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INTERNATIONAL OLIGOPOLY AND ASYMMETRIC LABOUR MARKET INSTITUTIONS

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ABSTRACT

Asymmetries in labour relations can have important effects on imperfectively competitive rivalries between firms. Such asymmetries are particularly striking in cross-country comparisons and are therefore of greatest interest in international markets. Using a simple duopoly model, we focus on two asymmetries. First, one firm may face a noncooperative union and second, institutional factors may allow one firm to commit itself to particular labour input before its rival sets output, giving it a natural Stackelberg leadership role. We examine the trade policy incentives resulting from these labour asymmetries, focusing on profit shifting tariffs, quotas and subsidies.

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1. Introduction

The institutional structure of labour markets varies from country to country. The contrast between Japanese labour relations and labour relations in North America and Western Europe has been a particularly popular recent theme in the business press. The formal economics literature, however, has relatively little to say about the consequences of asymmetries in labour institutions for rivalries between firms based in different countries. This paper has two principle objectives. The first objective is to examine the positive implications of two particular labour market asymmetries in an imperfectly competitive international environment. Our second objective is to analyze the consequences of these labour market asymmetries for strategic trade policies.

We use a two country, two firm Cournot duopoly model, with one firm located in each country. One of the two labour market asymmetries concerns the role of unions and is modelled as follows. One firm employs labour belonging to a monopoly union, while the other firm employs labour at its opportunity cost. The second asymmetry is that one firm treats labour as a fixed factor while the other firm treats labour as a variable factor. Using a standard noncooperative representation of union behaviour we find, as one would expect, that the introduction of a union in one country causes output in the industry to fall and reduces profit for the unionized firm. Union members benefit, of course (relative to the nonunion base), but this benefit falls short of the loss to the firm, so the unionized industry loses as a whole, despite the fact that worldwide producer surplus in the industry rises as output is reduced toward the monopoly level. The other firm is, therefore, a substantial beneficiary of union activity.

The second asymmetry leads to what we call the "labour commitment" effect. The modelling approach taken in the paper is to assume that one firm in the international duopoly makes a commitment to a labour force while the other does not. The point to be made is that such a commitment to labour might be translated (taking capital as fixed) into a commitment to a particular output level. The ability to make such a commitment would then provide that firm with a natural Stackelberg leadership advantage in its output rivalry with a firm that treats labour as a variable factor. The labour

commitment effect in itself (without the other firm being unionized) benefits the firm that is able to make the commitment and reduces the profit of its rival. Combined producer surplus in the industry tends to fall. In an extension we consider whether precommitment is advantageous in the presence of uncertainty, providing some insight into the question of why some firms may precommit while others do not.

The policy implications of these labour market asymmetries are interesting in that significant modifications are required in the recently rejuvenated subject of trade policy under imperfect competition. The principle effect of unionization is that the union is able to "skim off" part of the benefits of any interventionist trade policy, such as a rent-shifting subsidy or tariff,[1] while simultaneously partially undercutting the objectives of the policy. The optimal policy may, however, involve a higher level of intervention with a union than without. In effect, the policy has to undo the effect of the union in influencing output market behaviour.

The labour market asymmetries we examine are stylized versions of what we take to be important contrasts between North American or European and Japanese labour relations.[2] The labour commitment idea is motivated by the "lifetime contract" that is standard in parts of the Japanese economy. The union asymmetry has more general relevance, but is also of particular interest in cross-country comparisons. We emphasize, however, that we are not trying to model the institutional detail of either the Japanese or other western economies. Many firms in Japan do not make long term commitments to labour, and unions are an important force in some parts of the Japanese economy. Nevertheless, to the extent that one accepts the idea that major parts of the Japanese economy are systematically different from rivals in these two respects: the relative "friendliness" of unions and the commitment to

[1] Basic references on rent-shifting trade policies include Brander and Spencer (1981, 1985), Dixit (1984), and Eaton and Grossman (1986).

[2] One popular account of these contrasts is Crocker et. al. (1986) which claims "In Japan, unions are company unions. For the most part there is cooperation between the executive members and management. Conflict is abhorred, and the union assumes the role of keeping workers in line....Strikes are ... of short duration, and occur during employee's lunch hours or in their own time after work....In large companies in Japan, there is lifelong employment; that is, permanent employees are not laid off or terminated.

labour, then we would argue that the simplifications made in this paper are a useful starting point for the analysis of market rivalry.[3]

This paper draws on three themes in the economics literature: the theory of unions, precommitment under imperfect competition, and strategic trade policy. Our treatment of unions is similar to Sampson (1983) and is also related to papers by McDonald and Solow (1982) and Oswald (1982). There is relatively little work on the asymmetric impact of unions in partially unionized imperfectly competitive industries, which is the setting in this paper.[4] As for the precommitment leterature, most work assumes that capital is the committed variable. Widely cited papers by Dixit (1980), and Eaton and Lipsey (1980), among others, contain the idea that by installing a high level of capital in one period a firm can commit itself to a high level of output in subsequent periods, which acts as a credible threat in influencing the behaviour of potential (or actual) rivals. In this paper the commitment idea is extended to labour. The most closely related existing literature to our paper is the recent work concerning trade policy in imperfectly competitive markets of the oligopoly type. In such markets firms may earn profits, and firms (and governments) have incentives to undertake strategic activities in an effort to capture such profits or rents. Relevant papers include Brander and Spencer (1984, 1985), Dixit (1984), Eaton and Grossman (1986) and Krugman(1984).

In Section 2 of this paper we analyze the basic model of asymmetric unionization, and Section 3 is devoted to a simple model of labour commitment. In Section 4 we examine the trade policy consequences of union power and labour commitment. Section 5 discusses extensions, including consideration of the trade-off between commitment and flexibility under uncertainty. Section 6 contains a concluding summary.

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[3] Two references on Japanese labour relations are Hanami(1979) and Tsurumi(1978). Hanami reports (p. 88) that over 90% of unionized workers belong to "enterprise" or company unions. There is a substantial business policy literature on comparisons between Japanese and American business and labour relations. See, for example, Patrick and Rosovsky (1976).

[4] A tangentially related issue is described by Williamson (1968), in which a dominant firm conspires with a union to set high industry-wide wages so as to weaken the competitive position of smaller and more labour-intensive firms. (See also Salop and Scheffman (1983).)

2. Asymmetric Union Power

This section presents a simple model capable of capturing the relevant aspects of asymmetric union power. There are two countries, country A and country B, and two goods: good z and good m. The agents in the model are households, firms, a union in country A, and the national government of country A.

Households

Each household, i, maximizes utility subject to a budget constraint:

$$\max \quad u^i(z^i, m^i) \qquad \text{s.t.} \quad pz^i + m^i = w^i + \pi^i - t^i \tag{1}$$

where z^i and m^i are household i's consumption of goods z and m respectively, and where w^i represents the wage income of household i, π^i represents its profit income, and t^i represents the taxes it pays. The price of good m is normalized to be 1, so p is the relative price of good z. Each household offers (inelastically) 1 unit of labour to the labour market, for which it receives its wage w^i. The maximization given by (1) leads to indirect utility function[5]

$$v^i = v^i(p, \pi^i, t^i, w^i) \tag{2}$$

where the partial derivatives $v^i_\pi = v^i_w = -v^i_t$ are all equal to the household's marginal utility of income, λ^i. Using Roy's identity, household demand for good z is given by $z^i = -v^i_p/\lambda^i$. The aggregate demand for z is the sum of the individual demands, leading to inverse demand function $p(z;\cdot)$.

