Essays on International Trade and Political Economy: The Importance of Incentives, Information and Globalization

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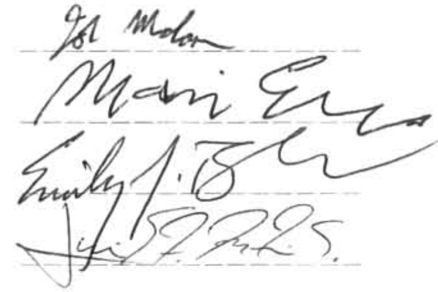

Chapter List

Chapter 1

Foreign Direct Investment and Host Country Policies: A Rationale for Using Ownership Restrictions

Chapter 2

Trade, Outsourcing, and the Invisible Handshake

Co-authored *with John McLaren*

Chapter 3

Lobbying under Asymmetric Information

Chapter 4

Trade Policy Making by an Assembly

Co-authored *with John McLaren*

Abstract

Chapter 1. This paper examines host governments' motivations for restricting ownership shares of multinational firms (MNFs) in foreign direct investment (FDI) projects. A host country has a profitable investment opportunity. The host government wants to capture the project's rent yet cannot observe the surplus created by the MNF. In contrast, a joint venture (JV) partner can observe the surplus. The host government can alleviate its informational constraints by using ownership restrictions to force a JV. This calls into question the wisdom of calls for 'liberalizing' FDI flows by the elimination of domestic JV requirements.

Chapter 2. We study the effect of globalization on the wage volatility and worker welfare in a model in which risk is allocated through long-run employment relationships. Globalization can take two forms: international integration of commodity markets and international integration of factor markets. We show that free trade and outsourcing have opposite effects on rich-country workers. Free trade hurts rich-country workers, while reducing the volatility of their wages; by contrast, outsourcing benefits them, while raising the volatility of their wages. We thus formalize, but also sharply circumscribe, a common critique of globalization.

Chapter 3. This paper analyzes an informational theory of lobbying in the context of strategic trade policy. A home firm competes with a foreign firm to export to a third country. The home policymaker aims to improve the home firm's profit by

using an export subsidy. The optimal subsidy depends on the strength of the demand which is unknown to the policymaker. The home firm is given a chance to lobby the policymaker. Surprisingly, the presence of lobbying costs can be advantageous for both: It makes the home firm's lobby effort a costly signal that can reveal its private information and eases the policymaker's information problem.

Chapter 4. Economists' models of trade-policy determination generally assume unitary government. We offer a congressional model. Under assumptions guaranteeing a median-voter outcome under a unitary model, we find a wide range of possible outcomes: Any policy from the 25th to the 75th percentile voter's optimum can emerge in equilibrium. We discuss implications for empirical work.

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All errors are mine.

Dedem Mustafa Erdil için ...

Chapter 1

Foreign Direct Investment and Host Country Policies: A Rationale for Using Ownership Restrictions

1.1 Introduction.

Foreign Direct Investment (FDI) has been one of the most widespread forms of international economic activity in recent years. In 1980, FDI stock abroad accounted for only 5% of world GDP. By 1998, this number had almost tripled to 14%.[1] From 2003 to 2004, the total outflows of FDI from the OECD countries rose from $593 million to 668 million.[2] Multinational Firms (MNFs) prefer FDI to circumvent trade barriers by directly producing and selling the products in host countries.[3] In turn, host countries often associate inflows of FDI with a wide variety of benefits the most common of which are technology spillover, human capital formation, international trade integration, a more competitive business environment and enterprise development. All of these tend to increase economic growth. Moreover, beyond strictly

[1] OECD (2001).
[2] OECD (2005).
[3] See Blonigen and Feenstra (1997).

economic benefits, FDI may help improve environmental and social conditions in host countries by, for example, bringing cleaner technologies and leading to more socially responsible corporate policies. Notwithstanding its many advantages, restrictions on FDI are fairly common. A frequently observed type of restriction is foreign ownership restriction. For instance, many less developed countries like India, Indonesia, Kenya, South Korea, Brazil, Mexico, Turkey[4], Nigeria, the Philippines, Thailand and most centrally planned economies impose restrictions on foreign equity participation. Many industrialized countries like Finland, France, Norway, Sweden, Switzerland and even the U.S. have also developed some kind of indigenization policy.[5]

Governments impose ownership restrictions to manipulate the distribution of rents to benefit their nationals. However, it is not clear why the host governments insist on using ownership restrictions when other potentially more efficient policy instruments (e.g., taxation and redistribution of rents) are available. In this paper, I develop a model that explains why we see use of ownership restrictions by host governments despite their inefficiencies. The model combines adverse selection with moral hazard. In such a framework, the purpose of the policy of ownership restriction is not to restrict access to foreign firms but to capture the rents that result from MNFs'

[4] For example, recent las limit the foreign share of the Turkish banking sector to 20% (See Milliyet, May 12, 2005).

[5] Indigenization is defined by Katrak(1983b) as the requirement that the host country imposes on an investor to share ownership of an affiliate with residents in the host country. Many countries have a policy that allows FDI only through ventures with local firms (see OECD (2004) for specific examples). Imposing a joint venture is similar to ownership restrictions in that they require the MNF to offer a minimum profit share to a domestic partner.

activity.[6] This is an important contribution to the existing literature which generally treats equity restrictions as ad hoc activity by governments.[7]

Interest in equity restrictions as a policy tool has received increasing attention in the past two decades because despite the worldwide surge in FDI flows, only a few developing countries have attracted sizable FDI. This is illustrated by the fact that in 1999 a great portion (about 80%) of total FDI to developing counties was limited to ten countries.[8] Many analysts have held restrictive government policies responsible for the failure to attract FDI and have offered liberalization as a key solution. As a result, many developing countries have recently relaxed their restrictive policies. These policy reforms are targeted mainly for international joint ventures rather than fully-owned foreign subsidiaries. To give an example, in the early 1990s, India allowed foreign equity participation by 51% in 35 high priority sectors but required decision through case-by-case study for any amount of participation exceeding this percentage.[9] However, many of the countries that liberalized did not experience an increase in FDI. This suggests that the restrictions may not have been strictly responsible for low FDI levels.[10]

[6] Note that the host government's objective in retaining rents may seem at odds with subsidies that are often offered to MNFs in the form of tax holidays and infrastructure provision. However, as the literature on time inconsistency problems in FDI policies has shown, these subsidies mainly pay for the sunk investments whose quasi-rents are subject to subsequent capture by the host government. (See, among others, Doyle and van Wijnbergen (1994) and, most recently, Schnitzer (1999).)

[7] Exceptions include Katrak (1983b), Falvey and Fried (1986), Stoughton and Talmor (1994), Dasgupta and Sengupta (1995), Asiedu and Esfahani (2001), Matoo, Olarreaga and Saggi (2001), Konrad and Lommerud (2001), Mukherjee (2003) and Diaw (2004).

[8] World Bank (2000).

[9] See Saqib (1995).

[10] Contractor (1991), UNCTD (1995).

In this paper, a simple model of FDI is developed to show that ownership restrictions can serve to improve the host government's welfare. The policy considerations that arise in my model mostly concern situations where the host country has a production advantage, hence attracting FDI. As Caves (1982) noted, for FDI to occur, the MNF must possess a firm-specific advantage which it can exploit more profitably through internalization than through licensing and the host country must have a production advantage for the relevant market. Following these arguments, I assume that there is an advantageous production opportunity in the host country. There is a pool of local firms capable of undertaking this project. There is also an MNF that can carry out the project via FDI. It is reasonable to assume that the MNF has a firm-specific advantage over the local firms such that it can create a higher surplus by making some effort that is both costly to exert and unobservable to those outside the firm. Given this, it is more efficient for the MNF than local firms to produce in the host market.

The MNF's decision to invest abroad is modeled as a two-step process. First, the MNF decides whether or not to establish a subsidiary in the host country. If it chooses to invest, it decides whether to establish a fully-owned firm or a joint venture with a local partner. If the MNF decides to form a JV with a local firm, the home firm plays no role in the determination of ownership shares in the JV. This assumption conforms to those in the existing transaction costs models of FDI. This follows directly from an assumption that local partners are drawn from a supply of homogeneous and competitive firms.[11] Although it is possible for the MNF to form a joint venture with a local firm, there is no additional benefit associated with a JV formation for the MNF. As a result, if there is no intervention by the host government, the MNF always chooses to form a fully-owned subsidiary to enter the domestic market.

The host government wants to maximize its welfare which consists of the weighted average of its tax revenue and any possible profit for the local firm. The key feature of the model is the problem of asymmetric information between the host government and the MNF. The host government does not know precisely the value of the extra surplus created by the MNF. The magnitude of this additional surplus depends on the effort level chosen by the MNF and the size of the firm specific advantage the MNF has. If this information were commonly known, the host government would simply let the MNF produce and tax the resulting profit. Under incomplete information, such a policy may result in ex-post inefficiency, since the host government's taxation can force the MNF to stay out of the host market. In this case, an alternative policy tool for the host government is to force the MNF to form a JV with a particular local firm determined by the host government (*ownership restriction*). It is assumed that unlike the host government, the local JV partner can observe the resulting extra surplus. There are two opposing effects of this policy. On the one hand, it causes the MNF to reduce its effort thereby leading the resulting surplus to decrease. On the other hand, it helps the host government to ease its information problem. The host government

[11] Assigning some bargaining power to the local partner does not change the results.

takes this trade-off into account and determines its optimal policy accordingly. I show that ownership restriction policy can alleviate the ex-post inefficiency resulting from asymmetric information.

The rest of the paper is organized as follows. The next section locates the argument in the existing literature. Section 3 describes the basic analytical framework. Section 4 discusses possible extensions and empirical implications of the model. Section 5 concludes the analysis.

1.2 Literature Review.

My paper is related to several earlier works. In this literature one can distinguish two mainstream approaches. On the one hand, there are models that analyze foreign direct investment in a symmetric information framework. Earlier models in this literature can generally be considered in this group. On the other hand, the more recent models use asymmetric information structure.

Within the first category of models, the pioneer work belongs to Katrak. Katrak (1983b) examines the costs and benefits of the '*national ownership*' or '*indigenization*' requirements often imposed by host governments on foreign direct investment projects. His analysis shows that optimum indigenization may depend on whether the subsidiary is autonomous or fully controlled by the parent company. The main point of his analysis is that indigenization may bring some costs as well as benefits to the host country and that an increase in indigenization beyond a certain point may cause the marginal costs to exceed the corresponding benefits. In addition, socially optimal level of indigenization is different and possibly smaller than the privately optimal level. Falvey and Fried (1986) added on the work of Katrak (1983b) by incorporating the interaction between ownership requirement and transfer pricing. Accordingly, in their model, indigenization has two purposes. It can both combat transfer pricing and shift control of the subsidiary to domestic owners. Indigenization is viewed as a means of splitting the profit of the multinational. Ownership requirements operate much like an increase in the host country tax rate, except that they also reduce the parent firm's equity share. In this framework, indigenization can be used as a policy tool due to the tax differences in the parent and host countries. The authors conclude that indigenization requirements' success in improving social welfare depends on their level and the parent firm's reaction. More recently, Matoo, Olarreaga and Saggi (2004) further demonstrate that ownership restrictions can be used to affect the entry mode of a foreign firm when there exists costly technology transfer. This occurs when the host government and the MNF prefer different modes of entry. Mukherjee (2003), as in Matoo et al., shows that the host government uses ownership restriction to influence the mode of FDI. However, both papers leave unanswered an important question: why do governments prefer share restriction to a profit tax? For instance, if the MNF prefers acquisition but the host government prefers direct entry, the government can use a higher tax rate under acquisition to deter the MNF's choice of FDI. Asiedu and Esfahani (2001) add to this analysis by examining both theoretically and empirically the ownership structures in FDI projects. They explore the extent to which equity restrictions and country conditions affect ownership decisions of MNFs. Their model builds on bargaining and transaction cost approaches. They assume that the tax rate that the government can charge is fixed due to transfer pricing possibilities. As a result, the host government cannot extract all the project rents via taxation and uses equity restriction to redistribute rents from the MNF to the local firm. In contrast to the authors' analysis, I do not model transfer pricing possibilities. Hence, restriction on taxation does not exist. I show that it is not optimal to use only taxation when there is asymmetry in the model. Relaxing the control assumption, Diaw's model (2004) analyzes the problems inherent in JVs in the absence of any dominant shareholders and provides a rationale for indigenization policies that restrict foreign ownership.

The papers discussed so far derive optimal ownership restrictions when either transfer pricing or technology transfer is present. My paper considers neither technology transfer nor transfer pricing. Among the papers that use the symmetric information framework, these papers are the only ones which consider the economic rationale for the imposition and determination of optimal ownership restrictions.

Other papers in this group do not derive optimal ownership restrictions but rather analyze the relationship of these restrictions with other issues like transfer pricing and technology transfer. For example, Svejnar and Smith (1984) study the international joint ventures emerging from negotiations between multinational firms and local firms in less developed countries. They show that the distribution of equity shares does not play a critical role in determining the tax burden of the new firm as long as the firms bargain over transfer prices. Their focus is more on the interaction of transfer pricing and local policy than on ownership restrictions. Lee and Shy (1992) further contribute to this framework by demonstrating the relationship between ownership restrictions and technology transfer. Accordingly, ownership restrictions may adversely affect the technology transferred to the host country. On the other hand, the effect of ownership restrictions on host country's welfare is ambiguous. From a different perspective, Al-Saadon and Das (1996) study the participating firms' and the host government's decisions whether to commit to transfer pricing and tax/subsidy policies, respectively. To this end, they construct a model of international joint venture in which ownership shares are endogenously determined as an outcome of bargaining between a MNF and a single host firm. They show that complementary choices (taxes or subsidies by the host government and transfer prices placed by the MNF on inputs) may influence the equity distribution of the joint venture. In their analysis, the host government does not directly affect ownership shares by restricting the MNF's shares. Rather, it can shape the determination of ownership shares in the JV through a tax/subsidy policy. More recently, Das and Katayama (2003) analyze the effect of foreign equity cap when there exists a joint venture. Unobservable effort levels are used to introduce moral hazard. They conclude that the foreign equity cap reduces welfare. My model is different from theirs since in addition to moral hazard I introduce adverse selection. Moreover, I have a completely opposite result; since, in my model, equity shares not only function as an efficiency variable but also help the host government to lessen its information disadvantage.

Models in the second category assume asymmetric information, as originally put forward by the work of Stoughton and Talmor (1994). They use a mechanism design approach to model the game between the parent firm and its subsidiary. Unlike Falvey and Fried (1986), they additionally take production decision into account. In a given bargaining situation, the host country would set the optimal combination of tax and indigenization rates (which appear multiplicatively in their model) by trading off its share in the cash flows with the output considerations of the multinational. My model is different from their model due to the fact that I do not consider parent-subsidiary relations but focus on the direct relation between a MNF and a host government. I also do not consider a game in which there is a chance for the MNF to switch funds from one place to another due to the differential tax rates in different countries. Approximating the approach of my paper, Dasgupta and Sengupta (1995) analyze the optimal regulation of MNFs by a host government interested in maximizing tax revenues, when the MNF has private information about its benefits from controlling the firm. In their model, this control does not result from the majority of the ownership shares. Rather, it is the consequence of other factors such as technological advantage. Control creates a private benefit for the MNF. Given these assumptions, the authors determine the optimal ownership restrictions. My paper is closely related to their paper but differs in the following. First, I extend their model by introducing moral hazard. Now the host government has to deal with two unobservable variables (namely, effort and firm-specific advantage) rather than one. Second, I do not consider transfer pricing problem. Furthermore, in my model, private benefit does not result from control. Instead, it arises from the firm-specific advantage of the MNF and its magnitude is closely related with the MNF's ownership shares. Finally, I further assume that there is an asymmetric information problem not only between the MNF and the host government, but also among the JV partners, with the latter being less severe. As a result, the motivation presented in this paper for using ownership restrictions is totally different than their paper. In contrast to the models discussed so far, Konrad and Lommerud (2001) explain the motives behind voluntary selling of ownership shares by MNFs to locals. They begin by showing that the presence of an asymmetric information problem between a MNF and its foreign affiliate can ease the hold-up problem[12] in foreign direct investment. They further establish that the hold-up problem is also alleviated by the MNF's selling of shares to locals. In my paper, there is no hold-up problem as in Konrad and Lommerud (2001). Therefore, without government restriction, there is no incentive for the MNF to share its profit with a local firm.

[12] The hold-up problem applies when a group of agents, e.g. a buyer and a seller, share some surplus from interaction and when an agent making an investment is unable to receive all the benefits that accrue from the investment. As a result of the hold-up problem, underinvestment occurs.

1.3 Model.

I consider a host country one which has a production advantage for the production of a particular good. Either a MNF or a local firm can take advantage of this profitable investment opportunity. The project involves the production of good y, using a variable input x and an initial outlay of fixed level of investment I. The variable input can be bought from the market at a cost c. The net revenue function (the revenue net of all costs except the cost of the input x) is denoted as $R(y)$. I assume that the market structure is monopoly[13] and $R'(y) > 0$ and $R''(y) < 0$. To simplify matters, I assume that one unit of output always requires one unit of input x. Therefore, x will denote the quantities of both input supplied and output. There is a pool of competitive local firms in the host country. The MNF has a firm-specific advantage over these firms so that it can create a higher surplus than any other local firm. Hence, ceteris paribus, it is more efficient for the MNF to undertake the project. The MNF has can enter the market in two ways. It can either enter as a fully-owned firm or it can form a joint venture with one of the domestic firms. It is assumed that local firms do not have any bargaining power and play no role in determining ownership shares in a possible JV. It is also assumed that from the MNF's perspective, there is no advantage in having a local JV partner. Therefore, as long as there is no outside intervention, the MNF chooses to form a fully-owned firm.

[13] One can justify this assumption by considering a situation in which a new sector is emerging in the host country's economy that requires a huge initial outlay.

The MNF can create an extra surplus which depends on a firm specific advantage b. To do so, it must exert effort represented by e. The realized surplus takes the form of $e * b$. The effort cost is convex and has the following form: $\frac{e^2}{2}$. The firm specific advantage b is assumed to be a random variable with support $[0, \bar{b}]$, distribution function $F(b)$ and density function $f(b)$. At the time of entering the domestic market, the MNF observes b's actual realization. This information is private and unobservable to the government of the host country. In case of a JV, however, the local JV partner notes the realized surplus $e * b$, but not the individual values of e or b. Hence, the effort level is unobservable by not only the host government but also any possible local JV partner. Once the surplus is realized, it is assumed that the local firm can costlessly claim its government-determined share by appealing to court.[14]

The host government wants to maximize its welfare which consists of the weighted average of its tax revenue and any possible profit made by the local firm.[15] There are two policy tools the host government can use to regulate the MNF: lump-sum tax/subsidy and domestic ownership requirement. Additionally, if the host government decides to use ownership requirements, it also picks the local partner for the JV randomly.[16]

Define x^* as the value of x that solves the equation $R'(x) - c = 0$. x^* is thus

[14]Later on, I will discuss the implications of what would have occurred had appealing the court being costly.

[15]For simplicity, I assume that the resulting product is sold to a third country in order to ignore consumer effects and keep the analysis well-focused.

[16]One can analyze the game between the local firms and the host government for the selection of the JV partner. However, that is beyond the scope of this paper.

the efficient level of input that maximizes the surplus $R(x) - cx$. Also, define $\pi^* = R(x^*) - cx^*$.

Assumption 1. $\pi^* - I \geq 0$.

Assumption 2. Local firms are liquidity constrained.

The first condition ensures that the project is profitable. The second condition simply means that local firms cannot borrow from outside, and are thus constrained by their current payoffs. In what follows, I analyze the model in which it is not possible for the JV partners to form a sustainable collusion.[17]

The timing of the game can be summarized as follows:

1. The MNF learns the actual value of the firm specific advantage b.

2. The host government designs a mechanism that states a lump-sum tax/subsidy and ownership restriction for the MNF's each report of b.

3. The MNF decides whether to enter or not. If it decides not to enter, the game ends here. Otherwise the game continues.

4. The MNF announces its b to the host government and its ownership share and tax/subsidy are determined by the mechanism stated in step 2.

5. The MNF chooses its effort level.

6. Production occurs and respective payoffs are realized.

[17] For the collusion to be sustainable, the local firm has to guarantee that it will not appeal the court once the project is completed. By disregarding collusion, I implicitly assume that it is not possible to design a binding contract that prevents the local firm to appeal the court. Later on, I discuss the likely consequences of relaxing this assumption on the model's outcome.

Optimal Mechanism.

Here, a mechanism that induces truthful revelation is considered.[18] In the context of the model, an optimal mechanism can be represented by the following seven tuple: $M1 \equiv \{\alpha(b), x^1(b), x^2(b), T_1^{LF}(b), T_2^{LF}(b), T^{MNF}(b), \gamma(b)\}$, where $\alpha(b) \in [0,1]$ is the probability that the host government let the MNF take part in the production process, $x^1(b)$ and $T_1^{LF}(b)$ are, respectively, the amount of input to be used and the payment to be made to the government by the local firm as a function of the report of b when the MNF is not allowed to operate in the host market, $x^2(b)$, $T_2^{LF}(b)$ and $T^{MNF}(b)$ are, respectively, the amount of input to be used, the payments to be made to the government by the local firm and the MNF as a function of the report of b when the MNF is allowed to operate in the host market. $\gamma(b) \in [0,1]$ represents the maximum ownership that the MNF can have if it is allowed to operate.

Given a mechanism, $M1$, denote by $\Pi^{MNF}(b'|b)$ the profit made by the MNF of type b if it reports type b'. Clearly,

$$\Pi^{MNF}(b'|b) = \left\{ \begin{array}{c} \alpha(b')\gamma(b')[R(x^2(b')) - cx^2(b') - I + eb] \\ -\alpha(b')T^{MNF}(b') - \alpha(b')\frac{e^2}{2} \end{array} \right\} \tag{1}$$

Note that in the above profit function, the cost of MNF's effort cannot be observed by other agents. Therefore, the only incentive for the MNF for incurring effort is ownership shares. The optimal effort level by the MNF given the ownership shares

[18] See Dasgupta et al., (1979); Baron and Myerson (1982).

can be found as:

$$\max_e \alpha(b')\gamma(b')[R(x^2(b')) - cx^2(b') - I + eb] - \alpha(b')T^{MNF}(b') - \alpha(b')\frac{e^2}{2}$$

$$\Rightarrow e = \gamma(b')b$$

Thus, one can rewrite equation (1) as follows:

$$\Pi^{MNF}(b'|b) = \left\{ \begin{array}{c} \alpha(b')\gamma(b')[R(x^2(b')) - cx^2(b') - I + \gamma(b')b^2] \\ -\alpha(b')T^{MNF}(b') - \alpha(b')\frac{[\gamma(b')b]^2}{2} \end{array} \right\} \quad (2)$$

The requirement of truthful reporting (incentive compatibility) gives us $\Pi^{MNF}(b|b) \geqslant \Pi^{MNF}(b'|b)$ for all b, $b' \in [0, \bar{b}]$. Likewise, $\Pi^{MNF}(b|b) \geqslant 0$ for all b by imposing the condition of individual rationality.

The local firm's profit can be written as follows:[19]

$$\Pi^{LF}(b) = \left\{ \begin{array}{c} [1 - \alpha(b)][R(x^2(b)) - cx^2(b) - I - T_1^{LF}(b)] \\ +\alpha(b)[1 - \gamma(b)][R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2] - \alpha(b)T_2^{LF}(b) \end{array} \right\}$$

The expected welfare of the government from this direct truthful mechanism is given by:

$$W = \int_0^{\bar{b}} \left\{ \phi_1 E[T] + \phi_2 \Pi^{LF}(b) \right\} dF(b) \quad (3)$$

where $E[T] = [1-\alpha(b)]T_1^{LF}(b)+\alpha(b)[T_2^{LF}(b)+T^{MNF}(b)]$, $\Pi^{LF}(b)$ is the local firm's net

[19]Note that there is nothing unknown about the local firm's profit once the host government obtains the truthful report about the benefit b from the MNF.

profit (after-tax), ϕ_1 is the weight given to the tax revenue and ϕ_2 is the weight given to the local firm's net profit in the welfare function. It is assumed that $\phi_1 > \phi_2$.[20]

To characterize the optimal mechanism, I make the following assumption for the distribution function $F(b)$:

Assumption 3. $[1 - F(b)]/f(b)$ is decreasing in b.

This is a standard monotonicity assumption that simplifies the analysis. It is analogous to the assumption of a decreasing hazard rate.

Assumption 4. If the MNF does not pay the determined share to the local JV partner, the LF can appeal the court. In court it can prove the true value of $e * b$ and obtain its true share from the project.

