increase in s_i increase the wage bill paid to union workers, hence $\frac{dt_i^{N_i}}{dK_{iA}} > 0$ and $\frac{dt_i^{N_i}}{ds_i} > 0$. An increase in δ_A increases the amount of wages that is dissipated to non-union workers. Therefore, an increase in

δ_A decreases the tariff the trade union of industry i would choose: $\frac{dt_i^{N_i}}{d\delta_A} < 0$. In contrast, an increase in N_i while keeping θ_{N_i} constant raises the relative wage share union workers obtain compared to non-union workers, hence $\frac{dt_i^{N_i}}{dN_i} > 0$. (However, when allowing θ_{N_i} to vary since it is proportional to N_i, we have $\frac{dt_i^{N_i}}{dN_i} < 0$.) As in the discussion of the other unilaterally optimal tariffs, the derivative with respect to u_i cannot be signed. □

Proof of Proposition 4.1. Follows directly from Lemma 3.1 and the unilaterally optimal tariffs as calculated in section 3.2. □

Proof of Proposition 4.2. Since the equilibrium tariff maximizes $aW_G + \sum_{K_j \in \Omega} W_{K_j} + \sum_{N_j \in \Omega} W_{N_j}$, which is a direct corollary of Lemma 3.1, (b), (c), and (d) follow from the comparative statics for the unilateral tariffs described in propositions 3.1, 3.2, 3.3, and 3.4. To see that (a) is true, note that δ_A, N_i, s_i, and K_{iA} only influence the payoffs of lobbies in industry i, and this only via their effects on profits and the wage bill. By Lemma 3.1, we know that these affect t^* additively. It is easily checked that the profit and wage bill effect of a tariff increase add up to $F^i - s_i \frac{\delta_A (L_i - N_i)}{N_i + \delta_A (L_i - N_i)} F^{iA}$. An increase in K_{iA}, an increase in s_i, or an increase in δ_A decrease this expression (i.e., the joint interest of industry i lobbies in trade protection decreases), whereas an increase in N_i increases the expression and thus leads to a higher equilibrium tariff. □

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TABLE 2. Overview of wage and employment determination in industry i

		in sector A	in sector B
wage	set	by union-firm bargaining	exogenously
	equal to[a]	weighted average of $AVPL_i$ and u_i	unemployment benefit u_i
	paid to	all workers in sector	all workers in sector
employment	set	by union-firm bargaining	by firms taking wage as given
	determined by[b]	$MVPL_i = u_i$	$MVPL_i = u_i$
	share of union workers employed in i	α_i	$\delta_B \beta_i$
	share of non-union workers employed in i	$\delta_A \alpha_i$	β_i

[a] $AVPL$ = average value product of labor
[b] $MVPL$ = marginal value product of labor

Table 3. List of symbols used in the paper

Symbol	Description
A	unionized sector
a	weight on domestic welfare in the governmental welfare function
α_i	share of industry i union workers employed in sector A
B	non-unionized sector
β_i	share of industry i non-union workers employed in sector B
C	contributions; subscript denotes the lobby making the contribution
D_i	demand for good i
δ_A	ratio of non-union workers to union workers employed in sector A
δ_B	ratio of union workers to non-union workers employed in sector B
E	other effects (besides tariff revenue and consumer surplus effect) a tariff on product of industry i has on welfare of a group; superscript denotes group and subscript industry
F	production function; superscript denotes industry and sector, subscript stands for input with respect to which production function is differentiated
f_i	fixed cost of joining the union in industry i
G	index for government
g_i	lobby group of industry i
i	industry index
K	capital; subscript denotes industry and sector
ℓ	number of lobbies
λ_i	labor to capital ratio in industry i
L_i	number of workers in industry i
M_i	import of good i
N_i	number of union members in industry i, union of industry i
n	number of non-numeraire industries
p_i	domestic price of good i
p_i^*	world market price of good i
s_i	bargaining strength of trade union in industry i; corresponding bargaining strength of capital owners is given by $1 - s_i$
t_i	specific tariff on good i; superscript denotes lobby for whom this tariff is optimal, and * indicates equilibrium tariff
θ	population share of lobby group; subscript denotes lobby
Θ	population share of all lobby groups
u_i	unemployment benefit (minimum wage) in industry i
V_i	indirect utility of an individual from consuming good i
$\bar{w}_i$	union wage in industry i
Ω	set of organized lobbies
W	welfare of a group; subscript denotes group