Firms

There is a unified world market for each good, and labour is the only factor of production. Good m is produced in both countries by a perfectly competitive zero-profit sector operating under constant returns to scale. The marginal product (and average product) of labour in this sector is c. Since the price of good m is 1, it follows that the wage in the competitive sector is also c.

[5] Basic duality theory is well exposited in many sources. A standard textbook reference is Varian (1978).

The world market for z is served by two firms: firm A and firm B, which are located in countries A and B respectively. The two firms produce a homogeneous product and have access to identical technologies. Implicitly the duopoly is maintained by some barrier to entry such as a sunk entry cost. We abstract from this since it is not directly relevant to our analysis. Firm A is assumed to have a monopoly union which sets the wage, w. Firm B faces a competitive labour supply and therefore hires labour at the competitive wage, c. All households receive either wage w or wage c. For simplicity we assume that one unit of labour produces one unit of good z. The outputs of firms A and B are denoted x and y respectively, so, surpressing income arguments, industry inverse demand can be written as $p = p(x - y)$. Profits for the two firms are:

$$\pi^A(x, y, w) = (p(x - y) - w)x \tag{3}$$

$$\pi^B(x, y) = (p(x - y) - c)y \tag{4}$$

The decisions of firms and households are taken to be decentralized. In other words, a household does not take into account the effect its consumption demand has on the profit of firms and, correspondingly, on its own income through its profit share. Similarly, firms do not take into account the effect own price changes have on the utility of shareholders through those shareholders' consumption. Profit maximization by firms and utility maximization by firms are treated as independent decisions.

Union Behaviour

There is considerable debate concerning the appropriate choice for a union's maximand. Prominent alternative maximands include union surplus (the excess of earnings over opportunity cost), the wage bill, and the wage of the median worker. (See Oswald (1982) for a good discussion of the alternatives. A particularly good treatment of the median voter approach to unions is Grossman (1984).)

Probably the most widely accepted view of the union is simply that it maximizes some function in which both the real wage and total union employment enter positively. (See Dertouzos and Pencavel (1981) for some empirical support.) We adopt this approach, and, following Sampson (1983), assume

the following form for the union's objective function,

$$U(w, x) = x\phi(w) + (n - x)\phi(c) \tag{5}$$

where n is the number of union members. Recalling that x union members are employed at union wage w, while the $n - x$ remaining union members earn wage c in the residual sector, one can think of $U(w, x)$ as the expected utility of a representative union member.[6] Under this "expected utility" interpretation, $\phi(\cdot)$ is the reduced form indirect utility (derived from the v^i functions) of the representative worker.

Formulation (5) is consistent with the idea that the union may take into account the effect that w has on price p and on profits and therefore on the utility of workers in their role as consuming households and as shareholders of firms. We prefer a decentralized interpretation, however, in which the union is viewed as ignoring the profit and product price effects of its wage policies on worker utility. This interpretation is appropriate as long as the product produced by the union firm is a small part of the consumption bundle of a typical worker and if equity ownership in the union firm is a small part of any one worker's portfolio. We take this to be the normal case. We do not require this indirect utility foundation for $\phi(\cdot)$; an alternative interpretation is simply that $\phi(\cdot)$ represents a behavioural description of union decision-making. The only restriction we actually impose on $\phi(\cdot)$ is the very natural requirement that it be increasing in its argument.

Firm and Union Interaction

The model of firm and union behaviour is a two stage game in which the union can act first, setting the wage in the first stage before either firm can set its output. The second stage equilibrium is a Nash equilibrium in outputs, taking the wage of workers in firm A as given by the previous stage. The union is assumed to understand the dependence of the second stage equilibrium outputs on the wage, leading to a sequentially rational equilibrium in the two stage game.[7] By assuming that the union can act first,

[6] This interpretation presupposes, of course, that the utility functions of the different worker/households are comparable, and that the conditions required for the existence of a representative worker are satisfied.

[7] We intend the term "sequential rationality" to describe the following idea. At each stage, each

this structure abstracts from bargaining between the union and firm A.[8]

As is normally the case with sequential models, the equilibrium is best characterized by considering the second stage first. In the second stage, firm A chooses x to maximize $\pi^A(x, y, w)$, from equation (3), given y and w, while firm B chooses y to maximize $\pi^B(x, y)$, from equation (4), taking x as given. Using subscripts to denote partial derivatives, the first order conditions are:

$$\pi^A_x = xp' + p - w = 0 \tag{6}$$

$$\pi^B_y = yp' + p - c = 0 \tag{7}$$

with second order conditions

$$\pi^A_{xx} = 2p' + xp'' < 0; \qquad \pi^B_{yy} = 2p'' + yp'' < 0 \tag{8}$$

We also assume that own marginal revenue falls as the rival's output rises, as indicated by condition (9).

$$\pi^B_{yx} = p' + yp'' < 0; \qquad \pi^A_{xy} = p' + xp'' < 0 \tag{9}$$

Conditons (8) and (9) are assumed to hold globally, which ensures that the output reaction functions of both firms are downward sloping, and in addition we assume that the following condition also holds globally.

$$D = \pi^A_{xx}\pi^B_{yy} - \pi^A_{xy}\pi^B_{yx} > 0 \tag{10}$$

Expression (10) is the Gale-Nikaido condition for global uniqueness of the Nash equilibrium in x and y.[9]

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player acts in its own noncooperative best interest, and this is anticipated by players in earlier stages. The first precise formulation is due to Selten, who used the term subgame perfection to desribe the idea. We prefer the more descriptive term "sequential rationality", first coined by Kreps and Wilson (1983) to describe a refinement of subgame perfection for games of incomplete information.

[8] We should emphasize that the union is not assumed to be "smarter" than the firms. Its asymmetric position arises solely from its ability to act first. The second stage Nash equilibrium output between firms need not arise from naive disequilibrium adjustment. On the contrary, it can be argued that the Nash equilibrium is the natural equilibrium that would arise between calculating, fully informed agents. We do not wish to take a particular stand on this point, although we would claim that the Nash equilibrium is a natural starting point for analyzing noncooperative games. A helpful discussison of the case for and against the Nash equilibrium can be found in Pearce (1984).

[9] These conditions hold for a wide variety of standard cost and demand conditions. They can,

Assuming that the conditions of the implicit function theorem hold, it then follows that first order conditions (6) and (7) define the outputs of the two firms as functions of the wage in firm A.

$$x = x(w); \qquad y = y(w) \tag{11}$$

From total differentiation of (6) and (7) and application of Cramer's rule, the slopes of these functions are as follows.

$$x'(w) = \pi^B_{yy}/D < 0 \quad ; \qquad y'(w) = -\pi^B_{yx}/D > 0 \tag{12}$$

Conditions (8) and (10) ensure that $x'(w) < 0$, while (9) and (10) ensure that the equilibrium output of firm B increases as the wage rate within firm A rises: $y'(w) > 0$.