Proposition 1. When assumptions 1, 2, 3 and 4 hold, the optimal mechanism is given by the following:

$$
\begin{aligned}
x^1(b) &= x^2(b) = x^*, \\
T_1^{LF}(b) &= T_1^{LF} = \pi^* - I, \\
T_2^{LF}(b) &= [1 - \gamma(b)][\pi^* - I + \gamma(b)b^2], \\
T^{MNF}(b) &= \gamma(b)[\pi^* - I + \gamma(b)b^2] - \frac{[\gamma(b)b]^2}{2} - \int_0^b [\gamma(\widetilde{b})]^2 \widetilde{b} d\widetilde{b}, \\
\gamma(b) &= \frac{b}{2\left[\frac{1-F(b)}{f(b)}\right] + b}, \ \alpha(b) = 1 \ \forall b \in [0, \overline{b}].
\end{aligned}
\tag{4}
$$

[20]This assumption implies that the host government value a dollar from a tax revenue more highly than a dollar in the hands of a local firm. It does not affect the model's outcome.

Proof. See appendix.

There are a few things that should be noted about the optimal mechanism given above. The first is that the mechanism design problem only arises between the MNF and the host government. Furthermore, the rent given to the MNF for truthful revelation is proportional to its share in the JV. Under this scenario, the LF cannot get any rent and makes zero profit.

Proposition 2. If the only possible policy tool is a lump-sum tax/subsidy,[21] the host government would not let the MNF to operate for certain values of b and the result would be ex-post inefficient.

Proof. See appendix.

Intuitively, if the host government uses only lump-sum tax/subsidy, either the LF or the MNF would operate and no JV would occur. This puts an extra restriction on the host government's welfare maximization problem.

One can perform a comparative static analysis of the results given in (4). The first one concerns what happens to $\gamma(b)$ as b changes:

$$\begin{aligned} \frac{d\gamma(b)}{db} &= \frac{2\left\{\frac{[1-F(b)]}{f(b)} + b\left[1 + \frac{[1-F(b)]f'(b)}{f(b)^2}\right]\right\}}{\left[2\frac{[1-F(b)]}{f(b)} + b\right]^2} \\ \frac{d\frac{[1-F(b)]}{f(b)}}{db} &= -1 - \frac{[1-F(b)]\, f'(b)}{f(b)^2} < 0, \text{ by assumption 3.} \\ &\Rightarrow \frac{d\gamma(b)}{db} > 0 \end{aligned}$$

[21]This simply means the host government will let either the local firm or the MNF operate, no JV is possible.

Thus, as the surplus amount b increases, more share is given to the MNF. Similarly, one can see what happens to the tax paid by the local firm to the host government as b changes:

$$\frac{d\left\{[1-\alpha(b)]T_1^{LF}(b)+\alpha(b)T_2^{LF}(b)\right\}}{db} = \frac{dT_2^{LF}(b)}{db}, \text{ since } \alpha(b) = 1 \ \forall b \in [0, \bar{b}]$$

$$= 2\gamma(b)b[1-\gamma(b)] + \gamma'(b)\left\{[1-2\gamma(b)]\, b^2 - (\pi^* - I)\right\}$$

Note that without knowing the exact value of $\pi^* - I$, one cannot say much about the sign of the above derivative. However, it is certain that for some $b \leq \bar{b}$, the above derivative is negative. As a result, the total tax collected from the local firm becomes a decreasing function of b for some $b > b^{\blacktriangledown}$. This result seems counterintuitive. However, when b is low, the share given to the local firm is high, and so is the tax paid by the local firm. As b increases the project's overall surplus increases while the LF's share decreases. Therefore, for $b \leq b^{\blacktriangledown}$, the tax paid by the local firm is an increasing function of b. However as $b > b^{\blacktriangledown}$, the decrease in the LF's share outweighs the increase in the overall rent, thus the tax paid by the LF decreases after $b^{\blacktriangledown}$. The value of $b^{\blacktriangledown}$ depends on the size of $\pi^* - I$. For instance if $\pi^* - I$ is very large, then $b^{\blacktriangledown} = 0$, and the LF's tax is everywhere decreasing with respect to b.

Also, using assumption 1,

$$\frac{dT^{MNF}(b)}{db} = \gamma'(b)\left\{(\pi^* - I) + 2\gamma(b)b^2\right\} + \gamma(b)^2 b > 0, \text{ and}$$

$$\frac{d[1-\alpha(b)]T_1^{LF}(b)+\alpha(b)[T_2^{LF}(b)+T^{MNF}(b)]}{db} = \frac{d[T_2^{LF}(b)+T^{MNF}(b)]}{db}, \text{ since } \alpha(b) = 1 \ \forall b \in [0, \bar{b}]$$

$$= \gamma(b)b[2 - \gamma(b)] + \gamma'(b)b^2 > 0 \text{ since } 0 \leq \gamma(b) \leq 1.$$

Consequently, both the tax from the MNF and overall tax are increasing in the surplus amount b.

These results can be summarized as follows: The host government never allows the LF to operate by itself.[22] In addition, the MNF's share in the project as well as the tax revenue collected by the host government increase as the project's overall return increases. The example below helps to further illustrate these results.

Example: Assume that the surplus amount b has a uniform distribution with a support $[0, 1]$ such that $f(b) = 1$ and $F(b) = b$. In addition, assume for simplicity

[22] In the limit as b goes to zero, the share of the MNF, $\gamma(b)$ goes to zero, too. For that reason, even though $\alpha(b) = 1$ for all b, as $b \longrightarrow 0$, the local firm operates by itself.

that $\pi^* - I = 0$. Then, the optimal mechanism is given as below:

$$
\begin{aligned}
x^1(b) &= x^2(b) = x^*, \\
T_1^{LF}(b) &= T_1^{LF} = \pi^* - I = 0, \\
T_2^{LF}(b) &= \frac{2b^3(1-b)}{(2-b)^2}, \\
T^{MNF}(b) &= \frac{b\,(b^3 - 4b^2 + 36b - 48)}{2(2-b)^2} - 12\ln\left(\frac{2-b}{2}\right), \\
\gamma(b) &= \frac{b}{2-b}, \\
\alpha(b) &= 1\ \forall b \in [0, \bar{b}].
\end{aligned}
$$

In this example, as b goes from 0 to 1, the MNF's optimal share increases from 0 (where the MNF does not operate) to 1 (where the MNF is the sole owner). Moreover, the overall tax revenue collected by the host government increases as b increases.

In Figure 1, it is shown that the higher is the firm-specific advantage reported by the MNF, the higher is the MNF's maximum ownership share. In Figure 2, we see that both the MNF's tax and total tax are increasing functions of b. On the other hand, the tax paid by the local firm first increases up to some point, then decreases as b increases. Finally, Figure 3 shows the menu of contracts, which consists of ownership shares and corresponding tax amounts, offered to the MNF by the host government for each report of b.

1.4 Discussion.

If foreign ownership restrictions are optimal to use, one might wonder why not all countries implement them. Moreover, why don't those countries that use ownership restriction policy do so in all industries? One reason might be that the incomplete information problem may not always be present. Without information asymmetries, taxation can do better than ownership restrictions. Also, it might not always be the case that appealing to court is costless for firms as I assumed here. Developing the model to include a fixed cost incurred by the local firm in court could drive the model to produce optimal policy that includes only taxation. This would occur, for example, if the fixed cost were high.

In terms of modeling, one might also consider an alternative scenario in which collusion is possible between the local firm (LF) and the multinational firm (MNF). The sustainable collusion occurs only if one can write a binding contract between the LF and the MNF in which the LF guarantees not to appeal to court for a monetary transfer from the MNF. In the absence of collusion, the relation between the host government and the MNF is governed by the incentive compatibility and the individual rationality constraints. These constraints lay out the outcomes available for the host government in a collusion-free setup. In contrast, the firms' capacity to collude may modify the set of achievable outcomes for the host government, because the MNF and the LF may have incentives to collectively deviate from truth-telling. Knowing this, the host government has to find the optimal response to the possibility of collusion. Under symmetric information among the MNF and the LF, any bargaining process will maximize their joint utility. When information is asymmetric, the MNF may want to conceal its private information from the LF in order to increase its utility, and this may prevent the maximization of joint utility. Thus, generally, collusion falls short of achieving full efficiency. I assume that the MNF has all the bargaining power and offers a side contract to the LF. Therefore, collusion has to be analyzed as an informed principal problem. Here, the revelation principle has to be replaced by the collusion-proofness principle, which allows me to restrict attention to direct revelation mechanisms that do not leave room for collusion.

The timing of the game is as follows:

1. The MNF learns the actual value of the firm specific advantage b.

2. The host government offers a grand contract to the MNF and the LF.

3. The MNF and the LF simultaneously accept or reject the grand contract. If they reject the grand contract,the game is over, otherwise, we move to the next step.

4. The MNF offers a collusion contract to the LF.

5. The LF accepts or rejects the MNF's offer. If the LF accepts the offer, the MNF and the LF go to step 6. If it rejects the offer, they go to step 7.

6. The MNF transfers the agreed monetary amount to the LF.

7. The MNF announces b to the host government and its ownership share and tax/subsidy are determined by the mechanism stated in step 2.

8. The MNF chooses its effort level.

9. Production occurs and respective payoffs are realized.

In the host government's maximization problem, if $\phi_2 > \phi_1$, collusion is not sustainable, since the host government's optimal action is to give everything to the local firm, which basically makes the LF the principal of the game. On the other hand, if $\phi_1 > \phi_2$, collusion may occur. In this case, the reservation utility of the MNF is type-dependent. The relevant question would be whether there exists a collusion-proof grand mechanism. If so, such a grand mechanism would necessarily be much more complex than the regular mechanism described here. If not, ownership restrictions will not be optimal to use. Such an extension would be interesting to consider.

Empirical Implications.

The first implication is related to the host government's welfare objectives. When $\phi_2 > \phi_1$, the host government can be considered partially corrupt; since in this scenario, it would transfer the surplus extracted via taxes from the project to the local firm. Since all tax revenue is given to the LF, the host country's citizens do not benefit from the project at all. This shows that there is a trade-off between the interest of the public and the interest of the local firm. In contrast, the opposite holds if $\phi_1 > \phi_2$. What is interesting is that in both scenarios it is optimal to use the share restriction. In other words, regardless of the level of corruption, the host government will always have an incentive to use ownership restrictions.

The second is that for the ownership restrictions to be used, the judicial system should be efficient. This means that the ownership restriction must be used in countries where the judicial system works properly. For example, if the judges are bribable, it is not possible to use ownership restrictions. It would be interesting to test both implications empirically.

1.5 Conclusion.

This paper analyzes host governments' optimal policy towards foreign direct investment under asymmetric information. Since the beginning of the 1970s, some countries have set indigenization goals which often take the form of ownership restrictions on MNFs. This has been the case, for instance, with India and Korea where as of the mid-1980s, only 5% of the MNF's subsidiaries were fully owned. On the other hand, during the same time period, in countries such as Mexico and Brazil which are often believed to have much more *anti-foreign* policy orientations than Korea, the corresponding figures were 50% and 60%, respectively.[23] The fact that developing country governments praise the merits of FDI flows does not mean that they will necessarily avoid imposing restrictions on FDI. I have sought to explain this phenomenon by particularly focusing on equity restrictions.

I show that under incomplete information, ownership restrictions can be welfare-improving by reducing the information problem of the host government. The host government takes advantage of the fact that the collusion between the MNF and the LF is unsustainable, and therefore uses the local firm to obtain greater project rents

[23] See Diaw (2004).

from the MNF.

The optimal ownership restriction is determined according to the surplus announced by the MNF such that, the higher is the surplus, the lower is the equity restriction. The host government faces a trade-off when restricting the MNF's ownership share. The lower share for the MNF means lower effort and hence lower surplus. At the same time, the lower share in ownership leads to a lower information rent for the MNF. The optimal share is the one where the value of the marginal increase in the local firm's profit (hence the host government's tax revenue) is equal to the value of the marginal decrease in the overall surplus.

This model provides a heretofore never offered rational explanation for the behavior seen by governments with respect to FDI and ownership status. Further, the model shows that this type of policy may be especially useful for governments that are at an informational disadvantage.

Appendix

Proof of Proposition 1.

The following lemma is useful to characterize the optimal mechanism:

Lemma. The mechanism $M1$ is incentive compatible iff the following conditions hold:

(1) $\alpha(b)\gamma(b)^2$ is non-decreasing in b.

(2) $\alpha(b)T^{MNF}(b) = \left\{ \begin{array}{c} \alpha(b)\gamma(b)[R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2] \\ -\alpha(b)\frac{\gamma(b)^2 b^2}{2} - \int\limits_0^b \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b} - k \end{array} \right\}$ where k is a constant.

Proof.

(a) *Necessity.*

Incentive compatibility implies $\Pi^{MNF}(b|b) \geqslant \Pi^{MNF}(b'|b)\ \forall b,\ b' \in [0, \bar{b}]$. Hence, one can write:

$$\Pi^{MNF}(b'|b) - \Pi^{MNF}(b'|b') \leq \Pi^{MNF}(b|b) - \Pi^{MNF}(b'|b') \leq \Pi^{MNF}(b|b) - \Pi^{MNF}(b|b').$$

Using (2), this gives:

$$\frac{\alpha(b')\gamma(b')^2[b^2 - (b')^2]}{2} \leq \Pi^{MNF}(b|b) - \Pi^{MNF}(b'|b') \leq \frac{\alpha(b)\gamma(b)^2[b^2 - (b')^2]}{2}. \qquad (5)$$

Given that $b > b'$,

$$\alpha(b)\gamma(b)^2 \geqslant \alpha(b')\gamma(b')^2. \tag{6}$$

Since $\alpha(b)\gamma(b)^2$ is non-decreasing in b, it is differentiable almost everywhere. Now, dividing (5) throughout by $b - b'$, when $b > b'$, I get:

$$\frac{\alpha(b')\gamma(b')^2(b+b')}{2} \leq \frac{\Pi^{MNF}(b|b) - \Pi^{MNF}(b'|b')}{b-b'} \leq \frac{\alpha(b)\gamma(b)^2(b+b')}{2} \tag{7}$$

Define $\Pi^{MNF}(b) = \Pi^{MNF}(b|b)$, i.e. the profit of type b from a truthful report. Taking the limit in (7) above as $b \longrightarrow b'$, I get:

$$\frac{d\Pi^{MNF}(b)}{db} = \alpha(b)\gamma(b)^2 b \text{ almost everywhere.}$$

Hence, I have:

$$\Pi^{MNF}(b) = \Pi^{MNF}(0) + \int_0^b \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b}. \tag{8}$$

Substituting in (2), I get:

$$\Pi^{MNF}(0) + \int_0^b \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b} = \left\{ \begin{array}{c} \alpha(b)\gamma(b)[R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2] \\ -\alpha(b)T^{MNF}(b) - \alpha(b)\frac{[\gamma(b)b]^2}{2}. \end{array} \right\}$$

Thus,

$$\alpha(b)T^{MNF}(b) = \left\{ \begin{array}{c} \alpha(b)\gamma(b)[R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2] \\ -\alpha(b)\frac{[\gamma(b)b]^2}{2} - \int_0^b \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b} - k, \end{array} \right\} \tag{9}$$

where $k = \Pi^{MNF}(0)$.

(b) *Sufficiency.*

Suppose type b reports that its type is b'. Then, using (2) and (8), its profit is given by:

$$\begin{aligned} \Pi^{MNF}(b'|b) &= \frac{\alpha(b')\gamma(b')^2(b-b')(b+b')}{2} + \int_0^{b'} \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b} + k \\ &= \frac{\alpha(b')\gamma(b')^2(b-b')(b+b')}{2} + \int_0^{b} \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b} + \int_b^{b'} \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b} + k \\ &= \int_0^{b} \alpha(\widetilde{b})\gamma(\widetilde{b})^2\widetilde{b}d\widetilde{b} + \int_{b'}^{b} [\alpha(b')\gamma(b')^2 - \alpha(\widetilde{b})\gamma(\widetilde{b})^2]\widetilde{b}d\widetilde{b} + k. \end{aligned}$$

Note that the first term does not involve b'. Hence, $\Pi^{MNF}(b'|b)$ is maximized when the second term is maximized. If $\alpha(b)\gamma(b)^2$ is non-decreasing in b, the second term is non-positive for $b \neq b'$. Therefore, it is maximized at $b' = b$.■

I am now in a position to prove proposition 1.

The expected welfare of the host government is:

$$W = \left\{ \begin{array}{c} \phi_1 \int\limits_0^{\bar{b}} \left\{ [1-\alpha(b)]T_1^{LF}(b) + \alpha(b)\left[T_2^{LF}(b) + T^{MNF}(b)\right] \right\} dF(b) \\ +\phi_2 \int\limits_0^{\bar{b}} \left\{ \begin{array}{c} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I - T_1^{LF}(b)] + \\ \alpha(b) \left[\begin{array}{c} (1-\gamma(b))[R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2] \\ -T_2^{LF}(b) \end{array} \right] \end{array} \right\} dF(b) \end{array} \right\}$$

$$= \left\{ \begin{array}{c} (\phi_1 - \phi_2) \int\limits_0^{\bar{b}} \left\{ [1-\alpha(b)]T_1^{LF}(b) + \alpha(b)T_2^{LF}(b) \right\} dF(b) \\ +\phi_1 \int\limits_0^{\bar{b}} \alpha(b)T^{MNF}(b)dF(b) \\ +\phi_2 \int\limits_0^{\bar{b}} \left\{ \begin{array}{c} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I] + \\ \alpha(b)[1-\gamma(b)][R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2] \end{array} \right\} dF(b). \end{array} \right\} \quad (10)$$

There are certain things to note here. First, since $\phi_1 - \phi_2 > 0$, the host government wants to have maximum $T_1^{LF}(b)$ and $T_2^{LF}(b)$. Also, since it only deals with the MNF, by the time it taxes the local firm, the value of b has already been truthfully reported to the government. As a result, no rent is given to the local firm. Therefore, in light of assumption 2, it is optimal to set:

$$\begin{array}{c} [1-\alpha(b)]T_1^{LF}(b) = [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I], \text{ and} \\ \alpha(b)T_2^{LF}(b) = \alpha(b)[1-\gamma(b)][R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2]. \end{array} \quad (11)$$

Hence, equation (10) can be rewritten as follows:

$$W = \phi_1 \int_0^{\bar{b}} [1-\alpha(b)] T_1^{LF}(b) dF(b) + \phi_1 \int_0^{\bar{b}} \alpha(b) T_2^{LF}(b) dF(b) + \phi_1 \int_0^{\bar{b}} \alpha(b) T^{MNF}(b) dF(b)$$

$$= \left\{ \begin{array}{c} \phi_1 \int_0^{\bar{b}} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I] dF(b) \\ +\phi_1 \int_0^{\bar{b}} \alpha(b)[1-\gamma(b)][R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2] dF(b) \\ +\phi_1 \int_0^{\bar{b}} \left\{ \begin{array}{c} \alpha(b)\gamma(b)\left[R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2\right] \\ -\alpha(b)\frac{[\gamma(b)b]^2}{2} - \int_0^{b} \alpha(\widetilde{b})\gamma(\widetilde{b})^2 \widetilde{b} d\widetilde{b} - \Pi^{MNF}(0) \end{array} \right\} dF \end{array} \right\} (b)$$

$$= \left\{ \begin{array}{c} \phi_1 \int_0^{\bar{b}} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I] dF(b) \\ +\phi_1 \int_0^{\bar{b}} \alpha(b) \left[R(x^2(b)) - cx^2(b) - I + \gamma(b)b^2 - \frac{[\gamma(b)b]^2}{2}\right] dF(b) \\ -\phi_1 \int_0^{\bar{b}} \left\{ \int_0^{b} \alpha(\widetilde{b})\gamma(\widetilde{b})^2 \widetilde{b} d\widetilde{b} \right\} dF(b) - \phi_1 \Pi^{MNF}(0). \end{array} \right\} \qquad (12)$$

Now integrating by parts, I get:

$$\begin{aligned} \int_0^{\bar{b}} \left\{ \int_0^{b} \alpha(\widetilde{b})\gamma(\widetilde{b})^2 \widetilde{b} d\widetilde{b} \right\} dF(b) &= \int_0^{\bar{b}} \alpha(\widetilde{b})\gamma(\widetilde{b})^2 \widetilde{b} d\widetilde{b} - \int_0^{\bar{b}} F(\widetilde{b})\alpha(\widetilde{b})\gamma(\widetilde{b})^2 \widetilde{b} d\widetilde{b} \\ &= \int_0^{\bar{b}} \alpha(b)\gamma(b)^2 b[1-F(b)] db. \end{aligned}$$

Hence, substituting in equation (12), I obtain:

$$W = \left\{ \begin{array}{c} \phi_1 \int\limits_0^{\bar{b}} \left\{ \begin{array}{c} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I] \\ +\alpha(b) \left[\begin{array}{c} R(x^2(b)) - cx^2(b) - I \\ +\gamma(b)b^2 - \frac{[\gamma(b)b]^2}{2} - \gamma(b)^2 b \frac{[1-F(b)]}{f(b)} \end{array} \right] \end{array} \right\} f(b)db \\ -\phi_1 \Pi^{MNF}(0). \end{array} \right\} \tag{13}$$

The mechanism design problem thus consists of choosing $\Pi^{MNF}(0)$ and the seven-tuple $\{\alpha(b), x^1(b), x^2(b), T_1^{LF}(b), T_2^{LF}(b), T^{MNF}(b), \gamma(b)\}$ such that the last expression is maximized subject to (6) [the associated $T_1^{LF}(b)$, $T_2^{LF}(b)$ and $T^{MNF}(b)$ schedules, of course, are given by (11) and (9), respectively]. First, consider the maximization problem without regard to (6). Since $\Pi^{MNF}(0)$ enters negatively, it must be set equal to zero. It is then clear that the problem is one of pointwise maximization of the integral in (13). It is clear that $x^1(b)$ and $x^2(b)$ should be chosen to maximize:

$$R(x(b)) - cx(b) - I + \gamma(b)b^2 - \frac{[\gamma(b)b]^2}{2} - (\gamma(b)^2 b)\frac{1-F(b)}{f(b)}.$$

i.e. $x^1(b) = x^2(b) = x^*$. Also, when I maximize the above expression for $\gamma(b)$ for $b > 0$, I get $\gamma(b) = \frac{b}{2\left[\frac{1-F(b)}{f(b)}\right]+b}$. It is also clear that $\alpha(b) = 1$ iff

$$\begin{aligned} &\pi^* - I + \gamma(b)b^2 - \tfrac{[\gamma(b)b]^2}{2} - (\gamma(b)^2 b)\tfrac{1-F(b)}{f(b)} \geq \pi^* - I \\ &\Rightarrow \gamma(b)b^2 - \tfrac{[\gamma(b)b]^2}{2} - (\gamma(b)^2 b)\tfrac{1-F(b)}{f(b)} \geq 0 \end{aligned} \tag{14}$$

If I plug in the value of $\gamma(b)$ for $b > 0$ in (14), I obtain:

$$1 \geq \frac{bf(b) + [1 - F(b)]}{bf(b) + 2[1 - F(b)]} \Rightarrow \alpha(b) = 1 \ \forall b \in [0, \bar{b}].$$

Since $\alpha(b) = 1$ and $\frac{d\gamma}{db} > 0$ (by assumption 2, $\frac{1-F(b)}{f(b)}$ is decreasing), $\alpha(b)\gamma(b)^2$ satisfies the implementability requirement that it be non-decreasing. Finally, note that from (11) and (9),

$$\begin{aligned}
T_1^{LF}(b) &= T_1^{LF} = \pi^* - I, \\
T_2^{LF}(b) &= [1 - \gamma(b)][\pi^* - I + \gamma(b)b^2] \\
&= \left[1 - \frac{b}{2\left[\frac{1-F(b)}{f(b)}\right] + b}\right]\left[\pi^* - I + \frac{b^3}{2\left(\frac{1-F(b)}{f(b)}\right) + b}\right], \\
T^{MNF}(b) &= \gamma(b)[\pi^* - I + \gamma(b)b^2] - \frac{[\gamma(b)b]^2}{2} - \int_0^b [\gamma(\tilde{b})]^2 \tilde{b}\, d\tilde{b} \\
&= \left\{ \begin{array}{c} \left[\frac{b}{2\left[\frac{1-F(b)}{f(b)}\right]+b}\right]\left[\pi^* - I + \frac{b^3}{2\left(\frac{1-F(b)}{f(b)}\right)+b}\right] \\ - \int_0^b \frac{\tilde{b}^3}{\left[2\left(\frac{1-F(\tilde{b})}{f(\tilde{b})}\right)+\tilde{b}\right]^2} d\tilde{b}. \end{array} \right\}
\end{aligned}$$

Proof of Proposition 2.