We now analyze the preceeding stage, in which the union in firm A sets the wage to maximize union objective function (5), knowing that $x = x(w)$ and $y = y(w)$ from (11). The first order condition is:

$$U_w \equiv dU/dw = (\phi(w) - \phi(c))x'(w) + x\phi'(w) = 0 \tag{13}$$

Rearrangement yields:

$$\phi(w) - \phi(c) = -x\phi'(w)/x'(w) > 0 \tag{14}$$

Because $\phi(.)$ is strictly increasing, it follows from (14) that w must exceed c: the union raises the wage above the opportunity cost of labor: $w > c$.

Government

We focus on policies that might be undertaken by the government of country A, although extensions to the two country strategic game between governments A and B can be easily constructed. Country A includes households 1,...,N. All members of the union are residents of country A, as are all shareholders

however, be violated by by quite plausible structures, particularly if marginal cost is strongly downward sloping or if demand is strongly convex. The properties of these "perverse" cases are well understand and will not be taken up here. The basic point is that comparative static properties and consequent policy recommendations reverse for such cases. Because of their poor stablilty properties it can be argued that these cases are of no empirical relevance, although it can also be argued that the traditional treatment of stability is inconsistent with proper game theoretic foundations for the Cournot model and therefore is meaningless as a criterion for ruling out certain cases. We take no position on such issues here.

of firm A. while all shareholders of firm B and workers in firm B are residents of country B. The government maximizes a social welfare function, W^A, defined over the utilities of individual households.

$$W^A = W^A(v^1(p, \pi^1, t^1, w^1), ..., v^N(p, \pi^N, t^N, w^N)) \tag{15}$$

The government is able to maximize (15) using lump sum taxes t^i, subject to its budget constraint. Writing down the appropriate Lagrangian, with μ as the Lagrange multiplier associated with the government budget constraint, taking the first order conditions with respect to $t^1 ... t^N$, and rearranging yields the following condition (using W^A_i to denote $\partial W^A / \partial v^i$).

$$W^A_i \lambda^i = \mu \quad \text{for all i,} \quad i = 1, ...N \tag{16}$$

Condition (16) implies that welfare maximization leads to an outcome in which an extra dollar of income has the same social value, μ, nomatter which household receives it. This is a consequence of the assumption that the government has nondistortionary taxes t^i available.

Welfare effects are examined using the total differential of welfare.

$$dW^A = \Sigma_1^N (W^A_i (v^i_p dp + v^i_\pi d\pi^i + v^i_t dt^i - v^i_w dw^i)) \tag{17}$$

Note that $\Sigma_1^N \pi^i \equiv \pi^A$, and let $z^A \equiv \Sigma_1^N z^i$, the consumption of z in Country A. Then, recalling that $\lambda = v^i_\pi = -v^i_t = v^i_w$, and using Roy's identity: $v^i_p = -\lambda^i z^i$, expression (17) simplifies to the following.

$$dW^A = \mu(-z^A dp + d\pi^A - \Sigma dt^i + \Sigma dw^i) \tag{18}$$

The terms inside expression (18) are standard surplus measures: $-z^A dp$ is the change in consumer surplus, and the other three terms are changes in profit, taxes, and factor income respectively. Net taxes, Σt^i will differ from zero when tariffs and subsidies are introduced. Labour is supplied inelastically to the economy so all factor income can be thought of as a factor rent. For infinitesimal changes μ is just some number which can be normalized to equal 1 by the appropriate choice of units for utility index W^A. For discrete changes, welfare effects are calculated by integrating dW. If the changes are large, μ, which

is the social marginal value of income, may vary over the range of integration. Even for large changes, however, it is clear from the form of (18) that the procedure of adding together surplus measures is valid for obtaining qualitatively correct welfare effects. (This fact that optimal lumpsum redistribution allows this "surplus-equivalent" approach has been made by Starrett (1979), among others.) The presence of a variable μ merely makes welfare a (presumably concave) monotonic transformation of overall surplus. In the rest of the paper we make the logically inessential but expositionally convenient assumption that the changes we consider are small enough that μ can be treated as a constant, and we normalize it to equal 1. The total differential of welfare is then as follows.

$$dW^A = -z^A dp + d\pi^A - \Sigma dt^i - \Sigma dw^i \tag{19}$$

Welfare Effects of Unionization

It is fairly clear that the output and profit of firm A are reduced by the introduction of a union in A, as would be the case if firm A were a monopoly, but in addition, the consequent increase in the output of its rival further reduces firm A's profit. Total rents to union members rise as a result of unionization. (Without unionization all workers earn only the competitive wage, c.) Producer surplus in Country A, which is the sum of profit and rent to workers, falls. These ideas are expressed in Proposition 1.

Proposition 1: (i) Unionization of firm A reduces producer surplus in Country A: the gain to union members falls short of the loss to firm A.

(ii) Unionization of firm A reduces total output of the industry. The gain in profit to firm B more than offsets the loss of surplus in A so world producer surplus rises. ***

Proof

(i) Producer surplus in A is $S^A(w) \equiv \pi^A(x(w), y(w), w) + wx(w) + (N - x)c$ Noting that $\pi^A_x = 0$ and $\pi^A_w = \partial\pi^A/\partial w = -x$, it follows that

$$dS^A/dw = \pi^A_y y'(w) + (w - c)x'(w) \tag{20}$$

Noting also that $\pi^A_y = xp' < 0$ and using (12), expression (20) must be negative. The result stated

in the proposition then follows because the effect of increasing w on producer surplus in A is negative everywhere on the path from a wage equal to c to to the union wage.

(ii) The introduction of the union reduces industry output if $x'(w) + y'(w) < 0$ for all wage levels on the path from c to the union wage. From (10) and (12),

$$x'(w) + y'(w) = (\pi^B_{yy} - \pi^B_{yx})/D = p'/D < 0 \tag{21}$$

The change in world producer surplus is obtained by adding the change in π^B to the change in S^A.

$$d(S^A + \pi^B)/dw = \pi^A_y y'(w) + (w - c)x'(w) - \pi^B_x x'(w) \tag{22}$$

Using (6) and (7) and the fact that $\pi^B_x = yp'$ yields $w - c - \pi^B_x = xp'$. Then from (21), (22), and $\pi^A_y = xp'$, we obtain

$$d(S^A + \pi^B)/dw = xp'(x'(w) + y'(w)) > 0 \tag{23}$$

as was to be shown. ***

It is an immediate corollary of Proposition 1 that welfare in Country A and in the world as a whole falls as a result of unionization.

A Linear Example

Calculations using a linear example provide some indication of the relative magnitudes of the effects analyzed above. Assuming a linear demand curve of the form $p = a - b(x + y)$, and assuming also that $\phi(\omega) = \omega$, so $U(x, w) = (w - c)x$, one obtains the following illustrative comparisons[10] of the nonunion Nash equilibrium and the Nash equilibrium arising from unionization of firm A.