Given a mechanism with only lump-sum tax/subsidy, denote by $\Pi^{MNF}(b'|b)$ the profit made by the MNF of type b if it reports type b'. Clearly,

$$\Pi^{MNF}(b'|b) = \left\{ \begin{array}{c} \alpha(b')[R(x^2(b')) - cx^2(b') - I + eb] \\ -\alpha(b')T^{MNF}(b') - \alpha(b')\frac{e^2}{2}. \end{array} \right\} \tag{15}$$

The optimal effort level by the MNF given the ownership shares can be found as:

$$\max_e \alpha(b')[R(x^2(b')) - cx^2(b') - I + eb] - \alpha(b')T^{MNF}(b') - \alpha(b')\tfrac{e^2}{2},$$

$$\Rightarrow e = b.$$

Thus, one can rewrite equation (15) as follows:

$$\Pi^{MNF}(b'|b) = \left\{ \begin{array}{c} \alpha(b')[R(x^2(b')) - cx^2(b') - I + b^2] \\ -\alpha(b')T^{MNF}(b') - \alpha(b')\frac{b^2}{2}. \end{array} \right\} \tag{16}$$

(a) *Necessity.*

Incentive compatibility implies $\Pi^{MNF}(b|b) \geqslant \Pi^{MNF}(b'|b)\ \forall b,\ b' \in [0, \bar{b}]$. Hence, one can write:

$$\Pi^{MNF}(b'|b) - \Pi^{MNF}(b'|b') \leq \Pi^{MNF}(b|b) - \Pi^{MNF}(b'|b') \leq \Pi^{MNF}(b|b) - \Pi^{MNF}(b|b').$$

Using (16), this gives:

$$\frac{\alpha(b')[b^2-(b')^2]}{2} \leq \Pi^{MNF}(b|b) - \Pi^{MNF}(b'|b') \leq \frac{\alpha(b)[b^2-(b')^2]}{2}. \tag{17}$$

Given that $b > b'$,

$$\alpha(b) \geqslant \alpha(b'). \tag{18}$$

Since $\alpha(b)$ is non-decreasing in b, it is differentiable almost everywhere. Now, dividing (17) throughout by $b - b'$, when $b > b'$, I get:

$$\frac{\alpha(b')(b+b')}{2} \leq \frac{\Pi^{MNF}(b|b) - \Pi^{MNF}(b'|b')}{b-b'} \leq \frac{\alpha(b)(b+b')}{2} \tag{19}$$

Define $\Pi^{MNF}(b) = \Pi^{MNF}(b|b)$, i.e. the profit of type b from a truthful report. Taking the limit in (19) above as $b \longrightarrow b'$, I get:

$$\frac{d\Pi^{MNF}(b)}{db} = \alpha(b)b \text{ almost everywhere.}$$

Hence, I have:

$$\Pi^{MNF}(b) = \Pi^{MNF}(0) + \int_0^b \alpha(\widetilde{b})\widetilde{b}d\widetilde{b}. \tag{20}$$

Substituting in (16), I obtain:

$$\Pi^{MNF}(0) + \int_0^b \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} = \left\{ \begin{array}{c} \alpha(b)[R(x^2(b)) - cx^2(b) - I + b^2] \\ -\alpha(b)T^{MNF}(b) - \alpha(b)\frac{b^2}{2}. \end{array} \right\}$$

Thus,

$$\alpha(b)T^{MNF}(b) = \left\{ \begin{array}{c} \alpha(b)[R(x^2(b)) - cx^2(b) - I + b^2] \\ -\alpha(b)\frac{b^2}{2} - \int_0^b \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} - k, \end{array} \right\} \tag{21}$$

where $k = \Pi^{MNF}(0)$.

(b) *Sufficiency.*

Suppose type b reports that its type is b'. Then, using (16) and (20), its profit is given by:

$$\begin{aligned} \Pi^{MNF}(b'|b) &= \frac{\alpha(b')(b-b')(b+b')}{2} + \int_0^{b'} \alpha(\widetilde{b})bd\widetilde{b} + k \\ &= \frac{\alpha(b')(b-b')(b+b')}{2} + \int_0^{b} \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} + \int_b^{b'} \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} + k \\ &= \int_0^{b} \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} + \int_{b'}^{b} [\alpha(b') - \alpha(\widetilde{b})]\widetilde{b}d\widetilde{b} + k. \end{aligned}$$

Note that the first term does not involve b'. Hence, $\Pi^{MNF}(b'|b)$ is maximized when the second term is maximized. If $\alpha(b)$ is non-decreasing in b, the second term is non-positive for $b \neq b'$. Therefore, it is maximized at $b' = b$.■

The expected welfare of the host government is:

$$W = \left\{ \begin{array}{c} \phi_1 \int_0^{\bar{b}} \left\{ [1-\alpha(b)]T^{LF}(b) + \alpha(b) \left[T^{MNF}(b) \right] \right\} dF(b) \\ +\phi_2 \int_0^{\bar{b}} \left\{ [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I - T^{LF}(b)] \right\} dF(b) \end{array} \right\}$$

$$= \left\{ \begin{array}{c} (\phi_1 - \phi_2) \int_0^{\bar{b}} [1-\alpha(b)]T^{LF}(b)dF(b) + \phi_1 \int_0^{\bar{b}} \alpha(b)T^{MNF}(b)dF(b) \\ +\phi_2 \int_0^{\bar{b}} \{[1-\alpha(b)][R(x^1(b)) - cx^1(b) - I]\} dF(b). \end{array} \right\} \tag{22}$$

As before, since $\phi_1 - \phi_2 > 0$, the host government wants to have maximum $T^{LF}(b)$. Therefore, in the light of assumption 2, it is optimal to set:

$$[1-\alpha(b)]T^{LF}(b) = [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I]. \tag{23}$$

Hence, equation (22) can be rewritten as follows:

$$W = \phi_1 \int_0^{\bar{b}} [1-\alpha(b)]T^{LF}(b)dF(b) + \phi_1 \int_0^{\bar{b}} \alpha(b)T^{MNF}(b)dF(b)$$

$$= \left\{ \begin{array}{c} \phi_1 \int_0^{\bar{b}} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I]dF(b) \\ +\phi_1 \int_0^{\bar{b}} \left\{ \begin{array}{c} \alpha(b) \left[R(x^2(b)) - cx^2(b) - I + b^2 \right] \\ -\alpha(b)\frac{b^2}{2} - \int_0^{b} \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} - \Pi^{MNF}(0) \end{array} \right\} dF(b) \end{array} \right\}$$

$$= \left\{ \begin{array}{c} \phi_1 \int_0^{\bar{b}} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I]dF(b) \\ +\phi_1 \int_0^{\bar{b}} \alpha(b) \left[R(x^2(b)) - cx^2(b) - I + b^2 - \frac{b^2}{2}\right] dF(b) \\ -\phi_1 \int_0^{\bar{b}} \left\{ \int_0^{b} \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} \right\} dF(b) - \phi_1 \Pi^{MNF}(0). \end{array} \right\} \tag{24}$$

Now integrating by parts, I get:

$$\begin{aligned} \int_0^{\bar{b}} \left\{ \int_0^{b} \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} \right\} dF(b) &= \int_0^{\bar{b}} \alpha(\widetilde{b})\widetilde{b}d\widetilde{b} - \int_0^{\bar{b}} F(\widetilde{b})\alpha(\widetilde{b})\widetilde{b}d\widetilde{b} \\ &= \int_0^{\bar{b}} \alpha(b)b[1-F(b)]db. \end{aligned}$$

Hence, substituting in equation (24), I obtain:

$$W = \left\{ \begin{array}{c} \phi_1 \int_0^{\bar{b}} \left\{ \begin{array}{c} [1-\alpha(b)][R(x^1(b)) - cx^1(b) - I] \\ +\alpha(b)[R(x^2(b)) - cx^2(b) - I + b^2 - \frac{b^2}{2} - b\frac{[1-F(b)]}{f(b)}] \end{array} \right\} f(b)db \\ -\phi_1 \Pi^{MNF}(0). \end{array} \right\} \tag{25}$$

The mechanism design problem thus consists of choosing $\Pi^{MNF}(0)$ and the five-tuple $\{\alpha(b),\ x^1(b),\ x^2(b),\ T^{LF}(b),\ T^{MNF}(b)\}$ such that the last expression is maximized subject to (18) [the associated $T^{LF}(b)$ and $T^{MNF}(b)$ schedules, of course, are given by (23) and (21), respectively]. First, consider the maximization problem without regard to (18). Since $\Pi^{MNF}(0)$ enters negatively, it must be set equal to zero. It is then clear that the problem is one of pointwise maximization of the integral in (25). It is clear that $x^1(b)$ and $x^2(b)$ should be chosen to maximize:

$$R(x(b)) - cx(b) - I + b^2 - \frac{b^2}{2} - b\frac{1-F(b)}{f(b)}.$$

i.e. $x^1(b) = x^2(b) = x^*$. It is also clear that $\alpha(b) = 1$ iff:

$$\begin{aligned} \pi^* - I + b^2 - \tfrac{b^2}{2} - b\tfrac{1-F(b)}{f(b)} \geq \pi^* - I \\ \Rightarrow b \geq 2\tfrac{1-F(b)}{f(b)}, \text{ for } b > 0. \end{aligned} \tag{26}$$

Since $\frac{1-F(b)}{f(b)}$ is decreasing in b, $\alpha(b)$ satisfies the implementability requirement that it be non-decreasing. Finally, note that from (23) and (21),

$$\begin{aligned} T^{LF}(b) &= T^{LF} = \pi^* - I, \\ T^{MNF}(b) &= \pi^* - I + 2\left(\frac{1-F(b)}{f(b)}\right)^2 \\ T^{Total} &= \begin{cases} T^{MNF}(b) \text{ if } b \geq 2\frac{1-F(b)}{f(b)} \\ T^{LF} \text{ if } b < 2\frac{1-F(b)}{f(b)} \end{cases} \end{aligned}$$

As seen in the above mechanism, for $b < 2\frac{1-F(b)}{f(b)}$, even though the MNF creates more surplus, it is not allowed to operate in the host country. This creates ex-post inefficiency.■

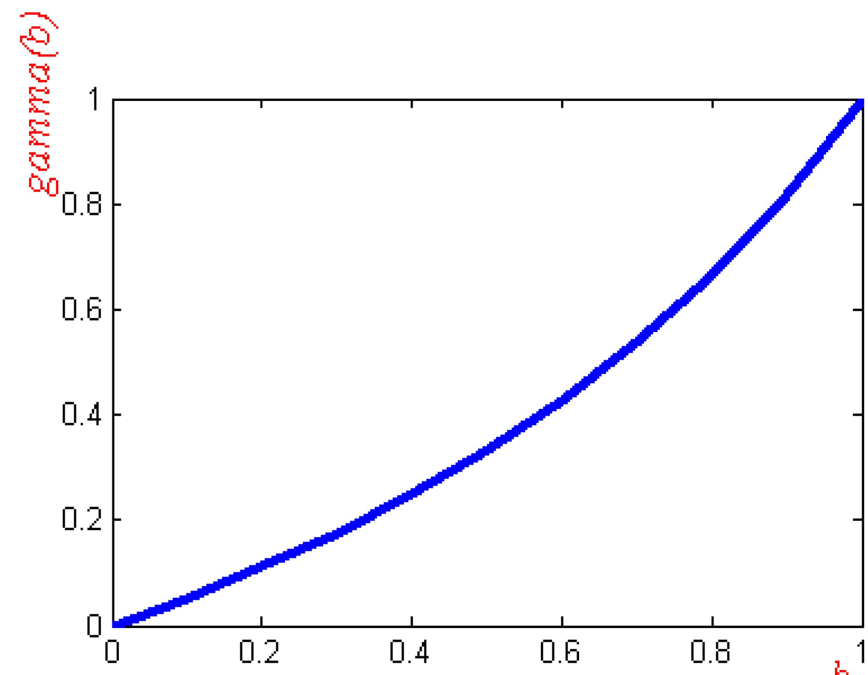

Figure 1. MNF's share

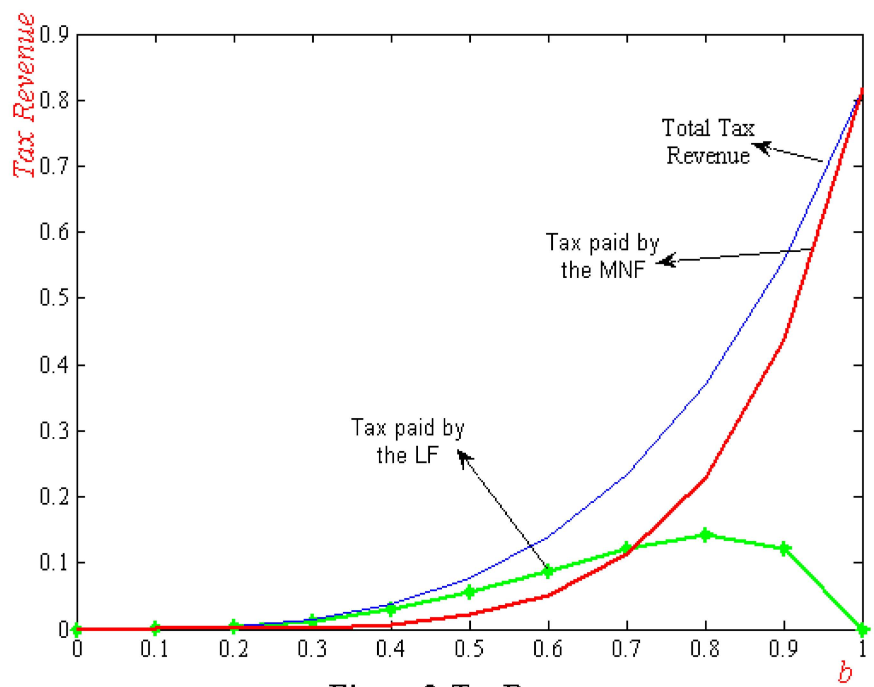

Figure 2. Tax Revenue

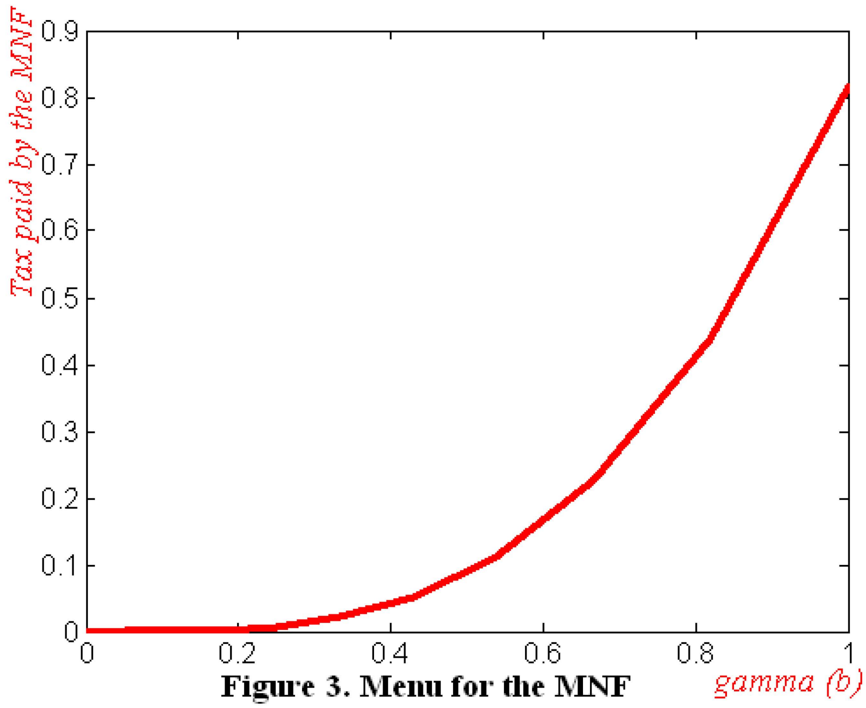

Figure 3. Menu for the MNF

Chapter 2

Trade, Outsourcing, and the Invisible Handshake

Co-authored with John McLaren

2.1 Introduction.

A key feature of globalization in recent years has been the striking increase in international labor-market integration. This is manifested both in foreign direct investment, which allows a firm access to labor in several countries at once, and also in outsourcing of business services.

A parallel phenomenon has been the rise in income volatility for individual workers. This was documented in Gottschalk, Moffitt, Katz and Dickens (1994). A recent journalistic account with evidence from individual case studies, survey data, and labor-market data is found in Gosselin (2004). By some measures, volatility of individual earnings in the United States has doubled since the 1970's. A key theme in these accounts is the claim that the security of worker's jobs has been diminished, and the loyalty felt by employers to long-term workers is weaker, than in previous eras. Outsourcing, both international and domestic, has often been cited as related to the weaker employment relationships, as in Holstein (2005). Evidence on the growing fragility of employment relationships is reported in Valletta (1999).

We ask in this paper if it is possible that these phenomena may be related, that is, if greater international integration may lead to greater volatility of wages.

We explore that possibility in the context of a simple model of risk-bearing in employment relationships in which complete contracts are unavailable for informational reasons. In this environment, the only way for an employer to share risk with a worker is to develop a long-run relationship in which the firm promises to smooth out (partially or completely) shocks to wages, and the worker in turn promises a long-run commitment to the firm. This arrangement is enforceable only through the threat that if one reneges, he or she will lose the benefit of the trust on which the relationship was founded, and will need to suffer the whims of the market and search for a new worker (or employer, as the case may be). Integration of one's country's labor market with another can make it easier or harder to search for a worker, thus respectively reducing or increasing the potential for risk-sharing relationships, and thus increasing or reducing the volatility of wages as the case may be.

This paper is related to an earlier one by McLaren and Newman (2004), which studied the effect of globalization on risk-sharing in an abstract economy with symmetric agents. Here, by contrast, the asymmetry between workers and employers is the focus, and the distribution of income between workers and employers. In addition, that paper, unlike the current paper, confined attention to stationary risk-sharing relationships, which are in general sub-optimal. In addition, the two-good setup of the present paper allows us to analyze the effects of free trade, which was not possible with the earlier paper. See Kocherlakota (1996) for an extensive analysis of optimal history-dependant risk-sharing relationships in a similar model. The argument is also related to the literature initiated by Ramey and Watson (2001), showing how improvements in search technology can have perverse effects on incentives.

This exercise is also close in spirit to Thomas and Worrall (1988).[24] They analyze self-enforcing labor contracts between a risk-neutral employer and a risk-averse employee in the presence of an exogenous and randomly fluctuating labor spot market. The employer offers wage smoothing to the employee, implying wages above the spot wage in slumps, and in return the worker accepts a wage below the spot market in booms. Both sides know that if either reneges on this agreement, both will be forced to use the spot market from then on. The presence of the spot market generally puts a binding constraint on the amount of insurance the employer can provide. By contrast, in this paper, there is no exogenous spot market, but rather a search pool which either employer or employee can enter at any time. The value of entering the search pool is endogenous, since it depends on how easy it is to find a match and also on how well cooperation works with the new partner once a match has been found. Thus, this is a general equilibrium exercise, while the Thomas and Worrall

[24] The approach to finding the optimal contract with a risk-averse worker follows that paper. It should be pointed out that this project adds moral hazard, raising issues studied, for example, in MacLeod and Malcomson (1989).

model is partial equilibrium in character. The aim is to ask how improvements in the market mechanism such as an improvement in search technology or an increase in international openness would affect wage-smoothing within the firm.

A related argument has been made by Bertrand (2004). She shows that firms hit with stiff import competition (or anything else that has a negative effect on balance sheets) can effectively have a higher discount rate due to an increased risk of bankruptcy. This leads to tightened incentive-compatibility constraints and thus higher wage volatility within a given employment relationship. The effect is shown to have empirical support.

In our model, workers are risk-averse, while the employers are risk-neutral. There are two sectors, a 'careers sector' in which production is risky and requires unobservable effort by a worker and by an employer, and a 'spot market sector' with risk-free Ricardian technology. An employer in the 'careers sector' would like to commit credibly to a constant wage, in effect selling insurance at the same time as it purchases labor, but without enforceable contracts it can do so only by reputational means, and so is constrained by its incentive-compatibility constraints. Workers without a careers-sector employer and careers-sector employers without a worker search until they have a match. Because of the need to elicit effort, wage compensation in the 'careers sector' is 'back-loaded' in equilibrium; a worker puts in effort today in order to earn compensation that will be due to her tomorrow. For this reason, new workers are always cheaper than incumbent workers. This is the source of the firm's problem:

during adverse shocks, when the firm's profitability is low, if it is still paying the same high wage as in good states as promised, it will be tempted to renege, dumping the current worker and picking up a new, cheaper one instead. If it is easy to find a new worker quickly, workers will know not to trust an employer's promise of wage insurance and will demand a high wage in good times.

There are two countries, which differ only in their ratios of workers to employers. Globalization can take two forms: Free trade, and 'outsourcing,' in which the two countries' labor markets are integrated. From the point of view of the labor-scarce economy, free trade pushes down the price of labor-intensive 'spot-market-sector' output, which makes labor cheaper and also loosens employers' incentive-compatibility constraints, lowering the variance of wages. On the other hand, outsourcing, by making it easier for a firm in a labor-scarce economy to hire workers in a labor-abundant economy, sharpens employers' incentive-compatibility constraints, raising the variance of wages in the careers sector. At the same time outsourcing creates efficiencies in matching workers to employers that spill over, in general equilibrium, to benefit workers as consumers, raising real incomes for workers worldwide. Thus, *free trade reduces the volatility of rich-country wages, but makes rich-country workers worse off; outsourcing raises the volatility of rich-country wages, but makes rich-country worker better off.*

We present the formal model in the next section. In the following sections we characterize optimal wage contracts, derive the conditions under which those contracts will exhibit volatile wages, and study the comparative statics of wage volatility. Then, in the final section, we show how the general equilibrium is changed by free trade and outsourcing.

2.2 Model.

We analyze the questions at hand with a two-good, two-country, two-factor general equilibrium model. In this section, we will describe the key features of the closed-economy version in detail; we will treat the two-country version later.

Production.

Consider first a closed-economy model with two types of agent, 'workers,' of which there are a measure L, and 'employers,' of which there are a measure E. (We will examine the case of an open economy later.) There are two sectors. A risk-free sector, sector Y, uses only workers, each of whom produces one unit of output per period employed in the sector. A second sector, X, which will serve as a numeraire sector, employs both employers and workers. In order for production to occur in this sector, one worker must team up with one employer. We will call a given such partnership a 'firm.' In each period, X-production requires that a worker and employer must both put in one unit of non-contractible effort. This effort causes a disutility for the worker equal to $k > 0$. Within a given firm, denote the effort put in by agent i by $e^i \in \{0, 1\}$, where $i = W$ indicates the worker and $i = E$ denotes the employer. The output generated in that period is then equal to $R = x_\epsilon e^W e^E$, where ϵ is an iid random variable that takes the value $\epsilon = G$ or B with respective probabilities π_ϵ, where $\pi_G + \pi_B = 1$ and $x_G > x_B$. The variable ϵ indicates whether the current period is one with a good state or a bad state for the firm's profitability. Of course, since X is the numeraire, output and revenue are equal. The average revenue is denoted by $\overline{x} = \pi_G x_G + \pi_B x_B$.

Production in the Y sector is straightforward. Each worker in that sector produces one unit of output per period, receiving an income of ω^y. Since this is a constant-returns-to-scale sector with only one factor, we must have $\omega^y = p^y$, where p^y is the price of Y-sector output.

Search.

Workers without an X-sector employer and X-sector employers without a worker search until they have a match. Search follows a specification of a type used extensively by Pissarides (2000). If a measure n of workers and a measure m of employers search in a given period, then $\Phi(n, m; \phi)$ matches occur, where Φ is a concave function increasing in all arguments and homogeneous of degree 1 in its first two arguments, with $\Phi_{mn} = \Phi_{nm} > 0$. The parameter ϕ is a measure of the effectiveness of the search technology. It is convenient to denote by Q^E the steady-state probability that a vacancy will be filled in any given period, or in other words, $Q^E = \frac{\Phi(n,m;\phi)}{m}$, where m and n are set at their steady-state values. Similarly, denote by $Q^W = \frac{\Phi(n,m;\phi)}{n}$ the steady-state probability that a searching worker will find an X-sector job in any given period. Search has no direct cost, but for those who are currently in X-sector firms it does have an opportunity cost: If an agent is searching for a new partner, then she is unable to put in effort for production with her existing partner if she has one. On the other hand, for workers in the Y sector, there is no opportunity cost to search.[25]

There is also a possibility in each period that a worker and employer who have been together producing X output in the past will be exogenously separated from each other. This probability is given by a constant $(1-\rho) \in (0,1)$.

Preferences.

There is no storage, saving or borrowing, so an agent's income in a given period is equal to that agent's consumption in that period.

Employers. All employers have the same linear homogeneous quasi-concave per-period utility function, $U(c^X, c^Y)$, defined over consumption c^X and c^Y of goods X and Y, respectively. This yields indirect utility function $v(I, p^x, p^y) = \frac{I}{\Psi(p^x, p^y)}$, where I denotes income; p^x and p^y denote the prices of the two goods respectively; and Ψ is a linear homogenous function that generates the consumer price index derived from the utility function U. (In other words, $\Psi(p^x, p^y)$ is the minimum expenditure required to obtain unit utility with prices p^x and p^y). Recalling that X is our numeraire sector, we have $p^x \equiv 1$, and it is convenient to write the consumer price index as $P(p^y) \equiv \Psi(1, p^y)$. Note that by Shephard's Lemma, the elasticity of $P(p^y)$ with respect to p^y is equal to good Y's share in consumption.

Workers. All workers have the same per-period utility function $\mu(U(c^X, c^Y))$

[25] Thus, the X-sector jobs are more challenging jobs that require a worker's full attention, while Y-sector jobs are more casual, and permit a worker to earn an income while searching for something else. Adding an opportunity cost to search in the Y sector would add an additional dimension of complexity without adding anything of real importance to the questions at hand.

over consumption of goods X and Y. The function μ is a strictly increasing and strictly concave von-Neumann-Morgenstern utility function. Thus, using the notation developed just above, if in a given period a worker receives a wage ω and faces a consumer price index of $P = P(p^y)$, then the worker's utility for that period is given by $\mu(\frac{\omega}{P})$.

In other words, workers are risk-averse and employers are risk-neutral, but both will exhibit the same demand behavior for a given income.

Goods market clearing.

In each period, the total amount of each good produced must equal the amount consumed. Since given the relative price p^y both workers and entrepreneurs will consume X and Y in the same proportions, this amounts to the condition that $p^y = \frac{U_2(1,r)}{U_1(1,r)}$, where the subscripts denote partial derivatives, and r denotes the ratio of Y production to X production.[26] In other words, the relative price must be equal to the marginal rate of substitution between the two goods determined by the production ratio. We assume that $U_2(1,r) \to \infty$ as $r \to 0$, and $U_1(1,r) \to \infty$ as $r \to \infty$, which (given that U is quasi-concave and hence the marginal rate of substitution is strictly decreasing in r) implies a unique, market-clearing value of $p^y \in (0,\infty)$ for any $r \in (0,\infty)$. Further, p^y is strictly decreasing in r.

[26] Obviously, in the closed-economy version of the model r will refer to the ratio of domestic Y and X production, while in the open-economy version the world output ratio will be the relevant variable.

Sequence of events.

The sequence of events within each period is as follows. (i) Any existing matched employer and worker in the X sector learn whether or not they will be exogenously separated this period. (ii) The profitability state ϵ for each X-sector firm is realized. Within a given employment relationship, this is immediately common knowledge. The value of ϵ is not available to any agent outside of the firm, however. (iii) The wage, if any, is paid, and immediately consumed. (iv) The employer and worker simultaneously choose their effort levels e^i. At the same time, the search mechanism operates. Within an X-sector firm, if $e^i = 0$, then agent i can participate in search. At the same time, all Y-sector workers search. (v) Each X-sector firm's revenue, R, is realized. (vi) For those agents who have found a new potential partner in this period's search, new partnerships with a new self-enforcing agreement are formed. This is achieved by a take-it-or-leave-it offer made by the employer to the worker.

We will focus on steady-state equilibria. In such an equilibrium, the expected lifetime discounted profit of an employer with vacancy is denoted V^{ES} and the expected lifetime discounted utility of a searching worker is denoted V^{WS}, where the S indicates the state of searching. Similarly, we can denote by V^{ER} and V^{WR} the payoffs to employers and workers respectively at the beginning of a cooperative X-sector relationship. Of course, the values V^{ij} are endogenous, as they are affected by the endogenous probability of finding a match in any given period and by the endogenous value of entering a relationship once a match has been found. However, any employer will take them as given when designing the wage agreement. We can write:

$$V^{WS} = \mu(\omega^y/P) + Q^W \rho\beta V^{WR} + Q^W(1-\rho)\beta V^{WS} + (1-Q^W)\beta V^{WS}, \text{ and}$$
$$V^{ES} = Q^E \rho\beta V^{ER} + Q^E(1-\rho)\beta V^{ES} + (1-Q^E)\beta V^{ES}. \quad (27)$$

Given those values, a self-enforcing agreement between a worker and an employer is simply a sub-game perfect equilibrium of the game that they play together. We assume that the employer has all of the bargaining power, so the agreement chosen is simply the one that gives the employer the highest expected discounted profit, subject to incentive constraints. Without loss of generality, we will assume that the 'grim punishment' is used, meaning here that if either agent defects from the agreement at any time, the relationship is severed and both agents must search for new partners. Thus, the payoff following a deviation would be V^{ES} for an employer and V^{WS} for a worker.

To sum up, risk-neutral employers with vacancies search for risk-averse workers, and when they find each other, the employer offers the worker the profit-maximizing self-enforcing wage contract, which then remains in force until one party reneges or the two are exogenously separated. This pattern provides a steady flow of workers and employers into the search pool, where they receive endogenous payoffs V^{ES} and V^{WS}. These values then act as parameters that constrain the optimal wage contract.

The analysis will proceed as follows. We will characterize optimal labor contracts in the X sector. It turns out that optimal contracts are very much affected by the values of p^y and Q^E. We will show how they change as we vary p^y and Q^E exogenously, and then we will show how p^y and Q^E are determined endogenously, to complete the general equilibrium analysis. We then will examine how these two values change with international integration of: (i) goods markets, and then (ii) labor markets, to see how the behavior of wages is affected by globalization.

We first turn to the form of optimal contracts.

2.3 The form of optimal contracts in the X sector.

In general, optimal incentive-constrained agreements in problems of this sort can be quite complex because the specified actions depend on the whole history of shocks and not only the current one. (See Thomas and Worrall (1988) and Kocherlakota (1996).) In analyzing the equilibrium, it is useful to note that in our model the employment contracts offered by employers always take one of two very simple forms, which we will call 'wage stabilization" and "wage volatility." Derivation of this property is the purpose of this section.

The equilibrium can be characterized as the solution to a recursive optimization problem. Denote by $\Omega(W)$ the highest possible expected present discounted profit the employer can receive in a subgame-perfect equilibrium, conditional on the worker receiving an expected present discounted payoff of at least W. Arguments parallel to those in Thomas and Worrall (1988) can be used to show that Ω is defined on an interval $[W_{min}, W_{max}]$ and is decreasing, strictly concave, and differentiable. This function must satisfy the following equation:

$$\Omega(W_0) = \max_{\left\{\omega_\epsilon, \widetilde{W}_\epsilon\right\}, \epsilon=G,B} \sum_{\epsilon=1}^{2} \pi_\epsilon \left(x_\epsilon - \omega_\epsilon + \beta\rho\Omega\left(\widetilde{W}_\epsilon\right) + \beta\left(1-\rho\right)V^{ES}\right) \tag{28}$$

subject to

$$x_\epsilon - \omega_\epsilon + \beta\rho\Omega(\widetilde{W}_\epsilon) - (1-\beta(1-\rho))V^{ES} \geq 0 \tag{29}$$

$$\mu(\frac{\omega_\epsilon}{P}) - k + \beta\rho\widetilde{W}_\epsilon + \beta(1-\rho)V^{WS} \geq \mu(\frac{\omega_\epsilon}{P}) - \mu(\frac{\omega^y}{P}) + V^{WS} \tag{30}$$

$$\sum_{\epsilon=1}^{2} \pi_\epsilon \left[\mu(\frac{\omega_\epsilon}{P}) - k + \beta\rho\widetilde{W}_\epsilon + \beta(1-\rho)V^{WS}\right] \geq W_0 \tag{31}$$

$$W_{min} \leq \epsilon \leq W_{max}, \text{ and} \tag{32}$$

$$\omega_\epsilon \geq 0. \tag{33}$$

The right-hand side of (28) is the maximization problem solved by the employer. She must choose a current-period wage ω_ϵ for each state ϵ, and a continuation utility $\widetilde{W}_\epsilon$ for the worker for subsequent periods following that state. Constraint (29) is the employer's incentive compatibility constraint: If this is not satisfied in state ϵ, then the employer will in that state prefer to renege on the promised wage, understanding that this will cause the worker to lose faith in the relationship and sending both parties into the search pool. Constraint (30) is the worker's incentive compatibility constraint. The left-hand side is the worker's payoff from putting in effort in the current period, collecting the wage, and continuing the relationship. The right-hand side is the payoff from shirking and searching, which is the same as the payoff from being in the Y sector except that the current-period wage is equal to the wage ω_ϵ paid by the X-sector employer, instead of ω^y. (Recall that workers are able to work in the Y sector and receive ω^y while searching.[27]) If this constraint is not satisfied, the worker will prefer to shirk by searching instead of working.[28] Constraint (31) is the target-utility constraint. In the first period of an employment relationship, the employer must promise at least as much of a payoff to the working as remaining in the search pool would provide. Thus, in that case $W_0 = V^{WS}$ (and so $V^{ER} = \Omega(V^{WS})$). Thereafter, the employer will in general be bound by promises of payoff she had made to the worker in the past. Finally, (32) and (33) are natural bounds on the choice variables.

Constraint (30) can be replaced by the more convenient form:

$$\widetilde{W}_\epsilon \geq \widetilde{W}^*, \text{ where } \widetilde{W}^* \equiv \frac{(1-\beta(1-\rho))V^{WS} - \mu(\frac{\omega^y}{P}) + k}{\beta\rho}. \tag{34}$$

The value $\widetilde{W}^*$ is the minimum future utility stream that must be promised to the

[27]Note that we are assuming that a worker cannot receive a Y-sector wage while searching if that worker is shirking on an X-sector job. This makes sense if, for example, *effort* is not observable and third-party verifiable but *physical presence* on the job site is, and a worker can search while physically at the X-sector job site but cannot produce Y-sector output while there. Thus, an X-sector employer would be able to sue to recover the wage just paid if the worker was absent, working another job, instead of on site at the location of the X firm.

[28]Throughout, we will assume that it is optimal to induce the worker to exert effort in each state as long as the employment relationship continues. This is clearly the case in a substantial portion of the parameter space, and so we are implicitly restricting attention to that portion. We will comment in Section 5 on the parameter restrictions implicit in this assumption.

worker in order to convince the worker to incur effort and forgo search. It can be seen easily that $\widetilde{W}^* > V^{WS}$.[29] The following condition must hold in general equilibrium:

$$W_{min} \leq \widetilde{W}^*.$$

If this condition did not hold, then it would never be possible to elicit effort in the X sector, so output of X would be zero; therefore p^y, and so ω^y and P would both be equal to zero, and the worker's incentive compatibility constraint could easily be satisfied, leading to a contradiction. Of course, with this condition, condition (34) now makes the lower bound in constraint (32) redundant, so we can replace it with constraint (35):

$$\widetilde{W}_\epsilon \leq W_{max}. \tag{35}$$

This allows us to derive the first-order conditions for the problem. Let the Kuhn-Tucker multiplier for (29) be denoted by ψ_ϵ, the multiplier for (34) by ν_ϵ, and the multiplier for (31) by λ. The first-order conditions with respect to ω_ϵ and $\widetilde{W}_\epsilon$ respectively are:

$$-\pi_\epsilon + \frac{\lambda \pi_\epsilon \mu' \left(\frac{\omega_\epsilon}{P}\right)}{P} - \psi_\epsilon \ \leq \ 0 \tag{36}$$

$$\beta\rho\pi_\epsilon \Omega'\left(\widetilde{W}_\epsilon\right) + \beta\rho\lambda\pi_\epsilon + \beta\rho\psi_\epsilon \Omega'\left(\widetilde{W}_\epsilon\right) + \beta\rho\nu_\epsilon \ \geq \ 0 \tag{37}$$

[29] Note that in equilibrium V^{WR} must be at least as large as V^{WS}, in order for (31) to be satisfied in the first period of an employment relationship. It is then quickly verified that if $\widetilde{W}^* \leq V^{WS}$, (27) implies that (30) cannot be satisfied.

(Condition (36) is an inequality to allow for the possibility that $\omega_\epsilon = 0$ at the optimum, and (37) is an inequality to allow for the possibility that $\widetilde{W}_\epsilon = W_{max}$ at the optimum.)

To sum up, in each period the employer maximizes (28), subject to (29), (34), (31), (35) and (33). In the first period of the relationship, the worker's target utility W_0 is given by V^{WS}, but in the second period it is determined by the values of $\widetilde{W}_\epsilon$ chosen in the first period and by the first-period state, and similarly in later periods it is determined by choices made for earlier dates. We impose an assumption:

Assumption 1. In the first period of an employment relationship, the employer's incentive-compatibility constraint (29) does not bind in either state.

We will discuss sufficient conditions for this later. We can now prove that under Assumption 1, the equilibrium always takes the same simple form: A one-period 'apprenticeship' in which the Y-sector wage ω^y is paid, followed by a time-invariant but perhaps state-dependent wage. The key idea is that it is never optimal to promise more future utility than is required to satisfy the worker's incentive constraint (34), so after the first period of the relationship, the worker's target utility is always equal to $\widetilde{W}^*$. This means that after the first period, the optimal wage settings by the firm are stationary. We can now establish a detailed proof through the following two propositions.

Proposition 1. Consider the first period of an employment relationship. If the employer's incentive-compatibility constraint does not bind in either state, the wage is set equal to ω^y in each state and the continuation payoff for the worker in each state is set equal to $\widetilde{W}^*$.

Proof. Suppose, first, that the worker's incentive compatibility constraint does not bind in state ϵ in the first period. Then $\psi_\epsilon = \nu_\epsilon = 0$, and (37) becomes:

$$\Omega'\left(\widetilde{W}_\epsilon\right) + \lambda \geq 0.$$

Since by the envelope theorem, $\Omega'(W_0) = -\lambda$, this and the concavity of Ω imply that $\widetilde{W}_\epsilon \leq W_0 = V^{WS}$. But since $V^{WS} < \widetilde{W}^*$, this implies that the worker's incentive compatibility constraint (34) will be violated, a contradiction. Therefore, the worker's incentive compatibility constraint must bind in each state, ensuring that $\widetilde{W}_\epsilon = \widetilde{W}^*$. Given that $\widetilde{W}_\epsilon = \widetilde{W}^*$ and $W_0 = V^{WS}$, the target utility constraint (31) is exactly satisfied by setting the wage in each state in the first period equal to ω^y. Therefore, ω^y is the minimum first period wage required to make the worker willing to accept the job. The condition (36), with $\psi_\epsilon = 0$, then ensures that it is indeed optimal to pay the same wage in both states. **Q.E.D.**

Note that Proposition 1 makes clear that workers joining X-sector employment receive the same payoff that they would receive in the Y sector, or in other words, $V^{WR} = V^{WS}$. From (27), this immediately tells us:

$$V^{WS} = \frac{\mu(\frac{\omega^y}{P})}{1-\beta}. \tag{38}$$

Now we can use the fact that the worker's target utility for the second period of the relationship (denoted as W_0 in (28)) is equal to $\widetilde{W}^*$ to characterize the equilibrium from that point forward.

Proposition 2. Under the conditions stated for Proposition 1, there is a pair of values ω_ϵ^* for $\epsilon = G, B$ such that in the second period and all subsequent periods of an X-sector employment relationship regardless of history (provided neither partner has shirked), the wage ω_ϵ^* is paid whenever the state is ϵ. In addition, the worker's continuation payoff is always equal to $\widetilde{W}^*$. Further, after the first period there are three possible cases:

(i) The employer's incentive compatibility constraint (29) never binds, and $\omega_G^* = \omega_B^*$.

(ii) The employer's incentive compatibility constraint (29) binds in the good states but not in the bad states, and $\omega_G^* > \omega_B^*$.

(iii) The employer's incentive compatibility constraint (29) always binds, and $x_G - \omega_G^* = x_B - \omega_B^*$.

Proof. See Appendix.

As a result, we need concern ourselves with only two types of possible equilibrium wage contracts: The type that features $\omega_G^* = \omega_B^*$ after the first period, which we will call wage-smoothing agreements; and the type with $\omega_G^* \neq \omega_B^*$ after the first period, which we will call fluctuating-wage agreements.

To sum up, if the employer's incentive constraint does not bind, the worker goes through an 'apprenticeship period' at the beginning of the relationship, followed by a constant wage. If the employer's constraint ever binds, then it binds only (and always) in the bad state, resulting in a fluctuating-wage equilibrium. Otherwise, the wage is constant after the apprenticeship. Now, the natural question is under which conditions the employer's bad-state incentive constraint will bind. We address this next.

2.4 Conditions for wage smoothing.

In the case of a wage-smoothing agreement, the wage paid can be computed by substituting (38) into (34) with equality, and then substituting both into (31) with equality. This determines the equilibrium wage as the unique solution to:

$$\mu(\frac{\omega^*}{P}) = \mu(\frac{\omega^y}{P}) + \frac{k}{\beta\rho}. \tag{39}$$

We will henceforth call this the 'efficiency wage,' and denote it by ω^*.

Here, we show that for given parameters if it is sufficiently difficult for an employer to find a new worker or if Y-sector output is sufficiently cheap, the equilibrium involves wage smoothing. Otherwise, it involves a fluctuating wage.

First, note that the wage-smoothing agreement is preferred by the employer whenever it is feasible. Therefore, if we assume a wage-smoothing equilibrium and then compute the values V^{ES} and $\Omega(\widetilde{W}^*)$ that it implies, then applying those to the bad-state employer's incentive constraint gives a necessary and sufficient condition for wage-smoothing to occur.

We can now find V^{ES} as follows:

$$V^{ES} = Q^E \beta\rho[\Omega(\widetilde{W}^*) + \omega^* - \omega^y] + Q^E\beta(1-\rho)V^{ES} + [1-Q^E]\beta V^{ES} \qquad (40)$$

Note in addition that:

$$\Omega(\widetilde{W}^*) = \frac{\overline{x} - \omega^* + \beta(1-\rho)V^{ES}}{1-\beta\rho}. \qquad (41)$$

If we substitute (41) into (40) and rearrange, we get:

$$V^{ES} = \left[\frac{Q^E\beta\rho}{(1-\beta)[1-\beta\rho(1-Q^E)]}\right](\overline{x} - \beta\rho\omega^* - (1-\beta\rho)\omega^y) \qquad (42)$$

It is easy to verify that this is increasing in Q^E and decreasing in $\omega^y = p^y$.

Now, the employer's incentive constraint in the bad state is:

$$x_B - \omega^* + \beta\rho\Omega(\widetilde{W}^*) - (1-\beta(1-\rho))V^{ES} \geq 0$$

Substituting in (41), this becomes:

$$\begin{aligned} x_B - \omega^* + \beta\rho\left(\overline{x} - x_B\right) &\geq (1-\beta)V^{ES}, \text{ or} \\ x_B - \omega^* + \beta\rho\pi_G\left(x_G - x_B\right) &\geq (1-\beta)V^{ES}. \qquad (43) \end{aligned}$$

This condition allows us to identify the conditions under which wage smoothing will occur:

Proposition 3. For given p^y, there is a value $Q^{E\,\prime}(p^y) \in [0,1]$, such that if $Q^E < Q^{E\,\prime}(p^y)$ a wage-smoothing equilibrium can be sustained, while if $Q^E > Q^{E\,\prime}(p^y)$ it cannot. Further, $Q^{E\,\prime}(p^y)$ is decreasing in p^y.

Proof. The value $Q^{E\,\prime}(p^y)$ can be defined for any p^y as the solution to

$$x_B - \omega^* + \beta\rho\pi_G\,(x_G - x_B) = (1-\beta)V^{ES}.$$

Taking total derivatives with respect to $Q^{E\,\prime}$ and p^y gives the result. **Q.E.D.**

The function $Q^{E\,\prime}(p^y)$ is shown by the VV curve in Figure 1. Values of Q^E and p^y above or to the right of this curve are points imply that equilibrium X-sector wages must be volatile.

At this point it may be useful to review how the pieces fit together. *Workers in the X sector are promised higher future wages in order to motivate current effort. Thus, in a wage-smoothing equilibrium, the worker is paid the opportunity wage ω^y during the 'apprenticeship' of the first period, and then the higher efficiency wage ω^* thereafter. For this reason, an incumbent worker is always cheaper than a new one, although they have the same productivity. Employers in the X-sector thus are always to some degree tempted to shirk on their commitment to their incumbent workers and search instead for a new one; this temptation is strongest in bad states when the* *worker's productivity is low. If this temptation is strong enough, the wage-smoothing equilibrium is untenable, because workers will know that X-sector employers will not honor their promises. This happens when it is easy to find a new worker, or when Q^E is high. That is why points to the right of the VV curve imply equilibrium with wage volatility.*

We turn to those fluctuating-wage equilibria next.

2.5 Fluctuating-wage equilibria.

In a fluctuating-wage equilibrium, the two state-dependant wages are determined by the worker's binding incentive-compatibility constraint and the employer's binding bad-state incentive constraint. This first of these conditions can be simplified by substituting (38) into (34) with equality, and then substituting both into (31) with equality to obtain:

$$E_\epsilon \mu(\frac{\omega}{P}) = \mu(\frac{\omega^y}{P}) + \frac{k}{\beta\rho} \tag{44}$$

In other words, (44) states that the expected utility promised to an X-sector worker in any period after the first must be enough to compensate that worker next period, in expected value, for the current disutility of effort. Equation (44) is represented in Figure 2 by the downward-sloping curve WW. The figure measures the bad-state wage ω_B on the vertical axis and the good-state wage ω_G on the horizontal axis. This curve is strictly convex due to the worker's risk aversion.

The second of these conditions can be derived from the employer's binding bad-state incentive constraint:

$$x_B - \omega + \beta\rho\Omega(\widetilde{W}^*) - (1 - \beta(1 - \rho))V^{ES} = 0 \tag{45}$$

Developing expressions for V^{ES} and $\Omega(\widetilde{W}^*)$ analogous to (42) and (41) and substituting them into (45) yields the equation:

$$\omega_B = \frac{-\beta\rho\pi_G\omega_G + Q^E\beta\rho\omega^y + x_B + (1 - Q^E)\beta\rho\pi_G(x_G - x_B)}{1 - \beta\rho(\pi_G - Q^E)}, \tag{46}$$

which is depicted in Figure 2 as the straight downward-sloping line EE.

The intersection of WW with the 45°-line is the efficiency wage, ω^*, and any movement along the curve toward that point represents an increase in the employer's profits, because it implies a lower expected wage. The downward-sloping line EE is the employer's incentive-compatibility constraint in the bad state. Any equilibrium pair of wages must lie on or above WW and on or below EE. The employer will choose the wage combination that minimizes expected wages, subject to the two constraints, and this amounts to choosing ω^* if it is on or below EE, and choosing the intersection of EE and WW closest to the 45°-line otherwise.

We are focusing here on the fluctuating-wage case, so by assumption, the constant-wage outcome is not sustainable. Therefore, we know that the intersection of EE with the 45°-line occurs below the intersection of WW with the 45°-line. Further, since we have shown that in equilibrium the good-state wage is never below the bad-state wage, the two curves must intersect below the 45°-line. Given the concavity of WW and the linearity of EE, there will clearly be two such intersections, but the one that will be chosen by the firm is the one closest to the 45°-line, as shown, because it will offer the lowest expected wage consistent with the constraints. This means that at the point of intersection that determines ω_B and ω_G, EE is flatter than WW. As a result, it is clear that anything that shifts the EE line down without shifting WW will raise ω_G and lower ω_B. In addition, it is useful to note that, since the WW curve is a worker indifference curve, anything that shifts down the WW line, whether or not it shifts the EE line, lowers worker welfare.

It can easily be verified by differentiating (46) that a rise in Q^E will shift the EE down. Therefore, we have the following:

Proposition 4. If the equilibrium has fluctuating wages, an increase in Q^E holding $\omega^y = p^y$ constant will raise ω_G and lower ω_B, in the process raising average X-sector wages, but having no effect on worker welfare.

A rise in Q^E increases the volatility of X-sector wages, by making it easier to find a replacement worker and thus sharpening the temptation to renege on promises to an incumbent worker in a bad profitability state. Thus, an improvement in the ease with which an employer can find a new worker has a negative indirect effect on profits in the form of higher expected wages, in addition to the positive direct effect.

At the same time, a rise in p^y will shift both curves upward. The WW curve shifts up because the worker's opportunity cost has risen. The EE curve shifts up because for given ω_G and ω_B the rise in the workers' opportunity cost lowers the degree to which new workers are cheaper than incumbents (recall that a new worker is paid her opportunity wage ω^y in the first period of employment). The net effect on wages can be signed as follows.

Proposition 5. If the equilibrium has fluctuating wages, an increase in p^y will raise ω_G and lower ω_B, in the process raising average X-sector wages and X-sector worker utility.

Proof. See Appendix.

A rise in p^y increases the volatility of X-sector wages, by increasing the opportunity cost of X-sector workers, which lowers the joint surplus available to a worker and employer in the X sector and also lowers the share of the surplus that can be captured by the employer. This sharpens the employer's incentive-compatibility constraints. Note the striking force of the sharpened incentive constraint: Even though the worker's opportunity wage *increases*, the wage paid by an X employer in the bad state *falls.* This is because the temptation to cheat is strongest in the bad state, and that temptation is increased by the rise in the worker's opportunity cost.