Unionization causes:

1. Output of firm A to fall by 50%
2. Output of firm B to rise by 25%
3. World output to fall by 12.5%
4. Profit of firm A to fall by 75%

[10] Details of the calculations are available from the authors upon request.

5. Profit of firm B to rise by 56%

6. Producer surplus in A to fall by 37%

It is clear from this example that the effects of partial unionization in the presence of imperfect competition can be very substantial.

Perhaps the most striking abstraction in the paper is our characterization of the domestic union. The union, as we model it, is able to unilaterally set the domestic wage. This is "unrealistic" in that unions do not set wages unilaterally, but engage in some kind of bargaining process with firms. As pointed out by the referee, if the union and firm could come to an efficient wage bargain (in the sense of being on the contract curve) then the results would be very different. One alternative approach would be to analyse the interaction between firm and union as a cooperative game. For example, if the Nash bargaining solution is adopted as the solution concept, then the presence of a maximizing union would have little effect. In essence, the union becomes a partner of the firm which shares in profits and wants the firm to be able to use labour efficiently. This simple minded cooperative game model of union behaviour fails to capture asymmetries between union and nonunion firms that observation suggests are important. Richer cooperative models with incomplete information and bargaining costs offer promising directions for understanding union behaviour, but we know of no simple accepted model that is a more natural candidate for analysis than the model we use.

As for empirical relevance, our model is consistent with one of the most robust empirical findings of labour economics: the union wage differential. Freeman and Medoff (1984) report that a wide variety of studies all find a substantial differential between union and non-union workers in the same occupation of between 10% and 30%. This differential seems to be due simply to the monopoly power of unions. This kind of magnitude is consistent with plausible parameters for the model we use here. In addition, our model of imperfect competition offers a simple explanation of why a wage differential between union and non-union firms in the same industry can persist. With imperfect competition of the Cournot type, low cost (non-union) firms do not drive high cost (union) firms out of business.

3. Asymmetric Labour Commitment

The last section has been devoted to the union power asymmetry. This section considers the possibility of commitment to labour as a strategic tool. We assume that firm B can precommit its labour force. This means that when firms A and B make their final output decisions, firm B's labour costs will have become a fixed or unavoidable cost. Thus the marginal variable cost of using the labour force on hand becomes zero. It is then in firm B's interest to use this labour force as long as marginal revenue remains positive. By shifting labour costs from the variable to the fixed category, firm B therefore creates a credible commitment to use its labour force. In the absence of other factors, this labour commitment implies a commitment to a particular level of output, giving firm B a Stackelberg leadership advantage.

One might ask why one firm should have the opportunity to precommit while the other does not. Ideally, one would like a theory in which the opportunity or the decision to precommit emerged endogenously. In the Japanese case, the practise of precommitment to labour arises from a variety of institutional forces. These institutional forces are themselves the product, at least in part, of economic forces. The modelling of the reasons for these institutions is, however, a very ambitious task and is beyond the scope of the present paper. Nevertheless, we regard the existence of important cross-country differences in labour market institutions as undeniable, and think it is worthwhile to explore the consequences of such differences, as we do here. We do make some comments about endogenous emergence of precommitment opportunities in Section 5.

With no union in country A, firms have profit functions as given by (3) and (4), where $w = c$ in (3). In the second stage firm A chooses output based on first order condition (6). This implicitly defines the reaction function:

$$x = x(y, c) \tag{24}$$

The effect of y on x is determined by totally differentiating (6) with respect to x to yield

$$x_y = -\pi^A_{xy}/\pi^A_{xx} \tag{25}$$

In the first stage, firm B maximizes (4) given $x = x(y, c)$ from (24). The first order condition for firm B is therefore

$$d\pi^B/dy = yp'(1 + x_y) + p - c = 0 \tag{26}$$

with second order condition $d^2\pi^B/dy^2 < 0$. Some well known properties of the Stackelberg equilibrium relative to the (non-union) Cournot equilibrium are summarized in Proposition 2.

Proposition 2: Firm B has a higher output and profit level as leader in the asymmetric labour commitment equilibrium than in the non-union Cournot equilibrium; firm A (the follower) has a lower output and profit. Total output and world welfare are higher with asymmetric labour commitment, while industry profit is lower. ***

Propostion 2 indicates that if a firm is able to commit itself to employing a certain quantity of labour, then it does better than its rival and better than it did at the Cournot solution. This gain occurs entirely at the expense of the rival firm, which suffers both a fall in price and a fall in output.

A Linear Example

As in the previous section, a linear example can be used to give some idea of the possible magnitudes of these effects. Without a union, comparison of the commitment and noncommitment regimes yields the following results. With labour commitment

1. output of firm A is 25 % lower,
2. output of firm B is 50 % higher,
3. world output is 12.5 % higher,
4. profit of firm A (and producer surplus in A) is 48 % lower,
5. profit of firm B is 12.5 % higher,

Comparing these results with those for unionization, we see that asymmetric labour commitment imposes larger costs on the firm A and has a smaller benefit for firm B. The reason is clear. While both asymmetries improve the relative position of firm B, unionization is anti-competitive and raises overall

surplus in the industry. Labour commitment, on the other hand, is procompetitive and therefore lowers the overall surplus, shrinking gains and magnifying losses. World welfare is of course higher under the commitment regime than under the unionized regime.

Labour is not the only factor of production; indeed, the idea that firms might undertake strategic commitments using capital has been an important recent theme in the industrial organization literature. Our results can be readily extended to the case of more than one factor.[11] The main economic point is that the presence of capital does not alter the basic principle associated with asymmetric labour commitment, although it does add some interesting complications. In particular, if firm A is able to choose its capital before firm B chooses labour, it will have an incentive to use capital strategically so as to partially offset the strategic advantage of commitment to labour by firm B.

4. Trade Policy Implications

The study of trade policy in the presence of imperfect competition is itself a new, or at least recently rejuvenated subject. Recent work has shown that imperfect competiton allows an additional motive, referred to as "profit-shifting", for the use of trade policy instruments such as tariffs and subsidies.

The motivation for a tariff arises when a foreign imperfectly competitive firm earns rents from an international market, at least part of which is in the domestic country. As shown in Brander and Spencer (1984), a tariff simply extracts some of these rents from the foreign firm, and such a policy is usually optimal from the domestic point of view, whether or not a domestic firm is also in the industry.

A subsidy to domestic firms is optimal when foreign and domestic firms are in Cournot competition for a profitable international market, which may or may not be located partly in the domestic country. As shown in Brander and Spencer (1985), this subsidy transfers rent from the foreign to the domestic firm, increasing the domestic firm's profits by more than the amount of the subsidy, and is therefore a welfare increasing policy for the domestic country.[12] In this section we examine the implications of

[11] Details are available from the authors.

[12] In a very elegant paper, Eaton and Grossman (1986) show that the nature of the optimal rent-shifting policy depends on the type of output rivalry. For example, with Bertrand price rivalry, taxes

domestic unionization for rent-shifting trade policy. The subsidy case is analyzed first, then tariffs and quotas are considered.