These results can be summarized in Figure 1 by observing that any movement up and to the right from a point above the locus VV must result in an increase in wage volatility. Further, any movement upward will raise the welfare of workers in both sectors, while any horizontal movement will leave worker welfare unchanged.

Note that if Q^E and p^y are close to the VV curve in Figure 1, ω_G^* is close to ω_B^*, so $x_G - \omega_G^* > x_B - \omega_B^*$. Further, from Proposition 4, as we increase Q^E holding p^y constant, ω_G^* rises and ω_B^* falls, so that either we reach the limit $Q^E = 1$ with the inequality $x_G - \omega_G^* > x_B - \omega_B^*$ still true, or there exists a value $Q^{E\prime}(p^y)$ such that $x_G - \omega_G^* = x_B - \omega_B^*$ at that value of Q^E and $x_G - \omega_G^* < x_B - \omega_B^*$ for higher values. The function $Q^{E\prime}(p^y)$ is represented in Figure 1 by the curve BB. Clearly, the employer's incentive-compatibility constraint will bind in both states if and only if the Q^E and p^y combination lies on the curve BB. Further, by Propositions 4 and 5, BB must be downward-sloping.

We can now use the process of elimination to characterize equilibrium at each point in Figure 1. By Proposition 3, any points below VV imply wage smoothing. Any point between VV and BB implies wage volatility, with the employer's constraint binding in the bad state but not in the good state. Any point on BB implies wage volatility with the employer's constraint binding in both states. Any point to the right of BB implies that equilibrium with X-sector production requires the employer's constraint bind in the good state but not the bad state, which by Proposition 4 is impossible. Therefore, no X production is possible for points to the right of BB.

Of course, in general equilibrium Q^E and p^y are both endogenous. We turn to this in the next section, which allows us to analyze the full equilibrium and how it changes with globalization.

2.6 General equilibrium, and the Effects of Globalization.

Suppose that we now have two countries. Call the first the 'US' and the second 'India.' The US has E employers and L workers, while India has E^* employers and L^* workers. Assume that

$$\frac{E}{L} > \frac{E^*}{L^*},$$

so that workers are relatively abundant in India.

There are three possible states to concern us: Autarky, in which there is no integration of goods or factor markets; Free trade, in which goods markets but not factor markets are integrated; and full integration. We will call the movement from the second to the third of these states 'outsourcing,' since it simply means that now employers in one country are free to hire workers from another. Thus, globalization conceptually has two distinct components, and we will see that the effects of trade per se on wage volatility are very different from the effects of outsourcing.

First, we will consider the steady state under autarky, which here means simply that American employers can match only with American workers; Indian employers can match only with Indian workers; and in each country, the quantities of each good produced must be equal to the quantities consumed.

We need to derive the equilibrium value of Q^E. Recall that the total number of employers searching for a worker in any one period is denoted m, the total number of workers searching for a new employer is denoted n, and in any period $\Phi(n, m; \phi)$ matches occur. Therefore, the fraction of searching employers who find workers is $Q^E = \Phi(n, m; \phi)/m = \Phi(\frac{n}{m}, 1; \phi)$, hence an increasing function of $\frac{n}{m}$. The steady-state level of searching employers therefore must satisfy the following equation:

$$m = m\left[1 - \Phi(\frac{n}{m}, 1; \phi)\right] + (1-\rho)(E-m) + (1-\rho)m\Phi(\frac{n}{m}, 1; \phi).$$

The first term on the right-hand side represents vacancies for which no worker was found; the second represents firms currently with workers who are exogenously separated from them; and the last term represents firms that find a worker to fill a vacancy but are immediately exogenously separated from her.

This can be simplified to:

$$m = E - \frac{\rho}{1-\rho}\Phi(\frac{n}{m}, 1; \phi). \tag{47}$$

Similarly,

$$n = L - \frac{\rho}{1-\rho}\Phi(\frac{n}{m}, 1; \phi). \tag{48}$$

This can be used to show the following.

Proposition 6. For any value of E/L, the steady-state value of n/m and hence Q^E is uniquely determined. We can thus write $Q^E(E/L)$. Further, $Q^E(E/L)$ is strictly decreasing.

Proof. See Appendix.

Thus, holding other parameters constant, when workers are more scarce, it is more difficult for an employer to find one to match with.

Next, we need to determine p^y. For this, given the identical and homothetic demands held by consumers in both countries, it will be sufficient to determine relative supplies of the two goods:

Proposition 7. Under autarky, the steady-state supply of X output is an increasing and linear homogeneous function of E and L, while the steady-state supply of Y output is decreasing in E, increasing in L, and linear homogeneous in E and L. Therefore, the relative supply of Y-sector output, r, is a decreasing function of E/L, and the relative price p^y of Y-sector output is an increasing function of E/L.

Proof. See Appendix.

Propositions 6 and 7 can be illustrated with the help of Figure 3, which is the same as Figure 1 except for the addition of the downward-sloping curve MM. This curve gives the combinations of Q^E and p^y obtained in an autarkic economy by varying E/L over the positive real line.[30] The MM curve is, then, the locus of market-clearing values that complete the general equilibrium in the autarkic case. The fact that Q^E is decreasing in E/L while p^y is increasing guarantees that MM must indeed be downward-sloping. In other words, from the top left-hand of the MM curve to

[30] More precisely, for a given value of E/L for an autarkic economy, we can find the steady-state value of Q^E (as in Proposition 6) and the steady-state value of the ratio of Y to X supplied, hence the equilibrium relative price p^y (as in Proposition 7). Tracing out the Q^E and p^y values so generated produces the MM curve as we vary E/L.

the bottom right-hand end, we move from labor-scarce economies (with high E/L), where the labor-intensive good is expensive and it is difficult to find a worker, to labor-abundant ones.[31,32]

Note that as goods X and Y become very close substitutes, MM becomes arbitrarily flat, while as they approach the case of perfect complementarity it becomes arbitrarily steep.[33] Therefore, the MM curve could be either flatter or steeper than the VV curve. It has been drawn flatter in this case for concreteness.

Now, we have all of the tools required to analyze the effects of globalization. First, we consider the effects of free trade, and then the effects of outsourcing.

2.6.1 Free Trade.

Free trade establishes a unified world market for goods X and Y, without allowing for movements of labor across borders. Given Proposition 7, if autarkic supplies of the

[31] We can now clarify the parameter assumptions implicit in assuming that it is always optimal to elicit effort. Clearly if, under the assumption that eliciting effort is always optimal, the employer's incentive compatibility constraint never binds, then eliciting effort is indeed always optimal. Thus, in Figure 3, it is always optimal to elicit effort for any point to the left of VV and for some positive range to the right of VV. This implies that there is a point on MM strictly to the right of VV such that for any point on MM to the left of that point always eliciting effort is optimal. Put differently, provided that E^*/L^* is sufficiently high, always eliciting effort is optimal, as assumed throughout the paper.

[32] We can now also clarify the conditions under which Assumption 1 will hold. It is easy to verify that the wage-smoothing condition (43) is a sufficient condition for Assumption 1, since the higher worker target utility in the second and later periods of the relationship, compared with the first period, make it more likely that the employer's incentive constraints will bind. Therefore, for the whole length of the MM curve to the left of VV and for at least a segment of positive length to the right of VV, Assumption 1 will be satisfied. Putting this together with the previous footnote indicates that there is a segment of MM including its intersection with VV plus some distance on both sides in which Assumption 1 and the assumption that it is always optimal to elicit effort are both satisfied. We focus our attention on that segment.

[33] If the elasticity of substitution implied by the utility function U between X and Y is high, then a given rise in E/L and consequent drop in r will require only a small change in the relative price p^y to restore market clearing. Conversely, a low elasticity of substitution will require a large movement in relative price.

two goods in the two countries are denoted X^i and Y^i respectively for country i, then the relative supply of Y will be equal to $r^{US} \equiv Y^{US}/X^{US}$ for the US under autarky; $r^{IN} \equiv Y^{IN}/X^{IN} > r^{US}$ for India under autarky; and $r^{FT} \equiv (Y^{US} + Y^{IN})/(X^{US} + X^{IN}) > r^{US}$ under free trade (note that free trade does not change the quantities produced in either country). As a result, the free-trade value of p^y will be lower than the autarkic US value. This will lower the real wage $\omega^y/P(p^y) = p^y/P(p^y)$ for US workers in the Y sector, and since US workers are indifferent between working in the two sectors, this also means that the steady-state welfare of US X-sector workers will fall. At the same time, by Proposition 5, we know that the variance of wages will fall. To sum up, we have the following:

Proposition 8. Free trade lowers the steady-state welfare of all US workers and raises the welfare of all workers in India. It also (weakly) lowers the variance of US wages and raises the variance of wages in India.

This change is represented by the move from point A to point B in Figure 3. (Note that the only reason for the qualifier 'weakly' in the proposition is the possibility that one or both countries is in the wage smoothing regime both with and without trade.)

2.6.2 Outsourcing.

Now, suppose that in addition to free trade we allow outsourcing to occur. In that case we have arrived at full integration; the two economies will combine to form one large one with $E + E^*$ employers and $L + L^*$ workers.

Since full integration essentially creates an autarkic economy with $E+E^*$ employers and $L + L^*$ workers, comparing full integration with autarky is straightforward. The ratio $(E + E^*)/(L + L^*)$ necessarily falls between E/L and E^*/L^*, so, again by Proposition 7, the free-trade value of p^y will be lower than the autarkic US value and above the autarkic Indian value. Thus, it is immediate that full integration has qualitatively the same effect on worker welfare in both countries, compared to autarky, as does free trade. However, what is not straightforward is the marginal effect of outsourcing on worker welfare, in other words, the difference in worker welfare between full integration and free trade. It can be shown that this effect is positive, for workers in both countries.

Proposition 9. The world relative supply of good Y, r, is lower under full integration than under free trade. Therefore, the relative price, p^y, is higher, and the welfare of workers in both countries is higher, under full integration than under free trade.

Proof. See Appendix.

This change is represented by the move from point B to point C in Figure 3. The point is that outsourcing allows for efficiencies in the matching of X-sector employers in the labor-scarce US market with workers in the worker-rich Indian market, thus allowing for the world X industry to increase its employment and output. More workers worldwide producing X also means fewer workers worldwide producing Y, so the world relative supply of Y falls, making Y relatively more expensive. This benefits workers producing Y, raising the opportunity cost of X-sector workers, and raising workers' equilibrium utility.

Further, from Proposition 6 it is clear that Q^E rises in the US. From Propositions 6 and 7, the rise in p^y and in Q^E together imply an increase in the volatility of US X-sector wages. Thus, outsourcing does indeed increase the variance of US workers' earnings, even though we have just seen from the previous proposition that their welfare also rises. This implies that in response to outsourcing *expected X-sector wages go up by more than enough to compensate for the additional risk.*

Finally, a comment on the overall effects of globalization, the movement from point A to C in Figure 3. Note that the effects of free trade and outsourcing on wage volatility run in opposite directions, and the net effect of globalization on wage volatility is therefore ambiguous. That it is truly ambiguous can be seen from the figure. If the elasticity of substitution between X and Y consumption is very high, the MM curve will be flatter than the VV curve as shown, while if the elasticity is very low, it will be steeper. In the former case, it is possible that globalization takes us from a point on MM in the wage-smoothing regime (in other words, to the left of VV), to a point on MM in the fluctuating-wage regime. In the latter case, the opposite is possible. More generally, the elasticity of substitution will govern whether price effects or Q^E effects will dominate. This provides our final result.

Proposition 10. If the elasticity of substitution between X and Y consumption is sufficiently small, globalization on balance lowers the volatility of US wages. If it is sufficiently large, it raises the volatility of US wages.

2.7 Conclusion.

We have incorporated imperfect risk-sharing through long-run employment relationships in an incomplete contracting world into an international general equilibrium model which can incorporate both trade and outsourcing as forms of globalization. We find that, as some critics of globalization have argued, globalization can indeed weaken long-run employment relationships in a way that adds to the volatility (or insecurity, or riskiness) in incomes of rich-country workers.

However, having done so, we also find that the argument is sharply qualified by a full accounting of general equilibrium effects. In particular, in our model:

(i) In contrast to international outsourcing *per se*, free trade does *not* add to the volatility of rich-country wages; rather it reduces such volatility.

(ii) International outsourcing does unambiguously raise the variance of rich-country wages, but it also raises averages real wages by more than enough to compensate for the added risk. This is because of general-equilibrium effects: Outsourcing creates efficiencies that increase the productivity of the outsourcing sector, lowering the price of its output and benefitting consumers worldwide.

Thus, we simultaneously formalize and sharply limit one argument on the dangers of globalization.

Appendix

Proof of Proposition 2.

Consider the second-period problem. Under conditions of Proposition 1, we know that the target continuation payoff for the worker is $\widetilde{W}^*$. We claim that the choice of next-period continuation payoff $\widetilde{W}_\epsilon$ will be equal to $\widetilde{W}^*$ for $\epsilon = G, B$. If $\nu_\epsilon > 0$, then complementary slackness implies that $\widetilde{W}_\epsilon = \widetilde{W}^*$. Therefore, suppose that $\nu_\epsilon = 0$. This implies that (37) becomes:

$$\Omega'\left(\widetilde{W}_\epsilon\right) \geq (-\lambda)\left(\frac{\pi_\epsilon}{\pi_\epsilon + \psi_\epsilon}\right).$$

Since, by the envelope theorem, $-\lambda = \Omega'(W_0)$, and as we recall $W_0 = \widetilde{W}^*$, this becomes:

$$\Omega'\left(\widetilde{W}_\epsilon\right) \geq \Omega'(W_0)\left(\frac{\pi_\epsilon}{\pi_\epsilon + \psi_\epsilon}\right). \tag{49}$$

If $\psi_\epsilon = 0$, this implies through the strict concavity of Ω that $\widetilde{W}_\epsilon = \widetilde{W}^*$, and we are done. On the other hand, if $\psi_\epsilon > 0$, (49) then implies that $0 > \Omega'\left(\widetilde{W}_\epsilon\right) > \Omega'\left(\widetilde{W}^*\right)$, implying that $\widetilde{W}_\epsilon < \widetilde{W}^*$. However, this violates (34). Therefore, all possibilities either imply that $\widetilde{W}_\epsilon = \widetilde{W}^*$ or lead to a contradiction, and the claim is proven.

Since $\widetilde{W}_\epsilon = \widetilde{W}^*$, the optimization problem in the third period of the relationship is identical to that of the second period. By induction, the target utility for the worker in every period after the first, regardless of history, is equal to $\widetilde{W}^*$, and so the wage chosen for each state in every period after the first, regardless of history, is the same.

Now, to establish the three possible outcomes, we consider each possible case in turn. Consider the optimization problem (28) at any date after the first period of relationship. First, suppose that the employer's constraint does not bind in either state. In this case, $\psi_\epsilon = 0$ for $\epsilon = G, B$. Condition (36) now becomes:

$$-\pi_\epsilon + \frac{\lambda \pi_\epsilon \mu' \left(\frac{\omega_\epsilon}{P}\right)}{P} \leq 0 \tag{50}$$

If this holds with strict inequality for some ϵ, then $\omega_\epsilon = 0$. This clearly cannot be true for both values of ϵ, because that would imply a permanent zero wage, and it would not be possible to satisfy (31). (To see this, formally, substitute $W_0 = \widetilde{W}^*$, the expression for V^{WS}, and $\omega_G = \omega_B = 0$ into (30), and note that the constraint is violated.) Therefore, for at most one state, say ϵ', can the inequality in (50) be strict. Denote by ϵ'' the state with equality in (50). Then $\mu'(0) < \frac{1}{\lambda} = \mu'(\omega_{\epsilon''})$. However, given that $\omega_{\epsilon''}$ is non-negative and μ is strictly concave, this is impossible. We conclude that (50) must hold with equality in both states, and therefore $\omega_G = \omega_B$.

Next, suppose that we have $\psi_G > 0$ and $\psi_B = 0$, so that the employer's constraint binds only in the good state. We will show that this leads to a contradiction. Recall from the previous proposition that $\widetilde{W}_\epsilon = \widetilde{W}^*$ for both states, and note that, by assumption, (29) is satisfied by equality for $\epsilon = G$. Since $x_B < x_G$, we now see that (29) must be violated for $\epsilon = B$ if $\omega_G \leq \omega_B$. Therefore, $\omega_G > \omega_B \geq 0$. This implies that (36) holds with equality in the good state. Applying (36), then, we have:

$$\frac{\mu'\left(\frac{\omega_G}{P}\right)}{P} = \frac{1}{\lambda}\left(1 + \frac{\psi_G}{\pi_G}\right) > \frac{1}{\lambda} \geq \frac{\mu'\left(\frac{\omega_B}{P}\right)}{P},$$

which contradicts the requirement that $\omega_G > \omega_B$. This shows that it is not possible for the employer's constraint to bind in the good state.

Now suppose that we have $\psi_G = 0$ and $\psi_B > 0$, so that the employer's constraint binds only in the bad state. Suppose that $\omega_G \leq \omega_B$. This implies that $\omega_B > 0$, so that (36) holds with equality in the good state. Then, from (36):

$$\frac{\mu'\left(\frac{\omega_B}{P}\right)}{P} = \frac{1}{\lambda}\left(1 + \frac{\psi_B}{\pi_B}\right) > \frac{1}{\lambda} \geq \frac{\mu'\left(\frac{\omega_G}{P}\right)}{P},$$

which implies that $\omega_G > \omega_B$. Therefore, we have a contradiction, and we conclude that $\omega_G > \omega_B$.

Finally, suppose that the employer's constraint binds in both states. Given that $\widetilde{W}_\epsilon = \widetilde{W}^*$ in both states, equality in both states for (29) requires that short-term profits $x_\epsilon - \omega_\epsilon^*$ are equal in the two states.

We have thus eliminated all possibilities aside from the two listed in the statement of the proposition. **Q.E.D.**

Proof of Proposition 5.

Recall that the WW curve is given by:

$$\pi_G \mu \left(\frac{\omega_G}{P\left(p^y\right)} \right) + \pi_B \mu \left(\frac{\omega_B}{P\left(p^y\right)} \right) = \mu \left(\frac{\omega^y}{P\left(p^y\right)} \right) + \frac{k}{\beta \rho}$$

If we take a total derivative of this condition, taking into account that $\omega^y = p^y$, we obtain:

$$\left\{ \begin{array}{c} \left(\frac{\pi_G}{P}\right) \mu' \left(\frac{\omega_G}{P}\right) d\omega_G + \left(\frac{\pi_B}{P}\right) \mu' \left(\frac{\omega_B}{P}\right) d\omega_B \\ -\left(\frac{\pi_G \omega_G P'}{P^2}\right) \mu' \left(\frac{\omega_G}{P}\right) dp^y - \left(\frac{\pi_B \omega_B P'}{P^2}\right) \mu' \left(\frac{\omega_B}{P}\right) dp^y \end{array} \right\} = \left(\frac{P - p^y P'}{P^2} \right) \mu' \left(\frac{p^y}{P} \right) dp^y \tag{51}$$

This can be rearranged as:

$$\begin{array}{c} \pi_G \mu' \left(\frac{\omega_G}{P}\right) \frac{d\omega_G}{dp^y} + \pi_B \mu' \left(\frac{\omega_B}{P}\right) \frac{d\omega_B}{dp^y} \\ = \left(\frac{\pi_G \omega_G P'}{P}\right) \mu' \left(\frac{\omega_G}{P}\right) + \left(\frac{\pi_B \omega_B P'}{P}\right) \mu' \left(\frac{\omega_B}{P}\right) + \left(\frac{P - p^y P'}{P}\right) \mu' \left(\frac{p^y}{P}\right) \end{array}$$

Recalling that $P(p^y)$ is the minimum expenditure required to obtain one unit of utility, given that the price of Y is p^y, Shephard's Lemma implies that $\frac{p^y P'}{P} = \alpha^y$, where α^y is the share of good Y in consumer expenditure. This allows us to rewrite the total derivative as:

$$\pi_G \mu' \left(\frac{\omega_G}{P} \right) \frac{d\omega_G}{dp^y} + \pi_B \mu' \left(\frac{\omega_B}{P} \right) \frac{d\omega_B}{dp^y} = \left(\frac{\alpha^y}{p^y} \right) E_\epsilon \omega_\epsilon \mu' \left(\frac{\omega_\epsilon}{P} \right) + \left(1 - \alpha^y\right) \mu' \left(\frac{p^y}{P} \right)$$

The EE curve is given by:

$$\beta\rho\pi_G\omega_G + [1 - \beta\rho(\pi_G - Q^E)]\omega_B = Q^E\beta\rho\omega^y + x_B + (1 - Q^E)\beta\rho\pi_G(x_G - x_B)$$

If we take the total derivative of this condition, again taking into account that $\omega^y = p^y$, we obtain:

$$\beta\rho\pi_G\frac{d\omega_G}{dp^y} + [1 - \beta\rho(\pi_G - Q^E)]\frac{d\omega_B}{dp^y} = Q^E\beta\rho \tag{52}$$

Equations (51) and (52) are then a system of two linear equations in two unknowns, $\frac{d\omega_G}{dp^y}$ and $\frac{d\omega_B}{dp^y}$. Solving, we obtain:

$$\frac{d\omega_B}{dp^y} = -\frac{\beta\rho\pi_G\left\{\left(\frac{\alpha^y}{p^y}\right)\left[\pi_G\omega_G\mu'\left(\frac{\omega_G}{P}\right) + \pi_B\omega_B\mu'\left(\frac{\omega_B}{P}\right)\right] + (1-\alpha^y)\,\mu'\left(\frac{p^y}{P}\right) - Q^E\mu'\left(\frac{\omega_G}{P}\right)\right\}}{D},$$

where

$$D \equiv \pi_G\left[\left[1 - \beta\rho(\pi_G - Q^E)\right]\mu'\left(\frac{\omega_G}{P}\right) - \beta\rho\pi_B\mu'\left(\frac{\omega_B}{P}\right)\right]$$

is the determinant of the system, and is positive because at the equilibrium the WW curve is steeper than the EE curve. Note that

$$\frac{\pi_G\omega_G\mu'\left(\frac{\omega_G}{P}\right) + \pi_B\omega_B\mu'\left(\frac{\omega_B}{P}\right)}{\omega^y} > \frac{\pi_G\omega_G\mu'\left(\frac{\omega_G}{P}\right) + \pi_B\omega_B\mu'\left(\frac{\omega_B}{P}\right)}{\pi_G\omega_G + \pi_B\omega_B} > \mu'\left(\frac{\omega_G}{P}\right)$$

The first inequality holds because the condition defining the WW curve implies that $\omega^y < \pi_G\omega_G + \pi_B\omega_B$, and the second holds because the middle expression is a weighted average of $\mu'\left(\frac{\omega_G}{P}\right)$ and $\mu'\left(\frac{\omega_B}{P}\right)$, of which the former is smaller. This implies that

$$\left(\frac{\alpha^y}{p^y}\right)\left[\pi_G\omega_G\mu'\left(\frac{\omega_G}{P}\right)+\pi_B\omega_B\mu'\left(\frac{\omega_B}{P}\right)\right]+\left(1-\alpha^y\right)\mu'\left(\frac{p^y}{P}\right)>\mu'\left(\frac{\omega_G}{P}\right)>Q^E\mu'\left(\frac{\omega_G}{P}\right)$$

so $\frac{d\omega_B}{dp^y}<0$.

Since $\frac{d\omega_B}{dp^y}<0$, (51) requires that $\frac{d\omega_G}{dp^y}>0$, and therefore $\frac{d(\omega_G-\omega_B)}{dp^y}>0$.

Q.E.D.

Proof of Proposition 6.

The number of employers paired with a worker is equal to $E-m$, and the number of workers paired with an employer is equal to $L-n$. These must always be equal, so:

$$E-L=m-n.$$

Suppose that $E>L$. Dividing both sides by L and using (48), we find:

$$\frac{E}{L}=\frac{m-n}{\left(\frac{\rho}{1-\rho}\right)\Phi\left(n,m;\phi\right)+n}+1,\ \text{so:}$$

$$\frac{E}{L}=\frac{1-\frac{n}{m}}{\left(\frac{\rho}{1-\rho}\right)\Phi\left(\frac{n}{m},1;\phi\right)+\frac{n}{m}}+1. \tag{53}$$

The right-hand side of (53) exceeds unity iff $\frac{n}{m}<1$. Clearly, the right-hand side of (53) needs to be greater than unity, so $\frac{n}{m}$ must be less than unity. Therefore, at an equilibrium, the right-hand side of (53) is strictly decreasing in $\frac{n}{m}$, so the equilibrium level of $\frac{n}{m}$ is uniquely determined for a given value of $\frac{E}{L}$, ρ, and Q^E. Furthermore, $\frac{n}{m}$ is a locally decreasing function of $\frac{E}{L}$ for given values of the other parameters.

Now, if $E < L$, a parallel argument can be developed by dividing through by n instead of m and later by E instead of L. **Q.E.D.**

Proof of Proposition 7.