Subsidies

The subsidy is denoted s, and we let α represent the marginal production cost of firm A given the subsidy s per unit. Then $\alpha = w - s$. We can then replace w with α in first order condition (6) and the subsequent comparative statics. Note that the equilibrium values of x and y depend on α rather than directly on w: $x = x(\alpha)$ and $y = y(\alpha)$. It follows from (12) that if w were held constant, an increase in the subsidy s, would cause a decrease in α, and induce an equilibrium expansion in x, the output of the domestic firm, and a contraction in y, the output of the foreign firm. It is this effect of the subsidy on the output equilibrium that gives the subsidy its rent-shifting effect.

We assume, however, that the union can alter the wage after the subsidy has been set. To be clear, the sequence of decisions is as follows: first the government sets the subsidy, taking into account how union and firms will respond. Next, the union sets the wage, taking the subsidy as given (fixed), but taking into account the equilibrium response of the two firms. Finally, taking the subsidy and the wage as given, the firms simultaneously choose output levels. The innovation in this paper is to introduce a union wage response between subsidy and output selections. This alters the problem significantly. The first order condition representing the choice of w by the union is (from (13)) given by

$$U_w = (\phi(w) - \phi(c))x'(\alpha) + x\phi'(w) = 0 \tag{27}$$

which implies $w = w(s)$. Total differentiation of (27) with respect to w and s, and using $\alpha'(s) = w'(s) - 1$ yields

$$w'(s) = (x'(\alpha)\phi'(w) + (\phi(w) - \phi(c))x''(\alpha))/U_{ww} \tag{28}$$

Expression (28) shows how the union wage responds to a change in the subsidy. The denominator must be negative by the second order condition for the union's maximization problem. Also, since $x'(\alpha) < 0$

rather than subsidies are called for.

(from (12)), it follows that $w'(s)$ tends to be positive.[13] In other words, we could reasonably expect increases in the subsidy to be taken up at least partly in higher wages. Examination of U_{ww}, which equals $(2x'(\alpha)\phi'(w) + (\phi(w) - \phi(c))x''(\alpha)) + x\phi''(w)$, shows that $w'(s)$ must be less than one, so the subsidy is not fully absorbed by higher wages. If demand happens to be linear and $\phi(\omega) = \omega$, it follows from (12) that $x''(\alpha) = 0$, in which case wage increases would absorb exactly half of subsidy increases.

The first order condition for maximization of country $A's$ welfare can be obtained from total welfare differential (19), incorporating the government budget constraint: $\Sigma t^i - sx = 0$. The following identities are useful in simplifying (19).

$$\Sigma dt^i = s dx + x ds \tag{28}$$

$$d\pi^A = (p - w + s)dx + x(dp - dw - ds) \tag{29}$$

$$\Sigma dw^i = x dw + (w - c)dx \tag{30}$$

Expression (28) is the total differential of the government budget constraint, (29) is the total differential of firm $A's$ profit: $(p - w + s)x$, and (30) is the total diffential of labour income: $wx - (N - x)c$. Substituting (28), (29), and (30) into (19) yields the following expression.

$$dW = (x - z^A)dp + (p - c)dx \tag{31}$$

Expression (31) has a clear interpretation. The first term is equal to net exports times the change in the relative price of good z. This term represents the usual terms of trade effect. If the price of good z rises, and country A is a net exporter of good z, then country A tends to gain. The second term arises only in the presence of some distortion, in this case imperfect competition, which causes price to differ from marginal cost. In effect, $(p - c)$ is the marginal rent, to the country as a whole, from producing and selling an extra unit of the imperfectly competitive good.[14]

[13] It is just possible that $x''(\alpha)$ is positive and large enough to more than offset $x'(\alpha)$, while not being large enough to violate second order conditions. We take this to be an unlikely possibility.

[14] The standard procedure for deriving the welfare differential in trade theory is to start with the direct utility function for a representative consumer, $u(z, m)$, totally differentiate to obtain $du = u_z dz + u_m dm$, divide through by u_m to obtain $dW = pdz + dm$, then substitute in the condition for balanced trade to

To obtain an expression for the optimal subsidy we make use of firm A's first order condition, $\pi_x^A = 0$, which can be written as

$$p - c = -xp' - s + w - c \tag{32}$$

Subsitituting (32) in (31) and dividing through by ds yields[15]

$$dW/ds = (x - z^A)p_s - (xp' - s - (w - c))x'(\alpha)\alpha'(s) \tag{33}$$

where $p_s = p'(x'(\alpha) - y'(\alpha))\alpha'(s)$ and $\alpha'(s) = w'(s) - 1$. Substituting p_s into (33) and solving for the optimal subsidy gives rise to the following expression.

$$s = xp'dy/dx - (w - c) - z^A p_s/(x'(\alpha)\alpha'(s)) \tag{34}$$

where dy/dx $(= -\pi_{yx}^B/\pi_{yy}^B)$ is the slope of the foreign firm's reaction function in output space, which is negative by (9) and (10). It is easy to see that $p_s < 0$: a subsidy lowers price. Expression (34) therefore implies that the optimal subsidy is positive. In the absence of a union, the optimal subsidy would be given by the same formula as (34) with $w - c = 0$. In other words, the presence of the union actually tends to increase the optimal subsidy in this framework.[16] The reasoning is very simple. The union absorbs part of the subsidy in higher wages. For example, with linear demand, $\phi(\omega) = \omega$, and $z^A = 0$ (no domestic consumption), in order to get a net subsidy of one dollar through to the domestic firm the nominal subsidy must be two dollars, one dollar of which "leaks" into higher wages. This leakage is a pure transfer, however, and does not alter the optimal net subsidy. Without a union, (and with no domestic consumption of z), the optimal subsidy brings the domestic firm to the Stackelberg leader position in output space. This target output is unaffected[17] by the presence of the union, but

yield (31). The derivation presented in the main text is more general. The reason that the balanced trade condition does not enter the main text's derivation directly is that it is implied by individual budget constraints that are implicit in the indirect utility functions and the government budget constraint. This is just an example of Walras' Law.

[15] Strictly speaking, this procedure represents an approximation as it ignores the effect that changes in the subsidy change real income and therefore change the demand for good z. Unless the industry in question is very large compared to the size of economy, this effect will certainly be negligible.

[16] In general, p' and dy/dx are endogenous, so some ambiguity does arise on this point, particularly if demand is highly nonlinear.

[17] This can be shown by substituting (34) (with $z^A = 0$) into the first order condition for the choice of x by firm A. We obtain $\pi_x^A = xp' + p - w + s = xp' + p + \pi_y^A(dy/dx) - c = 0$. This coincides with the first order condition for a nonunion Stackelberg leader choosing its output, x.

reaching this output requires a much higher nominal subsidy with the union because the union in effect taxes the subsidy process. If there were no domestic consumption in country A, then the third term of expression (34) would be zero, and the optimal subsidy would tend to be lower. The presence of domestic consumption increases the domestic incentive for subsidization of the production of z because such subsidies reduce the distortionary wedge between the price of good z and its marginal cost of production, c, moving production of good z toward the efficient level. These results are summarized in Proposition 3.

Proposition 3: In the presence of imperfectly competitive international markets the optimal subsidy is positive. The optimality of a subsidy is due to two main effects: the usual incentive to subsidize any good that is underconsumed due to imperfect competition, and a rent-shifting motive which works by credibly committing the domestic to a more aggressive stance in the output market. A union will take part of any subsidy in higher wages, implying that the optimal subsidy tends to be higher in the presence of a union. ***

An implication of this analysis is that one could expect unions to be strong proponents of export or output subsidies, since these subsidies are in part a direct transfer from taxpayers to union members.

Tariffs

We now consider the possibility of using tariffs to extract rent from a foreign firm in competition with a unionized domestic firm. In order for tariffs to have any significance, it must be the case that at least part of the market is in the domestic country. The basic ideas are most easily conveyed in the extreme case, where the market is located entirely in the domestic country. This is the case examined here.

Once again the sequence of decisions is as follows: first the domestic country will set the tariff, taking into account the wage and output responses that will follow. After the tariff is set, the union sets the wage, taking the tariff as given but anticipating the output responses. The third stage is one of simultaneous output choices by the two firms. Let r represent a specific tariff on imports, Analyzing the

third stage first, the profit functions of domestic and foreign firms are given by (3) and (4) respectively, with c replaced by $c + r$ in (4). As before, the output equilibrium is characterized by the simultaneous solution to first order conditions $\pi_x^A = 0$ and $\pi_y^B = 0$, yielding output solutions $x = x(w, r)$ and $y = y(w, r)$. Comparative static effects are easily calculated by total differentiation of these first order conditions and application of Cramer's Rule. In particular:

$$x_r = -\pi_{xy}^A / D > 0 \qquad y_r = \pi_{xx}^A / D < 0 \tag{35}$$

where D is given by expression (10). The effects $x_w(w, r)$ and $y_w(w, r)$ are as in (12).

Taking into account the dependence of x and y on w, the union sets w to maximize U as given by (5). This implicitly defines $w = w(r)$. Total differentiation of $w(r)$ then yields

$$w'(r) = -(x_r \phi'(w) + (\phi(w) - \phi(c)) x_{wr} / U_{ww}. \tag{37}$$

This derivative will, under standard conditions, be between 0 and 1, indicating that the effect of the tariff is to raise wages. For example, with linear demand and $\phi(w) = w$, then $w'(r) = 1/4$.

The basic reasoning is that the tariff makes the foreign firm less competitive, improving the competitive position of the domestic firm and raising its willingness to hire labour at any particular price. The union then has an incentive to raise its wage demand, and product price is higher than it would otherwise have been. The tariff raises product price and reduces consumer surplus. The effect of the union is to cause an even greater reduction in consumer surplus for any given tariff.

The third step in the argument is to consider the optimal tariff for the domestic country. The maximand is, as usual, given by expression (15), with total differential given by (19). The analysis differs from the subsidy case because tariff revenue must be included in the government budget constraint, which becomes: $\Sigma t^i + ry = 0$, with total differential

$$\Sigma dt_i + r dy + y dr = 0. \tag{38}$$

Substituting (29), (30), and (38) into (19), and keeping in mind that we have assumed that all consumption is in the domestic market so $z = z^A = x + y$, the welfare differential is

$$dW = -ydp + (p - c)dx + rdy + ydr \tag{39}$$

The first term represents the terms of trade effect on imports, the second term represents the increase in domestic surplus, and the third term and fourth terms are the increase in tariff revenue, which translates into increased consumption of the numeraire good. (Implicitly, trade balance is maintained by exports of the numeraire good equal to the revenue of firm B.)

Dividing (39) by dr and solving for r gives rise to:

$$r = -(y(1 - dp/dr) - (p - c)(dx/dt))/(dy/dt) \tag{40}$$

This has the same general form as the rule for the choice of the optimal tariff for Cournot firms in the absence of a union. (See Brander and Spencer (1984).) To the extent that dp/dr is less than one, the first term in the numerator represents the rent shifted to country A as a result of the fall in the producer price (net of the tariff). The producer price is $p - r$, so its rate of change as the tariff changes is $-(1 - dp/dr)$. The second term in the numerator reflects the rate of increase in the profit of the domestic firm as the tariff increases: the "profit shifting" effect.

This structure differs from the non-union case because the induced wage effect, du/dr, feeds into the comparative static effects dx/dr and dy/dr that appear in expression (40).

$$dx/dr = x_w u'(r) + x_r \qquad dy/dr = y_w u'(r) - y_r \tag{41}$$

Also, from (12), (35), and (41),

$$dp/dr = p'(dx/dr + dy/dr)) = (p')^2(u'(r) + 1)/D \tag{42}$$

The main implications of equations (40), (41) and (42) are expressed in Proposition 4.

Proposition 4: Asymmetric unionization has the following effects.

i) The response of both imports and domestic production to tariff changes tends to be reduced.

ii) Price responses to tariff changes tend to be greater in the presence of a domestic union.

iii) The effect of the domestic union on the size of the optimum tariff is ambiguous. ***

Part (i) follows directly from (41). The increase in the union wage induced by a tariff partially offsets the competitve advantage conferred by a tariff on the domestic firm, dampening the output responses to the tariff. Part (ii) then follows directly from (42). The effect of the union on the size of the optimal tariff is ambiguous (from (40)) because, on one hand, the presence of the union reduces the rate at which rent is shifted by increases in r, which tends to reduce the optimal tariff, while on the other hand, the union reduces the rate of decline in imports as r increases, making the tariff more effective as a revenue-raising tool.

Quotas

Now suppose that Country A uses a binding quota, $\bar{y}$, instead of a tariff to restrict imports. The monopoly union will, in our framework, use this knowledge in setting the wage. As before, the first order condition for the choice of x by firm A is given by $\pi_x^A(x, \bar{y}, w) = 0$. This defines the reaction function: $x = f(w, \bar{y})$ which has partial derivatives $f_w = 1/\pi_{xx}^A$ and $f_y = -\pi_{xy}^A/\pi_{xx}^A$. The union's maximization with respect to w then yields the following first order condition: $dW/dw = (\phi(w) - \phi(c))f_w(w, \bar{y}) - x = 0$

To compare the tariff and quota as policy tools imagine that the quota is set at precisely the level of imports that would occur with a particular tariff level, r. If the wage were the same in both (tariff and quota) regimes, then prices and outputs would also be the same. The wage, however, will not be the same in the two regimes because the problem faced by the union is very different under quotas than under tariffs. Specifically, the union has more power under quotas. Provided the quota is binding, a wage increase does not lead to an increase in imports and therefore has a smaller output and employment reducing effect,[18] leading to Proposition 5.