The number of employers producing output in this period is given by:

$$E - m_{t+1} = \rho[E - m_t + \Phi(n_t, m_t; \phi)] \tag{54}$$

The number of employers producing output is equal to $E - m_t = L - n_t$. Since the average output of a functioning firm is equal to $\overline{x}$, this must also equal $\frac{x_t}{\overline{x}}$. Therefore, we can rewrite (54) as follows:

$$\frac{x_{t+1}}{\overline{x}} = \rho\left[\left(\frac{x_t}{\overline{x}}\right) + \Phi(n_t, m_t; \phi)\right] \tag{55}$$

In steady state, (55) becomes:

$$\frac{x_{ss}}{\overline{x}} = \frac{\Phi(n_t, m_t; \phi)}{1-\rho} = \frac{\Phi\left(E - \frac{x_{ss}}{\overline{x}}, L - \frac{x_{ss}}{\overline{x}}; \phi\right)}{1-\rho}$$

Then, we have:

$$\Phi\left(\frac{E\overline{x}}{x_{ss}}-1,\frac{L\overline{x}}{x_{ss}}-1;\phi\right)=1-\rho \tag{56}$$

Thus, $x_{ss}(E,L)$ is increasing in E and L and linear homogenous in E, L.

$$y_t = L - \frac{x_t}{\overline{x}}, \tag{57}$$

where y_t is the output in the Y sector in period t. In steady state, this can be rewritten as follows:

$$y_{ss} = L - \frac{x_{ss}}{\overline{x}}.$$

Thus, from the properties just derived for x_{ss}, we see that $y_{ss}(E,L)$ is increasing in L and decreasing in E and linear homogenous in E, L. As a result, $r \equiv (\frac{y_{ss}}{x_{ss}})$ is decreasing in $\frac{E}{L}$. **Q.E.D.**

Proof of Proposition 9.

Recall from Proposition 7 that the steady-state values of X and Y output within one country can be written as functions $x_{ss}(E,L)$ and $y_{ss}(E,L)$ of E and L. We can thus speak of the isoquants of these functions. For example, the slope of the x_{ss} isoquant is given by $-\frac{\frac{\partial x_{ss}}{\partial E}}{\frac{\partial x_{ss}}{\partial L}}$. Taking derivatives of (56), we see that:

$$\frac{\frac{\partial x_{ss}}{\partial E}}{\frac{\partial x_{ss}}{\partial L}} = \frac{\Phi_E\left(\frac{E\overline{x}}{x_{ss}}-1,\frac{L\overline{x}}{x_{ss}}-1;\phi\right)}{\Phi_L\left(\frac{E\overline{x}}{x_{ss}}-1,\frac{L\overline{x}}{x_{ss}}-1;\phi\right)}$$

Notice that:

$$\frac{x_{ss}(E,L)}{L} = x_{ss}(\frac{E}{L},1).$$

Thus, $\frac{L\overline{x}}{x_{ss}}$ is decreasing in $\frac{E}{L}$. Similarly,

$$\frac{x_{ss}(E,L)}{E} = x_{ss}(1,\frac{L}{E}),$$

so $\frac{E\overline{x}}{x_{ss}}$ is increasing in $\frac{E}{L}$.

Therefore, the absolute value of the slope of the isoquant is smaller in a more labor-scarce economy. This is illustrated in Figure 4, which depicts a box whose height is the world supply of workers and whose length is the world supply of employers. In the figure, the US endowment of workers and employers is measured upward and rightward respectively from the lower left-hand origin, and India's endowments are similarly measured down and to the left from the upper right-hand origin. The allocation of the two factors between the two countries is given by the point a; the x_{ss} isoquant for the US going through that point is marked UU; and the x_{ss} isoquant for India going through that point is marked II. The finding that the absolute slope of the isoquant for a given country is decreasing in that country's $\frac{E}{L}$ ratio implies that these isoquants are strictly convex, and in addition, at every possible allocation point below the main diagonal $O_{US}O_{IN}$, UU is flatter than the corresponding Indian isoquant at that point.

Now under free trade *without* integration of factor markets, consider the change in Y output if we transfer workers from India to the US, at the same time reallocating employers from the US to India so that steady-state X output in the US is unchanged. This can be represented as a movement left along UU from point a. Suppose that we stop the process when the $\frac{E}{L}$ ratio in the two countries is the same (and therefore equal to the world $\frac{E}{L}$ ratio). In other words, we stop at point b. Since the US steady-state X isoquant is flatter than the Indian one at every point along this process, the movement from a to b results in an increase in X output in India, and therefore in the world. Given (57), this implies a reduction in worldwide Y output, and hence a reduction in r. Finally note that, under free trade, a reallocation of workers and employers across countries that results in the same factor ratio in each country – as for example in point b or any other point on the main diagonal – will replicate the outcome of integration of the labor markets. **Q.E.D.**

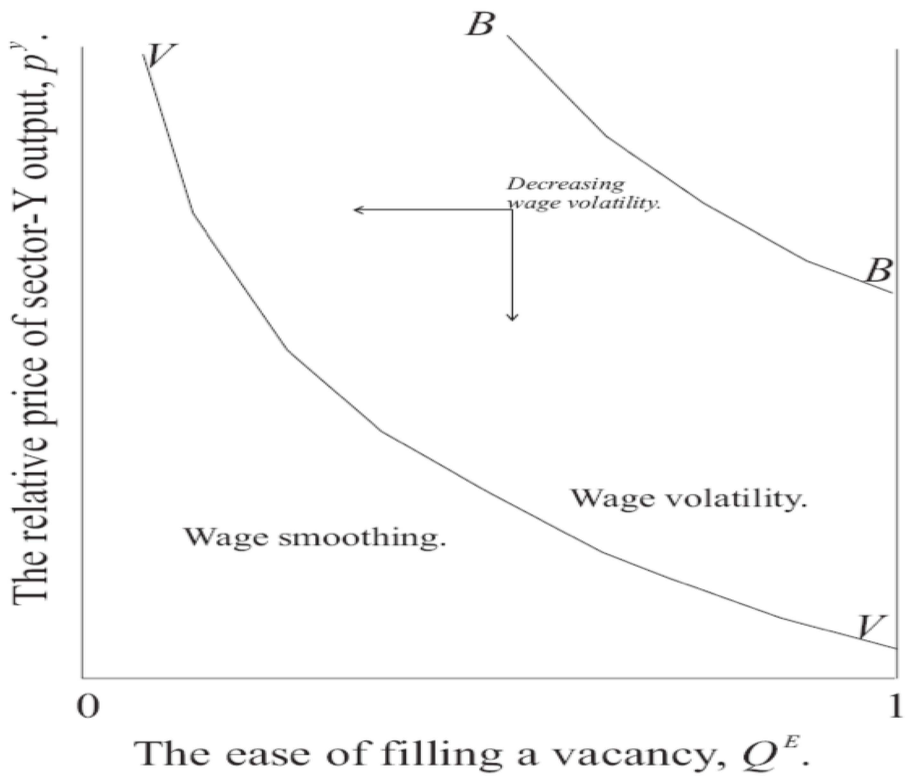

Figure 1. Type of Wage Contract and Comparative statics.

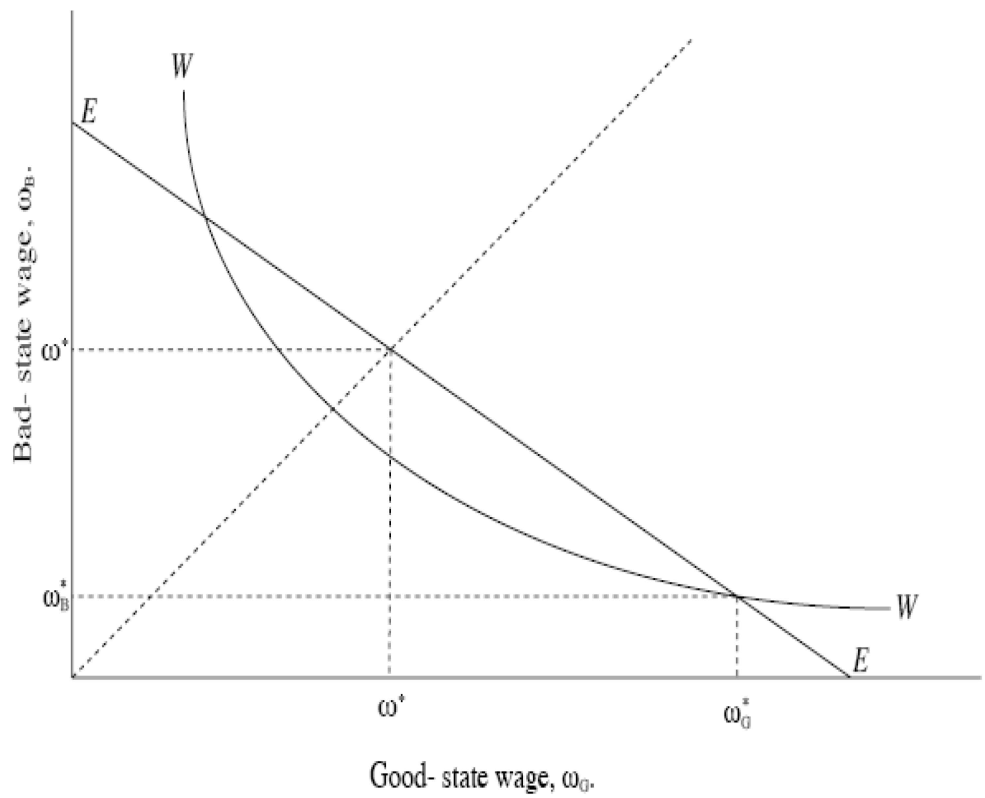

Figure 2. Fluctuating-wage equilibrium.

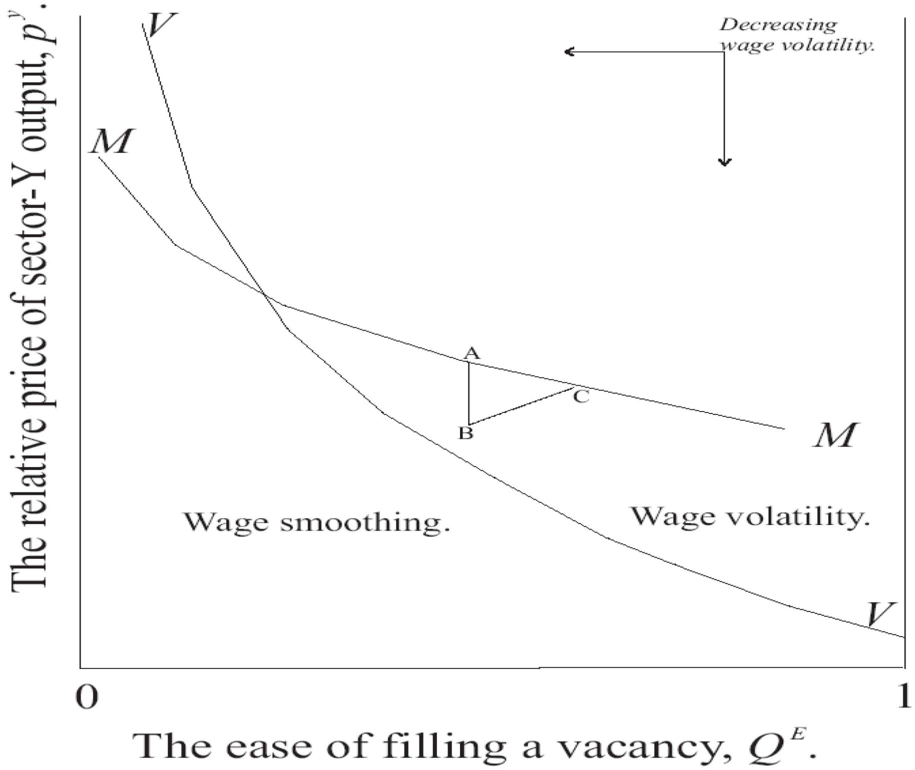

Figure 3. The effects of Globalization.

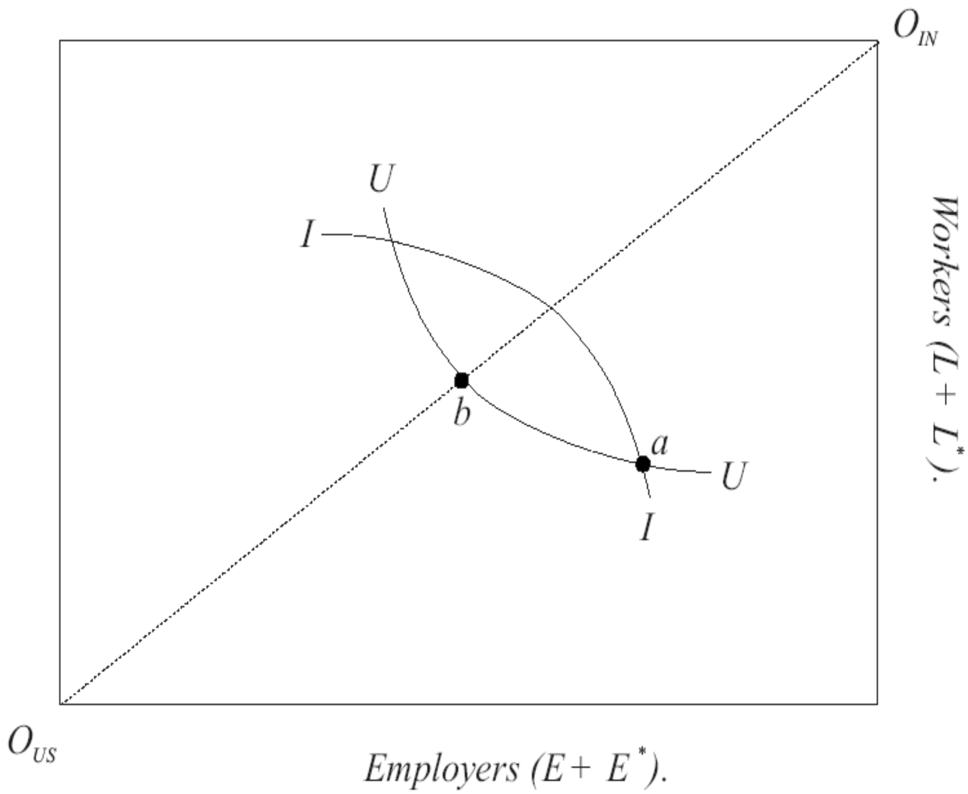

Figure 4. Effect of international outsourcing.

Chapter 3

Lobbying under Asymmetric Information

3.1 Introduction.

"I don't think it's a secret that, in Washington, the role of the lobbyist includes gaining access to the decision maker, all within a proper legal context. There are probably two dozen events and fund-raisers every night. Lobbyists go on trips with members of Congress, socialize with members of Congress – all with the purpose of increasing one's access to the decision makers. I think there are people who would prefer that there are no political contributions, people who would prefer that all members of Congress live an ascetic, monklike social life. This is the system that we have. I didn't create the system. This is the system that we have. Eventually, money wins in politics," – Jack Abramoff, a Washington lobbyist, who is under investigation by grand juries in Washington D.C. for his involvement in the Abramoff-Reed Indian Gambling Scandal.

When we look at the economics and political science literatures, as well as journalistic accounts and popular publications, we see that interest groups possess substantial political power. Some authors (e.g., Olson) are concerned about the negative impacts of interest groups. They claim that interest groups' activities are directed towards the redistribution of existing wealth rather than the creation of new wealth. In addition, they consider expenses on these activities to be socially wasteful. In contrast, others (e.g., Wilson) find interest groups' activities and resulting influence beneficial. A frequently advanced argument is that interest groups provide policy-relevant information to policymakers. Even in situations where the information-supplying groups distort this information, policymakers may still benefit from the information provided to them.

Most of the political economy literature treats the lobbying activities of interest groups either from a positive or negative perspective without incorporating the two. In this analysis, I allow for both perspectives and determine the conditions under which lobbying can be beneficial. For this purpose, my paper studies the informational theory of lobbying between a policymaker and an interest group under asymmetric information. It combines political economy with strategic trade policy. The analysis is directed towards the strategic issues involved in the behavior of interest groups and the agents they want to influence. The interest group in my model is a home firm that is trying to influence the home policymaker for subsidies via costly lobbying.[34] In order to gain access to the decision-making process, the home firm needs to incur lobbying costs. Lobbying can serve two purposes. The first is to provide policy-relevant information to the policymakers. I call this *the information*

[34] Since the interest group consists of only one firm, I avoid group-formation and collective-action problems and thus, keep the analysis well focused. This is a common assumption in the literature.

motive of lobbying. The second is to change the policymaker's decision so as to favor the interest group. I call this *the influence motive* of lobbying. In what follows, I analyze each motive.

The basic setup is taken from the Brander-Spencer (1985) model of strategic trade policy.[35] Two firms, a home and a foreign, compete in Cournot fashion to export to a third country. The home policymaker has a unilateral interest in adopting a per-unit export subsidy in order to maximize his/her welfare which is the weighted sum of the utilitarian social welfare (in this context, the home firm's profit net of the subsidy given) and the cash transfers received from the home firm.[36] However, the optimal subsidy depends on the strength of the consumer demand in the third country which is known only by the home and foreign firms. The policymaker has prior beliefs about demand conditions.[37] This information structure rests on the fact that informational asymmetries between firms and policymakers are often quite acute in trade policy. In the U.S. for example, when firms petition for antidumping or countervailing duty investigations, the investigators frequently rely on proprietary information provided by the petitioners. Even senior officials in the U.S. International Trade Commission (ITC) have expressed concerns that the information used in injury investigations is

[35] It is well known that a home policymaker can shift profit from foreign firms through the use of export subsidies under imperfect competition. See Brander and Spencer (1985).

[36] I assume that the foreign policymaker favors free trade and thus excluded from the analysis. From now on the word 'the policymaker' refers to the policymaker of the home country.

[37] This is consistent with the regulation literature in which the policymaker does not know the demand the regulated firm faces. See Lewis and Sappington (1988).

inadequate and biased.[38]

The home firm tries to influence *(lobby)* the policymaker via a costly signaling game. To do so, the firm needs to incur exogenous, fixed lobbying costs. These costs can take the form of either cash transfers from the firm to the policymaker or costs associated with activities like writing letters, making phone calls, etc. This enables the firm to reach the policymaker and convey its message. The lobby effort of the firm acts as a signal for the policymaker. Once the signal is received, the policymaker optimally determines the subsidy level by taking into account the strategic incentives of the home firm.

I show that under certain conditions lobbying activity can be beneficial both for the home firm and the policymaker. What makes the model interesting is that even when the home policymaker has no rent-seeking motive[39] he/she still has an incentive to charge the home firm for lobbying due to the informative role of the lobbying costs. At the same time, in some circumstances (e.g., facing a high demand in reality) the home firm finds the presence of lobbying costs advantageous for effectively conveying its private information to the policymaker. Yet, this is possible only for some intermediate values of the cost. For example, if the cost is too low, regardless of the level of demand the home firm faces, it can always afford this cost. In this case lobbying cannot have an information motive. On the other hand, if the cost is too

[38] See Brainard and Martimort (1997).
[39] See Tullock (1967).

high, the home firm cannot afford to pay this cost even if it faces a high demand, thus rendering communication worthless. In summary, lobbying is effective in conveying the firm's private information to the policymaker provided that the cost is neither too high nor too low.

3.2 Literature Review.

This paper complements the growing body of literature on political economy and strategic trade policy. In political economy, there are three mainstream approaches to modeling the activities of interest groups. The first approach consists of the so-called black box models. These models do not explain why interest groups are able to affect policy. Instead, they assume that interest groups exert '*pressure*' on the government through spending resources, i.e., using a black box production process of political pressure. Moreover, the government is modeled in reduced form because it is assumed to react mechanistically, i.e., in a predescribed, exogenously given way, to interest group pressure.[40] Because these models are not explicit about the activities that are involved, pressure may very well represent any interest group activity, or the aggregate influence of all instruments used by the interest group. The second approach uses common agency models, represented by the highly influential work of Grossman and Helpman (1994). In their model, they provide a microfoundation for a political welfare function and an explicit behavioral model for the link between influence weights and pressure in the interest function approach. Although models of

[40] See Becker (1983) and Becker (1985).

this kind provide a distinct behavioral model of interest group influence, they assume complete information. Also, players are supposed to stick to their choices, hence they assume commitment. The last approach uses information transmission models. The basic idea in these models is that interest groups are better informed than others about issues that are relevant to them. Hence, these models introduce incomplete information. Due to conflict of interests, strategic behavior by interest groups may be expected. Exogenous commitment is not assumed. Due to the relationship between lobbying expenditures and influence, an informational microfoundation is provided for the use and the specification of an influence function[41] as well as a political welfare function.[42] My model is different from the existing models in two respects. First, it combines the latter two approaches such that lobbying not only provides information but also influences the policy choice through contributions. Second, it is one of the few papers that study political influence in a strategic trade policy framework. Glass (2004) used a similar setup to analyze the government's problem of how to allocate export subsidies to different industries. However, my paper is different than hers in three aspects. First, I consider the lobbying costs both as exogenous (as in the benchmark model) and endogenous (as an extension). This is in contrast to her paper which treats lobbying costs as endogenous. Second, Glass considered lobbying costs as pure transfers such that they do not affect the government's welfare. In other words,

[41] See Lohmann (1995).
[42] See Potters and van Winden (1990).

lobbying has only an informative motive. On the other hand, I assign different roles to lobbying costs, so the assumptions of Glass can be enveloped as a particular case in my model. Finally, I analyze the lobbying activities of only one firm rather than many firms in different industries. In a different context, Ball(1995) studies lobbying with endogenous costs. He assumes a linear lobbying function from the outset. Again my approach is more general since I consider both exogenous and endogenous costs. In addition, I do not restrict the form of the lobbying function.

There is an extensive literature on strategic trade policy models with informational asymmetries. Collie and Hviid (1993) consider the case in which the domestic government knows the domestic firm's costs, but the foreign firm does not. The home policymaker uses an output subsidy not only to shift profit, but also to signal home firm's costs to the foreign firm. Qiu (1994) analyzes the problem where the domestic government anticipates the domestic firm's incentive to misrepresent its costs. Qiu assumes that the domestic firm is one of the two possible types: high-cost or low-cost. The domestic firm knows its own cost, but neither the domestic government nor the foreign firm can observe the firm's type, although each knows the distribution from which the type is drawn. The foreign firm's cost is common knowledge. The domestic government may set a menu of per-unit and lump-sum subsidies (or taxes), or it may adopt a uniform subsidy program that would apply to all firms. His model uses both screening and signaling techniques. Brainard and Martimort (1997) use a screening technique to examine cost-based informational asymmetries in the third market export subsidies model. They assume that the foreign firm observes the cost level of the domestic firm, but the domestic government cannot. Wright (1998) considers the case where neither the home policymaker, nor the foreign firm know the home firm's cost while the foreign firm's cost is common knowledge. He develops a two period Cournot model in which the only policy tool available is a per-unit export subsidy. The home firm signals its type to the home government through its output choice in the first period. My model is different from the existing models in this literature because, rather than deriving an optimal policy for the government, I seek to answer the question of whether lobbying is preferable and if so, under what conditions. In addition, I use a political influence approach that is absent in the strategic trade literature.

The remainder of the paper is organized as follows. In Section 3, the basic model is developed and the optimal per-unit export subsidy is characterized under complete and incomplete information in two different scenarios: when lobbying is allowed and when it is not allowed. Section 4 extends the analysis in two directions. First, the results of the main model are generalized by considering a case in which the distribution of firm type is continuous. Second, I study the implications of the model with endogenous lobbying costs under complete and incomplete information. Concluding comments are discussed in Section 5.

3.3 Model.

I use a simple model of international duopoly developed by Brander and Spencer (1985). Two symmetric firms, the home firm (Firm A) and the foreign firm (Firm B) which are respectively located in the home country (Country A) and the foreign country (Country B), produce a homogeneous output for a third market. It is assumed that both firms produce positive outputs with zero marginal costs, and compete in a Cournot fashion. For simplicity, the inverse demand function in the third country is given by $p = a - (q_A + q_B)$, where $a > 0$, p is the price of the product and q_i is the output of firm $i = A, B$. The policymaker in Country A engages in a policy intervention via a per-unit export subsidy, s. First, I consider a scenario in which there is a ban on lobbying. Then I let the home firm lobby the policymaker to affect the subsidy amount.[43] Lobbying is not free, i.e., the firm has to bear some cost in order to lobby the policymaker. In the main model, I assume that the cost of lobbying is exogenous and fixed. In addition, these costs have to be incurred before the host government determines the subsidy amount. Note that, no commitment is assumed by the host government.

Firm A's net payoff is given by

$$\pi_A [s, q_A (a, s), q_B (a, s)] = (a - (q_A + q_B) + s) q_A - \sigma c$$

[43] From now on, the word 'the firm' refers to Firm A.

where σ is a dummy variable taking on a value of 1 with lobbying and 0 without lobbying and c represents the exogenous fixed cost of lobbying.