Proposition 5: Other things equal, the quota regime will give rise to higher wages, higher prices, and

[18] More precisely, the absolute value of $f_w(w, \bar{y})$ is less than the absolute value of $x'(w)$. This is seen by noting from (12) that $x'(w) = \pi_{yy}^B/D = 1/(\pi_{xx}^A - \pi_{xy}^A\pi_{yx}^B/\pi_{yy}^B)$ where $-\pi_{xy}^A\pi_{yx}^B/\pi_{yy}^B > 0$, while $f_w = 1/\pi_{xx}^A < 0$. It follows directly that $|f_w| < |x'(w)|$.

lower domestic welfare than the tariff regime allowing the same import level. ***

Asymmetric Labour Commitment

We now consider how labour commitment by firm B affects the rent-extracting policy in country A. Taking export subsidies first, abstracting from union power, and looking at the simple case of no domestic consumption ($z^A = 0$), it can be shown using the same methodology as in the union power case that the optimal subsidy is given by the following expression.

$$s = xp'(dy/ds)/(dx/ds) \tag{43}$$

This formula corresponds to expression (34) for the union case with $(w - c) = 0$ and $z^A = 0$. In this case, however, the terms dx/ds and dy/ds are different. Firm A has the same reaction function as given by (24) except that c is replaced by $c - s$. It is easily seen that $x_s > 0$: a subsidy shifts out the reaction function of firm A. Firm B is able to take advantage of this reaction function, by virtue of its ability to precommit, and its maximization gives rise to first order condition (26). Total differentiation of (26) and some tedious but straightforward algebra then shows that, for most demand conditions, a subsidy to firm A tends to reduce the output of firm B: an export or production subsidy to the domestic firm lowers the output of its Stackelberg leader rival. The total effect of s on x is

$$dx/ds = x_y dy/ds + x_s \tag{44}$$

which will be positive. Expression (43) then implies that the optimal subsidy will be positive also.

The main point here is that the subsidy, by affecting the reaction of the domestic firm to foreign commitment levels, does influence the optimal foreign commitment level, and this influence can in general be used to alter the final equilibrium in favour of the domestic firm and in the domestic interest. This policy power arises because the domestic government can act before the foreign firm, offsetting some of firm B's first mover advantage in the output market.

In the case of a tariff similar principles operate. Foreign commitment to labour and output does not alter the form of the optimal tariff rule given by (40). Once again, however, the form of the comparative

static effects that feed into this expression are altered by foreign labour commitment. The sign of dx/dr does remain positive and the sign of dy/dt remains negative, but the magnitudes of the changes (for any given levels of the other variables), are different, leading to a different, but nonzero, optimal tariff.

5. Extensions

Uncertainty and Labour Commitment

Imagine one were to explain to a businessman the main point about labour commitment: that it pays the firm to commit itself to a labour force in order to make rivals acquiescent in the face of the firm's expansion of market share. As pointed out by a referee, the businessman would probably argue that such a strategy is much too risky. Demand for the product might fall, and the firm would wind up overcommitted. As a practical matter this point is too important to ignore. A simple form of uncertainty can, however, be captured fairly readily in our model of labour commitment.

We work with the case of linear demand, and impose a simple but natural form of uncertainty on the model. Inverse demand for output z is assumed to contain an additive random component and can be written as follows.

$$p = p^*(x + y) + e = a - b(x + y) - e \tag{45}$$

where p^* is the expected value of price, given x and y, and e is a random variable with mean 0 and variance σ^2. This price shock can be thought of as arising from a random component in individual preferences, or in the government's social welfare function or from some other source. Our main focus here is on the behaviour of firms so we do not elaborate on the standard problem of welfare measure in the presence of uncertainty, except to assert than a consistent interpretation can be easily developed.

The tradeoff between uncertainty and commitment arises because uncertainty is resolved before output is decided upon, but after the opportunity to precommit to a labor force (and output) has passed. Thus the committed firm is unable to respond to uncertainty, while the uncommitted firm is able to respond. Our method is to examine the consequences of uncertainty under the assumption that firm B precommits and firm A does not, then to ask whether it makes sense for firm B to precommit

at all. With linear demand, the maximand for firm A is: $\pi^A = (a - b(x + y) + e)x - cx$. Taking the first order condition for profit maximization and solving for x yields the following reaction function for x as function of y and random shock e.

$$x = x(y, e) = (a - c + e)/2b - y/2 \tag{46}$$

Firm B is able to precommit and therefore act as a Stackelberg leader with respect to firm A, but it must make its output decision before uncertainty is resolved. Firm B is assumed to be risk neutral and therefore to maximize expected profit. The maximization problem for firm B is given by:

$$\max \; E(\pi^B) = (a - b(E(x(y, e) - y - E(e))y - cy \tag{47}$$

where $E(x(y, e) = (a - c)/2b - y/2$ and $E(e) = 0$. Taking the first order condition and solving for y then yields:

$$y = (a - c)/2b \tag{48}$$

Equation (48) is simply the certainty output of firm B: uncertainty has no effect on the output of firm B in this simple model. The value of random variable e will, of course, affect the actual profits earned. The actual profit of firm B is $\pi^B = (a - c + 2e)(a - c)/8b$, which has expected value $(a - c)^2/8b$. Expected profit is equal to the profit earned by the firm in the certainty case.

Uncertainty has an effect because it influences the value of the alternative: the simultaneous Cournot regime, where neither firm precommits and both firms therefore have an opportunity to respond to the realization of demand shock e. The solution for that case is obtained by taking equation (46) and the corresponding reaction function for firm B, then solving the two linear equations for x and y. Using a superscript c to denote the Cournot regime, we have:

$$x^c = y^c = (a - c + e)/3b \tag{48}$$

Profit levels are $\pi^A = \pi^B = (a - c + e)^2/9b$, which has the expected value given in (49).

$$E(\pi^A) = E(\pi^B) = ((a - c)^2 + \sigma^2)/9b \tag{49}$$

Equation (49) has an interesting interpretation. Note that the expected value of profit is increasing in the variance of demand. This effect exists because firms have the opportunity to take advantage of randomness in demand. In good states of the world they can increase output and in bad states of the world they can reduce output. These adjustments allow them, on average, to do better than they could in the case of pure certainty with demand always at its expected level.[19]

In the pure certainty case, firm B has nothing to lose from commitment. In the case of uncertainty, however, commitment makes the firm give up a valuable option. Depending on the variance of ϵ precommitment may or may not be worthwhile. The expected profit levels are easily compared, leading to the conclusion that commitment is preferred if and only if condition (50) is satisfied.

$$\sigma^2 < (a-c)^2/8 \tag{50}$$

The meaning of (50) is clarified by relating uncertainty to the price cost margin. Specifically, commitment is preferred to flexibility if $\sigma < \sqrt{2}(p^* - c)$: if the standard deviation of price is less than $\sqrt{2}$ times the expected price cost margin under commitment. If there is no uncertainty ($\sigma = 0$) then commitment is obviously worthwhile. As uncertainty becomes more important, in the sense that the variance of demand rises, the net value of precommitment falls, and eventually turns negative.

This is a simple model which demonstrates an important general point that applies here and in all other commitment models: the value of precommiment is reduced by uncertainty. We obtain this result even with a linear demand function and risk neutrality. Risk aversion would, of course, only increase the importance of this effect. Nonlinear demand or nonlinear randomness could introduce ambiguities, and could magnify or diminish the costs of precommitment, but would clearly not undermine the basic economic point that commitment does have costs in an uncertain world because it forces the firm to give up flexibility.

Endogenous Commitment Opportunities

[19] Because x and y can respond to ϵ, the reduced form joint profit function is convex in ϵ, implying that randomness in demand improves expected profit.

As indicated by the referee, it would be valuable to have some sense why one firm should have the opportunity to precommit while the other does not. Our analysis of uncertainty suggests that if there were firm specific uncertainty (arising perhaps from different policy envirionments, different technologies. product differentiation, different financial structures, etc.) or if firms had different levels of risk aversion, one firm might choose to precommit while the other might choose to retain flexibility. even at the cost of being a Stackelberg follower. Working out a complete model of this sort is beyond the scope of the present paper, but the idea that firms in different countries might face different levels of uncertainty, leading to asymmetric commitment behaviour, seems worthy of further attention.

We hasten to add that there are other reasons for asymmetric commitment opportunities. As mentioned earlier, the reason why precommitment through labour is adopted by Japanese firms has much to do with a variety of economic and social institutions, most of which are not modelled here. This paper does, however, suggest the relevance of attitudes toward risk.

Labour and Output Commitment

In general, the hiring of a work force does not guarantee that everyone is put to work. First of all, the firm may be able to lay off or fire unwanted employees. Secondly, even if the firm cannot reduce its labour force, but is committed to keeping all workers on its payroll, this does not, in practice, directly imply commitment to an output level: hours per worker may be varied, effort may be varied, training activities may be substituted for production activities, and so on.

The first point to be emphasized is that when we refer to labour commitment in this paper, we do not simply mean hiring a labour force. Commitment can only arise if it will subsequently be in the firm's interest to use the labour force. As suggested by the referee, it is possible to create a commitment by introducing large severance or redundancy payments as the penalty for firing workers. A simpler idea is that the firm is contractually committed to retaining its labour force, either through explicit contracts, which have the force of law, or through implicit contracts, which are enforced through some kind of reputation mechanism. In either case, the commitment is enforced by the costs that the firm

would suffer if it violated the contract. Some legal systems and social institutions are better suited to enforcing commitments than are others. Perhaps the Japanese social and legal structure is better able to enforce labour commitments than is the case in other countries.

Our characterization of commitment is fairly extreme: one firm is simply able to precommit to a particular output level, before the other. The basic principles of commitment do apply, however, in much more general circumstances. Specifically, whenever a firm can shift costs from the variable to the fixed category, it can exploit a strategic commitment effect. If there are two firms, A and B, each with marginal costs c^A and c^B, then Nash equilibrium outputs will depend on marginal costs: $x = x(c^A, c^B)$; $y = y(c^A, c^B)$, where each firm's output (and profit) is inversely related to its own marginal cost and positively related to its rivals marginal cost. The essence of precommitment (as argued in Brander and Spencer (1983)), is to reduce own marginal costs by turning marginal costs into fixed costs, thereby expanding output and profit. The extreme (Stackelberg) version of commitment used here is equivalent to a case in which the firm lowers its marginal costs to zero for all output levels up to the Stackelberg level.

More generally, even if firms have some flexibility in the use of labour when they actually produce output, as long as marginal costs are lowered slightly, there is a commitment effect. Redundancy payments fit into this interpretation nicely. If the marginal cost of an extra unit of output (produced by one worker) is c, but the firm pays severance pay of q, then the effective marginal cost of production is only $c - q$, since the firm must pay at least q in any case. The q part of production cost has become a fixed cost. This creates a strategic commitment effect becaus lowered marginal costs commit a firm to a more aggressive output reaction function, even though marginal costs are not reduced all the way to zero.

Distortionary Taxes

The analysis of this paper assumes that the government has nondistortionary taxes available to it. The purpose of this assumption is to highlight the economic principles central to our paper without

dwelling on the important but well understood issues related to distortionary taxes. In practice, however, tax distortions are so important that distortionary taxes probably deserve some discussion in any paper dealing with government budget constraints.

The first point to note is that the connection between distortionary taxes and welfare economics has been the subject of a large literature. Useful textbooks include Tresch (1981) and Atkinson and Stiglitz (1980). In our model, distortionary taxes could be included in a variety of ways, the most plausible of which would be to add a third good, leisure, allowing workers to allocate their time between work and leisure. Government revenue would be raised from taxes on labour income or on consumption (or both), but leisure would be untaxed. Taxes would therefore distort the choice between leisure and work, creating a deadweight loss associated with raising government revenue. For small changes in policy, this marginal deadweight loss could be treated as a constant, say δ. The shadow value of a unit of government revenue would be $(1+\delta)$, implying that policies which lose revenues (like subsidies) should have their benefits divided by $(1+\delta)$ before being compared with costs. Such policies would clearly become much less attractive. Furthermore, the labour union effect of extracting part of any strategic subsidy as higher wages would further reduce the attractiveness of strategic subsidies. Policies which raise revenue, such as tariffs, would, on the other hand, become more attractive.

6. Concluding Summary

In this paper we draw attention to the idea that asymmetries in labour relations may have important effects on output rivalries between firms. Such asymmetries are particularly striking in cross-country comparisons and are therefore of greatest interest in international markets. We focus on two particular asymmetries, using a simple duopoly model. First, one firm is assumed to be unionized while the other hires labour at its opportunity cost. Secondly, one firm is able to commit itself to hiring (and using) a labour force of a particular size before its rival sets output. The existence of labour market asymmetries in the form of unions or commitments to labour significantly affect the strategic postitions of firms in rivalries with each other . Unionization of one firm confers a very substantial benefit on the rival and has

the effect of transferring rents to union members and reducing profits to the unionized firm. As for the labour commitment effect, we argue that the committed firm is in a natural Stackelberg leader position relative to its uncommitted rival. Precommitment to output using commitment to labour can, however, be damaging in a world of uncertainty where flexibility is important. We introduce uncertainty into our analysis and characterize, in a simple case, the tradeoff between the strategic value of commitment, and cost of lost flexibility.

A major objective of the paper is to examine the consequences of these labour market asymmetries for trade policy incentives, under the assumption that the two firms are in different countries. The trade policies considered are tariffs, quotas and subsidies. In this imperfectly competitive environment, such policies can be used to the national advantage because they shift rents from the foreign firm to domestic residents. The principle effect of a wage setting union is to "skim off" rents obtained from rent-shifting subsidies or tariffs. This changes the optimal subsidy or tariff and suggests caution in the use of such policies if government revenue cannot be obtained without imposing distortionary taxes. The effect of union power is particularly strong under (binding) import quotas, because the union recongnizes that higher wage demands will not have the effect of allowing greater import penetration. Labour commitment in the foreign country does not change the basic form of profit-shifting policies. It does alter the actual levels of the optimal policies, because trade policy can be used to partially undo the first mover advantage obtained by the foreign firm through commitment to its labour force.

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