The objective of the policymaker is to maximize his/her welfare which consists of the weighted average of the home firm's profit net of subsidy and the contributions (transfers) he/she receives from the firm.

The policymaker's net payoff is given by

$$W_A\left[s, q_A(a,s), q_B(a,s)\right] = (1-\lambda)\left\{\pi_A\left[s, q_A(a,s), q_B(a,s)\right] - sq_A(a,s)\right\} + \lambda\sigma c(s)$$

$$= (1-\lambda)\left[\left(a-(q_A+q_B)+s\right)q_A - sq_A\right] + (2\lambda-1)\sigma c \tag{58}$$

where λ and $1-\lambda$ are the weights on the value of the lobbying costs and social welfare in the policymaker's welfare function, respectively, and $0 \leq \lambda \leq 1$.

The primary concern of this paper is the effect of lobbying when country A's policymaker is incompletely informed of the strength of the demand in the third country which is represented by the demand intercept, a. The policymaker knows only that a is drawn from the set $\{a_L, a_H\}$, where $0 < a_L < a_H$. The policymaker's prior beliefs over the distribution of a are characterized by the parameter $\mu = \Pr(a = a_H)$. It is assumed that $\mu < \frac{3a_L}{a_H - a_L}$ (for positive output) and $0 < \mu < 1$ (for incomplete information).

Before studying lobbying under asymmetric information, it is useful to establish the results under complete information.

3.3.1 Complete Information when Lobbying is not allowed.

Suppose that the policymaker is completely informed of the demand intercept a when determining the subsidy s, and that lobbying is not allowed, e.g., $\sigma = 0$ (perhaps due to an enforced legal prohibition). The relationship between the firms (Firm A and Firm B) and the policymaker has the structure of a Stackelberg game such that the policymaker is acting as a leader when choosing the subsidy level, and the firms are acting as followers when choosing their outputs. Therefore, the first step is to solve for the output levels of the firms:

$$\begin{aligned} \text{Firm } A\text{'s objective} &: \quad \max_{q_A} \left(a - (q_A + q_B) + s\right) q_A \\ \text{Firm } B\text{'s objective} &: \quad \max_{q_B} \left(a - (q_A + q_B)\right) q_B \end{aligned}$$

Therefore, I have

$$q_A = \frac{a + 2s}{3} \text{ and } q_B = \frac{a - s}{3} \tag{59}$$

Anticipating that the firms will choose output levels according to (4), the policymaker chooses s as follows:

$$\max_s (1 - \lambda) \left[\left(a - \frac{2a + s}{3} \right) \frac{a + 2s}{3} \right]$$

$$\Rightarrow s = \frac{a}{4} \tag{60}$$

Hence, the welfare of the policymaker and the profit of the home firm can be found as

$$W_A(a) = (1-\lambda)\frac{a^2}{16},\ \pi_A(a) = \frac{a^2}{4}$$

Note that the welfare of the home government can be written as:

$$W_A[s, q_A(a,s), q_B(a,s)] = (1-\lambda)\{\pi_A[s, q_A(a,s), q_B(a,s)] - sq_A(a,s)\}$$

The first order condition for optimality is:

$$\frac{\partial W_A}{\partial s} = \frac{\partial \pi_A}{\partial s} + \frac{\partial \pi_A}{\partial q_A}\frac{\partial q_A}{\partial s} + \frac{\partial \pi_A}{\partial q_B}\frac{\partial q_B}{\partial s} - q_A - s\frac{\partial q_A}{\partial s} = 0 \tag{61}$$

The first term and the fourth term on the right hand side of equation (61) cancel each other, and the second term is equal to zero by the envelope theorem. Moreover, $\frac{\partial q_B}{\partial s} = -\frac{1}{3}$ and $\frac{\partial q_A}{\partial s} = \frac{2}{3}$. Then I have

$$2s = -\frac{\partial \pi_A}{\partial q_B} = q_A, \text{ since } \frac{\partial \pi_A}{\partial q_B} = -q_A$$

Furthermore, $\frac{\partial q_A}{\partial a} > 0$, so the optimal subsidy increases as demand increases.

The subsidy given by the policymaker increases the home firm's output and decreases the foreign firm's output. As the foreign firm's output decreases, the home firm's profit increases. Since a higher subsidy creates a higher profit, the home firm prefers a higher subsidy regardless of the level of demand it faces. On the other hand, the policymaker's optimal subsidy is higher, the higher the demand is, since a rise in demand increases the marginal effect of a decrease in the foreign firm's output on the home firm's profit. Thus, there is a partial conflict of interest between the policymaker and the home firm.

3.3.2 Complete Information when Lobbying is allowed.

Consider the case in which the policymaker observes a before choosing s, and the home firm is allowed to lobby. In this case, the home firm does not spend any money on lobbying the policymaker and I still obtain the same output and subsidy levels as in equations (59) and (60), respectively. The intuition is straightforward. There is no room for either the information motive or the influence motive of lobbying. First, the policymaker has perfect information about the demand conditions and no further information is needed. Second, since lobbying costs are exogenous, i.e., they do not depend on the policymaker's subsidy choice, the policymaker will select the same subsidy independent of lobbying. Consequently, the firm optimally chooses not to lobby and the same result is obtained as before.

3.3.3 Incomplete Information when Lobbying is not allowed.

Suppose that unlike the firms (Firm A and Firm B), the policymaker does not observe the demand intercept, a, but holds the priors $\Pr(a = a_H) = \mu$ and $\Pr(a = a_L) = 1 - \mu$. Suppose also that lobbying is prohibited. In this case, Firm A's and Firm B's problems are the same as before. However, the policymaker in Country A will maximize the expected value of its objective function.

The policymaker's problem is

$$\max_s (1-\lambda)E\left[\left(a-\frac{2a+s}{3}\right)\frac{a+2s}{3}\right]$$

$$\text{that is,} \max_s \left\{ \begin{array}{c} \mu\left[\left(a_H-\frac{2a_H+s}{3}\right)\frac{a_H+2s}{3}\right]+ \\ (1-\mu)\left[\left(a_L-\frac{2a_L+s}{3}\right)\frac{a_L+2s}{3}\right] \end{array} \right\}$$

$$\Rightarrow s=\frac{\mu a_H+(1-\mu)\,a_L}{4}$$

In this case, the subsidy level is independent of the actual realization of the demand intercept.

The corresponding payoffs are

$$E\left[W_A(a)\right]=(1-\lambda)\frac{\mu\,(8+\mu)\,a_H^2+2\mu\,(1-\mu)\,a_L a_H+(1-\mu)\,(9-\mu)\,a_L^2}{72}$$

$$\pi_A(a_H)=\frac{\left[(2+\mu)\,a_H+(1-\mu)\,a_L\right]^2}{36} \text{ and } \pi_A(a_L)=\frac{\left[\mu a_H+(3-\mu)a_L\right]^2}{36}$$

Choosing a policy according to the prior mean of a will of course yield a lower welfare for the policymaker than the result obtained under complete information.

3.3.4 Incomplete Information when Lobbying is allowed.

Consider again the case in which the policymaker does not observe a, but knows its prior distribution. Both the home firm and the foreign firm have complete information about a, and the home firm is given the opportunity to lobby the policymaker. It is further assumed that the policymaker cannot verify the truthfulness of the information he/she receives. As stated before, the home firm always prefers a higher subsidy irrespective of the demand it faces. Thus, the home firm facing a low demand has an incentive to convince the home policymaker that it faces a high demand in order to capture a higher subsidy. When deciding on the subsidy level, the policymaker takes into account the home firm's incentive to color the information. Note that since the cost of lobbying is exogenous, lobbying cannot have an influence motive. In contrast, due to policymaker's incomplete information, lobbying can be informative.

I model lobbying as a signaling game between Firm A and the policymaker. The order of the game is as follows:

1. Nature draws the demand intercept $a \in \{a_H, a_L\}$, with $\Pr(a = a_H) = \mu$.

2. Both firms observe the actual value of the demand intercept a.

3. Firm A chooses signal $k \in K \equiv \{n\} \cup M$, where M is the set of feasible lobbying messages and n denotes the no-message (no-lobbying) case. A message $m \in M$ bears cost $c \geqslant 0$ $[c(k) = c \; for \; k = m \in M \; and \; c(k) = 0 \; for \; k = n]$.

4. The policymaker observes signal k.

5. The policymaker decides on the per-unit export subsidy that maximizes its expected welfare $(E[W_A(s, a)])$.

6. Both firms produce and respective payoffs are realized.

Equilibrium Analysis.

Perfect Bayesian Equilibrium (PBE) is used for the equilibrium notion. Firm A's signaling rule is denoted by $\sigma(k|a)$ with $a \in \{a_H, a_L\}$ and gives the probability that Firm A facing demand intercept a sends signal $k \in M \cup \{n\}$. The policymaker's action rule is denoted by $\rho(k)$ and gives the policymaker's action in response to Firm A's signal. Finally, $g(a|k)$ with $a \in \{a_H, a_L\}$ denotes the policymaker's posterior belief. Formally, a set of strategies and beliefs constitutes a PBE if:

(i) for each $a \in \{a_H, a_L\}$, $\sigma(n|a) + \int_M \sigma(m|a)\,da = 1$ and if $\sigma(k|a) > 0$ then k solves $\max_{k \in \{n\} \cup M} \left[\pi_A(\rho(k), a) - c(k)\right]$, where $\pi_A(\rho(k), a)$ represents the profit of Firm A when facing subsidy $\rho(k)$ and demand intercept a before the signaling cost is deducted.

(ii) for each k, $\rho(k)$ solves $\max_{s \in S} E\left[\left(a - \left(\frac{a+2s}{3} + \frac{a-s}{3}\right)\right)\frac{a+2s}{3}|k\right]$,

$$\text{that is;} \max_{s \in S} \left\{ \begin{array}{c} \left[\left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3}\right] g(a_H|k) + \\ \left[\left(a_L - \frac{2a_L+s}{3}\right)\frac{a_L+2s}{3}\right] g(a_L|k) \end{array} \right\}$$

(iii) $g(a_H|k) = \frac{\mu\sigma(k|a_H)}{\mu\sigma(k|a_H)+(1-\mu)\sigma(k|a_L)}$, when $\mu\sigma(k|a_H) + (1-\mu)\sigma(k|a_L) > 0$.

Condition (i) requires that Firm A's signaling rule is a best reply against the policymaker's action rule. The second condition states that the policymaker's action rule is optimal given his/her posterior belief about a after having received signal k and the last condition says that the policymaker's posterior beliefs are Bayesian-consistent with his/her prior beliefs μ and $(1-\mu)$ and Firm A's signaling strategy. Note that whenever $\mu\sigma(k|a_H)+(1-\mu)\sigma(k|a_L)=0$, I cannot determine the posterior beliefs by using Bayes' rule. Instead, I will use a refinement called '*universal divinity*'[44] in order to eliminate any implausible equilibria. Accordingly, if $\mu\sigma(k|a_H)+(1-\mu)\sigma(k|a_L)=0$, then the belief $g(a_H|k)$ must be concentrated on the type $a\in\{a_H,a_L\}$, which is most likely to send the off-equilibrium signal k.

Lemma. The content of the message is immaterial, since every message $m\in M$ which is sent with positive probability induces the same action. Therefore, I lose no generality in considering only n (no-message sent) and m (message sent), equivalently M has only one element, m.

Proof. Suppose that messages $m_1, m_2\in M$ are both sent with positive probability in equilibrium. Then, $\pi_A(\rho(m_1),a)-c=\pi_A(\rho(m_2),a)-c$. For this case to hold, it is necessary that $\rho(m_1)=\rho(m_2)$. Therefore, both messages cause the same effect on the policymaker's action, and as a result there is no need to consider different messages.■

The intuition behind this result is simple. When the home firm decides to send a message, it already has to bear the cost of the message, independent of the content of the message. If a non-empty message is sent, the content of the message can be thought as cheap talk. As a result, if a message will make a difference in the policy-maker's action, the firm will always send the message that will cause the policymaker

[44]See Banks and Sobel (1987).

to take the most favorable action for the firm. Even though the content of the message is not important, one can think of m as saying that $a = a_H$.

Proposition 1. There are multiple signaling equilibria depending on the value of the exogenous cost c of signaling.[45]

1. A separating equilibrium exists:

   If $\frac{(a_H - a_L)(a_H + 5a_L)}{36} < c < \frac{(a_H - a_L)(5a_H + a_L)}{36}$,

   $\sigma(m|a_H) = 1,\ \sigma(n|a_H) = 0,\ \sigma(m|a_L) = 0,\ \sigma(n|a_L) = 1$

   $\rho(m) = \frac{a_H}{4},\ \rho(n) = \frac{a_L}{4}$

2. A pooling equilibrium (with both types sending no-message) exists:

   If $\frac{(1-\mu)(a_H - a_L)[(5+\mu)a_H + (1-\mu)a_L]}{36} < c$,

   $\sigma(m|a_H) = 0,\ \sigma(n|a_H) = 1,\ \sigma(m|a_L) = 0,\ \sigma(n|a_L) = 1$

   $\rho(m) = \frac{a_H}{4},\ \rho(n) = \frac{\mu a_H + (1-\mu)a_L}{4}$

3. A pooling equilibrium (with both types sending a message) exists:

   If $c < \frac{\mu(a_H - a_L)[\mu a_H + (6-\mu)a_L]}{36}$,

   $\sigma(m|a_H) = 1,\ \sigma(n|a_H) = 0,\ \sigma(m|a_L) = 1,\ \sigma(n|a_L) = 0$

   $\rho(m) = \frac{\mu a_H + (1-\mu)a_L}{4},\ \rho(n) = \frac{a_L}{4}$

[45] See appendix A and B for calculations. See also the figures at the end of appendices.

4. A semi-pooling equilibrium (in which only high type plays a mixed strategy) exists:

If $\frac{(1-\mu)(a_H-a_L)[(5+\mu)a_H+(1-\mu)a_L]}{36} \leq c \leq \frac{(a_H-a_L)(5a_H+a_L)}{36}$,

$\sigma(m|a_H) = 1 - \frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}$, $\sigma(n|a_H) = \frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}$,

$\sigma(m|a_L) = 0,\ \sigma(n|a_L) = 1$

$\rho(m) = \frac{a_H}{4},\ \rho(n) = \frac{3\sqrt{a_H^2-4c}-2a_H}{4}$

5. A semi-pooling equilibrium (in which only low type plays a mixed strategy) exists:

If $\frac{\mu(a_H-a_L)[\mu a_H+(6-\mu)a_L]}{36} \leq c \leq \frac{(a_H-a_L)(a_H+5a_L)}{36}$,

$\sigma(m|a_H) = 1,\ \sigma(n|a_H) = 0$

$\sigma(m|a_L) = \frac{\mu}{1-\mu}\frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{3\left(\sqrt{a_L^2+4c}-a_L\right)}$, $\sigma(n|a_L) = 1 - \frac{\mu}{1-\mu}\frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{3\left(\sqrt{a_L^2+4c}-a_L\right)}$

$\rho(m) = \frac{3\sqrt{a_L^2+4c}-2a_L}{4},\ \rho(n) = \frac{a_L}{4}$

The first case is the separating equilibrium. In this equilibrium, the cost of sending a message is high enough that a low demand firm decides not to send a message. On the other hand, a high demand firm finds it optimal to send a message, therefore the policymaker can separate both types and correctly anticipates the optimal subsidy level. The intuition is as follows. Even though the home firm always prefers a high subsidy, the marginal effect of a given subsidy is higher for the home firm facing a high demand. Consequently, the home firm benefits more from a given subsidy if it faces a high demand than if it faces a low one.[46] This allows a high demand firm to bear more cost than a low demand firm for a given subsidy. Two kinds of pooling equilibria exist: pooling on sending no-message and pooling on sending a costly message. The resulting subsidy level in each pooling equilibrium is the same as the one that exists without any signaling. There is an important difference between these two kinds of equilibria, however. Although both of them result in the same subsidy level, when there is pooling on sending a costly message, the firm is spending money without changing the policymaker's choice of subsidy. Therefore, from the firm's point of view, this type of equilibrium causes a waste of resources. There are also two kinds of semi-pooling equilibria. In the first one, a high demand firm plays a mixed strategy and in the second one, a low demand firm plays a mixed strategy.

Overall, pooling equilibria are not informative, i.e., they do not give any information about the firm's type, hence, the policymaker does not change his/her policy after the communication possibility is allowed. In contrast, separating and all types of semi-pooling equilibria are informative.

Proposition 2. The policymaker cannot be worse off with lobbying if he/she values contributions at least as much as social welfare, i.e., $\lambda \geq \frac{1}{2}$.

The formal proof of this proposition involves routine comparison of welfare outcomes and is omitted.[47] The following discussion provides intuition for the proposition

[46] Therefore, the single-crossing property is satisfied. See Fudenberg and Tirole (1991).

[47] See appendix C for welfare calculations.

stated above.

It is useful to consider first the case where $\lambda = \frac{1}{2}$. In this case, lobbying costs are in the form of a transfer from the firm to the policymaker such that they cannot affect the welfare of the policymaker (see (58)). Thus, any equilibrium that is informative can make the policymaker better off since the lobbying costs are not born by the policymaker. This is true for all equilibria except the pooling ones. Under the pooling equilibria, no information transmission occurs, hence the policymaker's welfare when lobbying is allowed is the same as his/her welfare when lobbying is prohibited. This result will carry over for the case when $\lambda > \frac{1}{2}$ with a slight difference. As transfers increase the welfare of the policymaker, in the pooling equilibrium where both types send a message, the policymaker is strictly better off with lobbying than without lobbying even if no information is transmitted. The only case where the policymaker's welfare does not change is the pooling equilibrium with both types sending no message. Moreover, when $\lambda > \frac{1}{2}$, lobbying costs can be considered as contributions since they positively affect the policymaker's welfare.

Proposition 3. There is a critical level of weight parameter (λ^*) below which the policymaker cannot be better off with lobbying.

Proof. Let λ^* be the value of λ which makes the policymaker's expected welfare the same under separating equilibrium and pooling equilibrium with both types sending no message. The policymaker obtains the highest welfare under separating equilibrium if $\lambda > \lambda^*$. In contrast, when $\lambda < \lambda^*$, the highest expected welfare occurs under pooling equilibrium with both types sending no message. Since the policymaker's welfare when lobbying is prohibited is the same as his/her welfare under pooling equilibrium with both types sending no message, it is easy to determine the case in which lobbying cannot make the policymaker better off by finding λ^*. I can find λ^* by solving

$$(1-\lambda)\frac{\mu a_H^2 + (1-\mu)\, a_L^2}{8} + (2\lambda - 1)\mu c = \frac{(1-\lambda)}{72}\left\{ \begin{array}{c} \mu(8+\mu)a_H^2 + 2\mu\,(1-\mu)\, a_H a_L \\ +(1-\mu)(9-\mu)a_L^2 \end{array} \right\}$$

where the left hand side is the policymaker's expected welfare under separating equilibrium and the right hand side is his/her welfare under pooling equilibrium with both types sending no message.

After some algebra, I have

$$\lambda^* = \frac{72c - (1-\mu)(a_H - a_L)^2}{144c - (1-\mu)(a_H - a_L)^2}$$

The intuitive argument behind this result is as follows. From equation (58), when $\lambda < \frac{1}{2}$, the lobbying costs incurred by the firm decrease the policymaker's welfare. In this case, one can interpret lobbying costs not as contributions or transfers but rather as expenses like making phone calls, hiring lawyers and writing letters, all of which are forms of social waste. From the policymaker's point of view, lobbying has a trade off. It provides information, but this information is costly. Hence, after some point, the costs exceed the benefits of information and a ban on lobbying can be welfare enhancing.

Proposition 4. When I compare the firm's expected payoff when lobbying is allowed and when it is not allowed, I can conclude that the firm can be better off or worse off with lobbying depending on the actual realization of a, the cost of lobbying, and the prior belief of the policymaker.

Proof. It is obvious that the firm facing a low demand can never be better off with lobbying. On the other hand, a high demand firm can benefit from the opportunity to lobby under certain conditions. First note that the firm's payoff under any type of pooling equilibria is the same as its payoff when lobbying is banned. Define $\mu_1 = \frac{\sqrt{8a_H^2 - 4a_L a_H + 5a_L^2} - (2a_H + a_L)}{a_H - a_L}$. The firm facing a high demand benefits from lobbying if

$$\begin{aligned}
\mu &\leq \mu_1 \text{ and} \\
c &< \frac{(1-\mu)(a_H - a_L)\left[(5+\mu)\,a_H + (1-\mu)\,a_L\right]}{36} \\
c &> \frac{\mu(4+\mu)\left[(4+\mu)\,a_H + (2-\mu)\,a_L\right]\left[\mu a_H + (6-\mu)\,a_L\right]}{576}.
\end{aligned}$$

This occurs under some region of both separating equilibrium and semi-pooling equilibrium with low type playing a mixed strategy.■

The effect of lobbying is ambiguous for the firm and depends on three parameters: a, c and μ. The first thing to note is if the firm faces a low demand, i.e., $a = a_L$, it cannot be better off with lobbying. The best outcome for a low demand firm occurs under pooling equilibrium where neither the high demand type nor the low demand type send a message. Also, it is worth noting that the firm facing a high demand may or may not benefit from lobbying the policymaker. It only benefits if the policymaker's prior belief is low (μ is small) and the message cost is neither too high nor too low. The intuition is as follows. Since the message is costly, a high demand firm prefers to pay the minimum amount that distinguishes itself from a low demand firm. If the policymaker's prior belief is high, he/she is already willing to grant a high subsidy, thereby abolishing the need to pay a lobbying cost even if the firm faces a high demand.

Lastly, a high demand firm benefits the most from the separating equilibrium. Surprisingly, not all the region under separating equilibrium makes the high demand firm better off, especially part of the region in which μ is high. In addition, a certain region of semi-pooling equilibrium (in which a low type playing a mixed strategy) makes the high type better off.

3.4 Extensions.

3.4.1 Continuous Demand Intercept.

In this section, it is assumed that the demand intercept a is distributed according to the density function $f(a)$ with support $[a_L, a_H]$. Everything else remains the same.

3.4.1.1 Complete Information.

This case is the same as the complete information case examined earlier, so all results hold as well.

3.4.1.2 Incomplete Information when Lobbying is not allowed.

The Policymaker's problem is to $\max_s E\left[\left(a-\frac{2a+s}{3}\right)\frac{a+2s}{3}\right]$

that is, $\max_s \int\limits_{a_L}^{a_H}\left[\left(a-\frac{2a+s}{3}\right)\frac{a+2s}{3}\right] f(a)\,da \Rightarrow s=\frac{E(a)}{4}$

The corresponding payoffs are $E\left[W_A(s,a)\right]=\frac{8E\left(a^2\right)+[E(a)]^2}{72}$ and $\pi_A(s,a)=\frac{[2a+E(a)]^2}{36}$

Here, the policymaker decides on the subsidy level according to his/her prior belief about the demand intercept. The result does not depend on the actual realization of a, and the welfare will be less than the outcome under complete information.

3.4.1.3 Incomplete Information when Lobbying is allowed.

Pooling Equilibrium.

It is the same equilibrium obtained under incomplete information without signaling. However, one of the following conditions has to be satisfied:

(i) $c \leq \frac{(a_H-a_L)(a_H+11a_L)}{144}$ or (ii) $c \geqslant \frac{(a_H-a_L)(11a_H+a_L)}{144}$

Separating Equilibrium.

A separating equilibrium exists if

$$\frac{(a_H-a_L)(a_H+11a_L)}{144} < c < \frac{(a_H-a_L)(11a_H+a_L)}{144}$$

Let $a^\star$ be the demand intercept of Firm A who is indifferent between sending a message and not.[48]

$\pi_A(\rho(m),a^\star)-\pi_A(\rho(n),a^\star)=c$. Since $\frac{\partial(\pi_A(\rho(m),a)-\pi_A(\rho(n),a))}{\partial a}>0\Rightarrow$

$$\begin{array}{lcl} \text{if } a>a^\star \Longrightarrow \sigma(m)=1,\ \sigma(n)=0 & \multirow{2}{*}{$\Rightarrow$} & \rho(m)=\frac{E(a|a>a^\star)}{4} \\ \text{if } a<a^\star \Longrightarrow \sigma(m)=0,\ \sigma(n)=1 & & \rho(n)=\frac{E(a|a<a^\star)}{4} \end{array}$$

[48] See appendix D.

$E\left[W_A\left(a > a^{\star}\right)\right] = \frac{8E\left(a^2|a>a^{\star}\right)+[E(a|a>a^{\star})]^2}{72}$, $E\left[W_A\left(a < a^{\star}\right)\right] = \frac{8E\left(a^2|a<a^{\star}\right)+[E(a|a<a^{\star})]^2}{72}$

$\pi_A\left(a > a^{\star}\right) = \frac{[2a+E(a|a>a^{\star})]^2}{36}$, $\pi_A\left(a < a^{\star}\right) = \frac{[2a+E(a|a<a^{\star})]^2}{36}$

Note that with continuum of types, the policymaker cannot separate every single type but rather group the types into two categories and determine the subsidy accordingly.

3.4.2 Endogenous Lobbying Costs.

Until now, I assumed that lobbying costs are exogenous. However, in real life we often see that interest groups might *choose* to run a costly advertising campaigns or make a huge contribution to policymakers' campaign spending. Hence, it is plausible to assume that interest groups have discretion over the size and scope of their lobbying efforts. In this section, I relax the exogenous cost assumption and let the domestic firm choose the size of the transfer amount (contributions) that goes to the policymaker. I use the agency framework used in Grossman and Helpman (1994). Accordingly, the firm is the principal and the policymaker is the agent of this game. The firm offers a contribution schedule that maps each subsidy level into a contribution. The policymaker then sets a subsidy and collects the contribution associated with his/her subsidy choice. I assume that the payoff functions for the firm and the policymaker are continuous and contributions are non-negative, i.e., $c(s) \geq 0$. In addition, I restrict $\lambda \geq \frac{1}{2}$ so that the politician values a dollar in his/her hand at least as highly as in the hands of the firm. In this case, unlike the exogenous lobbying cost case, the contributions are paid once the host government determines the subsidy level. Here, commitment by the firm is assumed.

The policymaker's net payoff with endogenous contribution schedule is given by

$$\begin{aligned} W_A\left[s, q_A\left(a, s\right), q_B\left(a, s\right), c(s)\right] &= (1-\lambda)\left[a-\left(q_A\left(a, s\right)+q_B\left(a, s\right)\right)\right] q_A\left(a, s\right) \\ &\quad +(2\lambda-1)\sigma c(s) \end{aligned} \tag{62}$$

Note that when $\lambda = \frac{1}{2}$, lobbying can have only an information motive when there is incomplete information. The influence motive cannot be present here since from (62) contributions have no direct effect on the policymaker's welfare. However, as $\lambda > \frac{1}{2}$, lobbying has both motives since contributions positively affect the policymaker's welfare.

Firm A's net payoff is given by

$$\pi_A\left[s, q_A\left(a, s\right), q_B\left(a, s\right), c(s)\right] = \left(a-\left(q_A\left(a, s\right)+q_B\left(a, s\right)\right)+s\right) q_A\left(a, s\right) - \sigma c(s)$$

I will first analyze the effect of endogenous lobbying costs under complete information, then extend the result to the incomplete information case.

3.4.2.1 Complete Information with Endogenous Lobbying Costs.

Discrete (two-type) Distribution.

In this section, I show that the freedom to choose the scale of lobbying can make a difference in a group's effort to communicate dichotomous information. In particular, when lobbying costs are fixed, there exists an equilibrium with full revelation only for certain values of c (see Proposition 1). When they are variable, an equilibrium with full revelation always exists. Consider a case where the firm with two types $\{a_L, a_H\}$ chooses the amount of contributions for each subsidy level assigned by the policymaker. I focus on the truthful (compensating) contribution schedules. Let s^o be the optimal subsidy choice with the truthful contribution schedule $c^o(.)$. The equilibrium can be characterized as follows:[49]

Proposition 5. $(\{c^o(.)\}, s^o)$ is a truthful Nash equilibrium of the lobbying game if and only if:

(a) $c^o(.)$ is feasible,

(b) s^o maximizes $W_A[s, q_A(a,s), q_B(a,s), c(s)]$,

(c) s^o maximizes $W_A[s, q_A(a,s), q_B(a,s), c(s)] + \pi_A[s, q_A(a,s), q_B(a,s), c(s)]$, and

(d) there exists an s^* that maximizes $W_A[s, q_A(a,s), q_B(a,s)]$ such that $c^o(s^*) = 0$.

Condition (a) limits the firm's contribution schedule to be among those that are feasible (i.e., contributions must be nonnegative and no greater than the aggregate payoff available to the firm). Condition (b) states that; given the contribution schedules offered by the firm, the policymaker sets the export subsidy to maximize his/her

[49] See the proposition 1, p. 839 in Grossman and Helpman (1994).

own welfare. Condition (c) stipulates that the export subsidy maximizes the joint welfare of the firm and the policymaker. The last condition states that I focus on the equilibrium in which the firm announces truthful contribution schedules. In addition, I assume that the firm chooses political contribution functions that are differentiable.

I know from earlier discussion that Firm A's and Firm B's output choices are given by (59). Hence, Firm A's payoff can be rewritten as:

$$\pi_A\left[s, q_A\left(a, s\right), q_B\left(a, s\right), c(s)\right] = \frac{(a+2s)^2}{9} - c(s)$$

Then, the policymaker's problem is

$$\max_s\, (1-\lambda)\,\frac{a^2+as-2s^2}{9} + (2\lambda-1)c(s)$$

The first order condition is

$$c'(s) = \frac{1-\lambda}{1-2\lambda}\frac{(a-4s)}{9}a \text{ and} \tag{63}$$

The second order condition is

$$c''(s) \leq \frac{4}{9}\frac{1-\lambda}{2\lambda-1}$$

Maximizing the expression stated in part (c) of the proposition 5, I have

$$\max_{s} (1-\lambda)\frac{a^2+as-2s^2}{9}+(2\lambda-1)c(s)+\frac{(a+2s)^2}{9}-c(s) \tag{64}$$

By using the first order condition of the policymaker in equation (63), the expression in (64) can be rewritten as

$$\max_{s} \frac{(a+2s)^2}{9}-c(s)$$

The first order condition is

$$c'(s)=\frac{4(a+2s)}{9} \tag{65}$$

The second order condition is

$$c''(s)\geq\frac{8}{9} \tag{66}$$

Combining equations (63) and (65), I get

$$\frac{1-\lambda}{1-2\lambda}\frac{(a-4s)}{9}=\frac{4(a+2s)}{9} \text{ and}$$

$$s^o=\frac{(7\lambda-3)}{(3-5\lambda)}\frac{a}{4} \tag{67}$$

It is also known that without any contributions, the policymaker optimally chooses

$s = \frac{a}{4}$. Thus, the policymaker's welfare without contributions is

$$(1-\lambda)W_A(a,s^*) = (1-\lambda)\frac{a^2}{8} \tag{68}$$

The policymaker's welfare after contributions is

$$\begin{aligned} W_A(a,s^o,c^o) &= (1-\lambda)W_A(a,s^o) - (2\lambda-1)c(s^o) \\ &= (1-\lambda)\frac{a^2 + a\left[\frac{(7\lambda-3)}{(3-5\lambda)}\frac{a}{4}\right] - 2\left[\frac{(7\lambda-3)}{(3-5\lambda)}\frac{a}{4}\right]^2}{9} - (2\lambda-1)c(s^o) \end{aligned} \tag{69}$$

Then, the contribution schedule can be obtained by using (68) and (69):

$$\begin{aligned} c(s^o) &= \frac{(1-\lambda)}{(2\lambda-1)}W_A(a,s^*) - \frac{(1-\lambda)}{(2\lambda-1)}W_A(a,s^o) \\ &= \frac{(1-\lambda)}{(2\lambda-1)}\left[\frac{a^2}{8} - \frac{a^2 + a\left[\frac{(7\lambda-3)}{(3-5\lambda)}\frac{a}{4}\right] - 2\left[\frac{(7\lambda-3)}{(3-5\lambda)}\frac{a}{4}\right]^2}{9}\right] \\ c(s^o(a)) &= \frac{(1-\lambda)(2\lambda-1)}{2(3-5\lambda)^2}a^2,\ \forall a \in \{a_L,\ a_H\} \end{aligned}$$

It is possible to rewrite c as a function of s:

$$\begin{aligned} c(s) &= \frac{(1-\lambda)}{(2\lambda-1)}W_A(a,s^*) - \frac{(1-\lambda)}{(2\lambda-1)}W_A(a,s) \\ &= \frac{(1-\lambda)}{(2\lambda-1)}\left[\frac{a^2}{8} - \frac{a^2+as-2s^2}{9}\right] \\ &= \frac{(1-\lambda)}{(2\lambda-1)}\frac{(a-4s)^2}{72} \end{aligned}$$

Note that if $\lambda > \frac{3}{5}$, the second order condition in equation (67) is not satisfied and the subsidy level goes to infinity. The intuition for this is straightforward. When $\lambda > \frac{3}{5}$, the policymaker values the contributions more than the social welfare. A unit increase in the socially optimal subsidy level increases the firm's payoff and distorts the welfare of the policymaker but the marginal increase in the firm's payoff is much larger than the marginal decrease in the policymaker's welfare. Therefore, the firm can easily compensate the policymaker for the distortion and the subsidy level goes to infinity. This case is not very interesting. Hence, I focus on the interior solution by restricting $\frac{1}{2} \leq \lambda < \frac{3}{5}$.

Note also that when $\lambda = \frac{1}{2}$, the firm chooses not to lobby under complete information. In this case, due to (62), contributions cannot influence the policymaker's subsidy choice. In addition, no information transmission is necessary. Thus, there is no room for lobbying. On the other hand, when $\lambda > \frac{1}{2}$, lobbying takes place due to the influence motive.

Continuous Distribution.

This case is exactly same as the case with two types. Therefore, I have

$$s^o = \frac{(7\lambda - 3)}{(3 - 5\lambda)} \frac{a}{4}, \ \forall a \in [a_L, \, a_H] \ \text{ and} \tag{70}$$

$$c(s^o(a)) = \frac{(1-\lambda)(2\lambda - 1)}{2(3 - 5\lambda)^2} a^2, \ \forall a \in [a_L, \, a_H]$$

3.4.2.2 Incomplete Information with Endogenous Lobbying Costs.

Discrete (two-type) Distribution.

In this case, lobbying has both the influence and the information motives. The optimal subsidy is the same as in (67).

Proposition 6. If we focus on the interior solution such that $\frac{1}{2} \leq \lambda < \frac{3}{5}$, there is a unique separating equilibrium. Then the truthful contribution schedule is given as:

$$c(a) = \frac{(1-\lambda)(2\lambda-1)}{2(3-5\lambda)^2}a^2 + \frac{(a-a_L)[(9-17\lambda)a+(11\lambda-3)a_L]}{36(3-5\lambda)}, \ \forall a \in \{a_L, \, a_H\} \text{ or}$$

$$c(s,a) = \frac{(1-\lambda)}{(2\lambda-1)}\frac{(a-4s)^2}{72} + \frac{(a-a_L)[(9-17\lambda)a+(11\lambda-3)a_L]}{36(3-5\lambda)}, \ \forall a \in \{a_L, \, a_H\}$$

Proof. See Ball (1995).

In this equilibrium, the a_L-type chooses the same contribution level that it would choose under complete information. The a_H-type, however, must choose a contribution which is larger than the one it would choose under full information to prevent the a_L-type from mimicking it.

Notice that when lobbying costs are fixed, there exists an equilibrium with full revelation only for certain values of c. But when they are variable, an equilibrium with full revelation always exists.

Continuous Distribution.

Again in this case, the optimal subsidy is the same as in (70). The lowest type will pay the same contribution as it would pay under full information, so

$$c(a_L) = \frac{(1-\lambda)(2\lambda-1)}{2(3-5\lambda)^2} a_L^2 \tag{71}$$

In addition, one needs the marginal cost of signaling a slightly higher value of a to match the marginal benefit to the firm in any state from having the policymaker believe that a is a bit higher. Therefore,

$$\begin{aligned} \pi_A\left[s(a'), a, c(a')\right] &= \frac{(a+2s(a'))^2}{9} \\ &= \frac{\left[2(3-5\lambda)a + (7\lambda-3)a'\right]^2}{36(3-5\lambda)^2}, \text{ since } s(a') = \frac{(7\lambda-3)}{(3-5\lambda)}\frac{a'}{4} \end{aligned} \tag{72}$$

If I take the derivative of this expression with respect to a' as $a' \to a$:

$$\begin{aligned} \left.\frac{\partial \pi_A\left[s(a'), a, c(a')\right]}{\partial a'}\right|_{a' \to a} &= \frac{1-\lambda}{3-5\lambda}\frac{a}{3} \text{ and by integrating:} \\ \int_{a_L}^{a} \frac{\partial \pi_A\left[s(\widetilde{a}), \widetilde{a}, c(\widetilde{a})\right]}{\partial \widetilde{a}} d\widetilde{a} &= \int_{a_L}^{a} \frac{1-\lambda}{3-5\lambda}\frac{\widetilde{a}}{3} d\widetilde{a} \end{aligned}$$

Hence, I can write

$$\begin{aligned}\pi_A\left[s(a),a,c(a)\right]-\pi_A\left[s(a_L),a_L,c(a_L)\right] &= \frac{1-\lambda}{3-5\lambda}\frac{(a^2-a_L^2)}{6}\\ \left[\pi_A(s(a),a)-c(a)\right]-\left[\pi_A(s(a_L),a_L)-c(a_L)\right] &= \frac{1-\lambda}{3-5\lambda}\frac{(a^2-a_L^2)}{6}\end{aligned}$$

By using (71) and (72), one can get

$$c(a)=\frac{(1-\lambda)\,(2\lambda-1)}{2(3-5\lambda)^2}a^2+\frac{(1-\lambda)}{(3-5\lambda)}\frac{a^2-a_L^2}{12}$$

One can alternatively write c as a function of s as follows:

$$c(s)=\frac{1-\lambda}{2\lambda-1}\frac{(a-4s)^2}{72}+\frac{1-\lambda}{3-5\lambda}\frac{a^2-a_L^2}{12} \tag{73}$$

The exogenous lobbying costs with a continuum of types cannot fully resolve the firm's credibility problem. By showing itself willing to bear the fixed cost, the firm can at best distinguish one set of states from another, in other words, the exogenous lobbying costs can only partition the type space into two regions. Hence, it is not possible for the policymaker to distinguish each type of the firm. However, when lobbying costs are endogenized, the policymaker can separate each type according to the contribution schedule given by (73).

3.5 Conclusion.

This paper has shown the conditions under which lobbying can be beneficial. Even when the policymaker has no rent-seeking objective, he/she has a strong incentive to make lobbying costly in order to mitigate his/her information disadvantage. This is coupled with the fact that the firm facing a high demand may prefer to pay for lobbying in order to make its claim credible.

The extension of the model with endogenous costs guarantees the policymaker have full information about demand conditions. As a result, the policymaker's welfare improves compared to the case in which lobbying costs are exogenous.

We have seen that, depending on the nature of the lobbying activities, lobbying can be beneficial or harmful for the policymaker. If these activities take the form of contributions, the policymaker always prefers lobbying. In contrast, if they are in the form of social waste, a ban on lobbying can be efficient. This shows us that when we analyze the costs and benefits of lobbying, we need to specify the type of activities interest groups engage.

Appendix

Appendix A.

In order to find all the equilibria of the signaling game, I need to consider nine different cases. However, four of them are impossible to hold:

$$\text{(i)}\left\{\begin{array}{c}\pi_A\left(\rho\left(m\right),a_H\right)-c<\pi_A\left(\rho\left(n\right),a_H\right)\\\pi_A\left(\rho\left(m\right),a_L\right)-c>\pi_A\left(\rho\left(n\right),a_L\right)\end{array}\right\}$$

$$\text{(ii)}\left\{\begin{array}{c}\pi_A\left(\rho\left(m\right),a_H\right)-c=\pi_A\left(\rho\left(n\right),a_H\right)\\\pi_A\left(\rho\left(m\right),a_L\right)-c>\pi_A\left(\rho\left(n\right),a_L\right)\end{array}\right\}$$

$$\text{(iii)}\left\{\begin{array}{c}\pi_A\left(\rho\left(m\right),a_H\right)-c=\pi_A\left(\rho\left(n\right),a_H\right)\\\pi_A\left(\rho\left(m\right),a_L\right)-c=\pi_A\left(\rho\left(n\right),a_L\right)\end{array}\right\}$$

$$\text{(iv)}\left\{\begin{array}{c}\pi_A\left(\rho\left(m\right),a_H\right)-c<\pi_A\left(\rho\left(n\right),a_H\right)\\\pi_A\left(\rho\left(m\right),a_L\right)-c=\pi_A\left(\rho\left(n\right),a_L\right)\end{array}\right\}$$

Proof. $\frac{\partial\pi_A(\rho(k),a)}{\partial a}>0$ and $\frac{\partial^2\pi_A(\rho(k),a)}{\partial a\partial\rho(k)}=\frac{\partial^2\pi_A(\rho(k),a)}{\partial\rho(k)\partial a}>0\Rightarrow$

If $\rho(m)>\rho(n)$, then

$$\pi_A\left(\rho\left(m\right),a_H\right)-\pi_A\left(\rho\left(n\right),a_H\right)>\pi_A\left(\rho\left(m\right),a_L\right)-\pi_A\left(\rho\left(n\right),a_L\right)$$

If $\rho(m)=\rho(n)$, then

$$\pi_A\left(\rho\left(m\right),a_H\right)-\pi_A\left(\rho\left(n\right),a_H\right)=\pi_A\left(\rho\left(m\right),a_L\right)-\pi_A\left(\rho\left(n\right),a_L\right)=0$$

If $\rho(m)<\rho(n)$, then

$$\pi_A\left(\rho\left(m\right),a_H\right)-\pi_A\left(\rho\left(n\right),a_H\right)<\pi_A\left(\rho\left(m\right),a_L\right)-\pi_A\left(\rho\left(n\right),a_L\right)$$

None of the four cases satisfies these conditions.

Appendix B.

In this section of the appendix, I will describe all the possible cases with detail. First, notice that due to $\frac{\partial^2 W_A(s,a)}{\partial s^2} < 0$, the policymaker never plays a mixed strategy. Second, since $\frac{\partial^2 \pi_A(a,s)}{\partial a \partial s} = \frac{\partial^2 \pi_A(a,s)}{\partial s \partial a} > 0$, the profit function satisfies the so called single-crossing property which is important for obtaining separating equilibria in signaling games.

$$\text{Define}\left\{\begin{array}{c} W = \frac{(a_H - a_L)(5a_H + a_L)}{36}, \quad X = \frac{(a_H - a_L)(a_H + 5a_L)}{36}, \\ Y = \frac{(1-\mu)(a_H - a_L)[(5+\mu)a_H + (1-\mu)a_L]}{36} \\ Z = \frac{\mu(a_H - a_L)[\mu a_H + (6-\mu)a_L]}{36}, \quad T = \frac{\mu(4+\mu)[\mu a_H + (6-\mu)a_L][(4+\mu)a_H + (2-\mu)a_L]}{576} \end{array}\right\}$$

where W, X, Y, and Z are the boundary values of c for each type of equilibrium. T shows the values of c that make the high demand firm's payoff under semi-pooling equilibrium (in which only low type plays a mixed strategy) and pooling equilibrium (with no message) equal.

Case 1.

$$\left\{\begin{array}{c} \pi_A(\rho(m), a_H) - c > \pi_A(\rho(n), a_H) \\ \pi_A(\rho(m), a_L) - c < \pi_A(\rho(n), a_L) \end{array}\right\}$$

$\sigma(m|a_H) = 1,\ \sigma(n|a_H) = 0,\ \sigma(m|a_L) = 0,\ \sigma(n|a_L) = 1$

$g(a_H|m) = 1,\ g(a_L|m) = 0,\ g(a_H|n) = 0,\ g(a_L|n) = 1$

$\rho(m) = \frac{a_H}{4},\ \rho(n) = \frac{a_L}{4}$

This case holds if $X < c < W$

Given the condition in case-1, posterior probabilities can easily be obtained and the policymaker determines his/her export subsidy as follows:

If $k = m \Longrightarrow g(a_H|m) = 1$ and $g(a_L|m) = 0$

The Policymaker's problem is $\max_s \left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3} \Rightarrow \rho(m) = \frac{a_H}{4}$

If $k = n \Longrightarrow g(a_H|n) = 0$ and $g(a_L|n) = 1$

The Policymaker's problem is $\max_s \left(a_L - \frac{2a_L+s}{3}\right)\frac{a_L+2s}{3} \Rightarrow \rho(n) = \frac{a_L}{4}$

Case 2.

$$\left\{\begin{array}{c} \pi_A(\rho(m), a_H) - c < \pi_A(\rho(n), a_H) \\ \pi_A(\rho(m), a_L) - c < \pi_A(\rho(n), a_L) \end{array}\right\}$$

$\sigma(m|a_H) = 0,\ \sigma(n|a_H) = 1,\ \sigma(m|a_L) = 0,\ \sigma(n|a_L) = 1$

$g(a_H|m) = 1,\ g(a_L|m) = 0,\ g(a_H|n) = \mu,\ g(a_L|n) = 1 - \mu$

$\rho(m) = \frac{a_H}{4},\ \rho(n) = \frac{\mu a_H + (1-\mu)a_L}{4}$

This case holds if $Y < c$

In this case, $\mu\sigma(m|a_H) + (1-\mu)\sigma(m|a_L) = 0$. I cannot determine $g(a_H|m)$ by using Bayes' rule. However, I can use universal divinity refinement. Since $\frac{\partial^2\pi(s,a)}{\partial s\partial a} = \frac{\partial^2\pi(s,a)}{\partial a\partial s} > 0$, high demand type has the weakest disincentive to deviate from $k = n$ to $k = m$, so $g(a_H|m) = 1$ and $g(a_L|m) = 0$.

If $k = m \Longrightarrow g(a_H|m) = 1$ and $g(a_L|m) = 0$

The Policymaker's problem is $\max_s \left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3} \Rightarrow \rho(m) = \frac{a_H}{4}$

If $k = n \Longrightarrow g(a_H|n) = \mu$ and $g(a_L|n) = 1 - \mu$

The Policymaker's problem is $\max_s \left\{ \begin{array}{c} \mu\left[\left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3}\right] + \\ (1-\mu)\left[\left(a_L - \frac{2a_L+s}{3}\right)\frac{a_L+2s}{3}\right] \end{array} \right\}$

$\Rightarrow \rho(n) = \frac{\mu a_H + (1-\mu)a_L}{4}$

Case 3.

$$\left\{ \begin{array}{c} \pi_A(\rho(m), a_H) - c > \pi_A(\rho(n), a_H) \\ \pi_A(\rho(m), a_L) - c > \pi_A(\rho(n), a_L) \end{array} \right\}$$

$\sigma(m|a_H) = 1,\ \sigma(n|a_H) = 0,\ \sigma(m|a_L) = 1,\ \sigma(n|a_L) = 0$

$g(a_H|m) = \mu,\ g(a_L|m) = 1 - \mu,\ g(a_H|n) = 0,\ g(a_L|n) = 1$

$\rho(m) = \frac{\mu a_H + (1-\mu)a_L}{4}$, $\rho(n) = \frac{a_L}{4}$

This case holds if $c < Z$

In this case, $\mu\sigma(n|a_H) + (1-\mu)\sigma(n|a_L) = 0$. I cannot determine $g(a_H|n)$ by using Bayes' rule. However, I can use universal divinity refinement. Since $\frac{\partial^2\pi(s,a)}{\partial s\partial a} = \frac{\partial^2\pi(s,a)}{\partial a\partial s} > 0$, low demand type has the weakest disincentive to deviate from $k = m$ to $k = n$, so $g(a_H|n) = 0$ and $g(a_L|n) = 1$.

If $k = m \Longrightarrow g(a_H|m) = \mu$ and $g(a_L|m) = 1-\mu$.

The Policymaker's problem is $\max_s \left\{ \begin{array}{c} \mu\left[\left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3}\right] + \\ (1-\mu)\left[\left(a_L - \frac{2a_L+s}{3}\right)\frac{a_L+2s}{3}\right] \end{array} \right\}$

$\Rightarrow \rho(m) = \frac{\mu a_H + (1-\mu)a_L}{4}$

If $k = n \Longrightarrow g(a_H|n) = 0$ and $g(a_L|n) = 1$

The Policymaker's problem is $\max_s \left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3} \Rightarrow \rho(n) = \frac{a_L}{4}$

Case 4.

$$\left\{ \begin{array}{c} \pi_A(\rho(m), a_H) - c = \pi_A(\rho(n), a_H) \\ \pi_A(\rho(m), a_L) - c < \pi_A(\rho(n), a_L) \end{array} \right\}$$

$\sigma(m|a_H) = 1 - \frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}$, $\sigma(n|a_H) = \frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}$

$\sigma(m|a_L) = 0$, $\sigma(n|a_L) = 1$

$g(a_H|m) = 1,\ g(a_L|m) = 0$

$g(a_H|n) = \frac{3\sqrt{a_H^2-4c}-(2a_H+a_L)}{a_H-a_L},\ g(a_L|n) = \frac{3\left(a_H-\sqrt{a_H^2-4c}\right)}{a_H-a_L}$

$\rho(m) = \frac{a_H}{4},\ \rho(n) = \frac{3\sqrt{a_H^2-4c}-2a_H}{4}$

This case holds if $Y \leq c \leq W$

Here, Firm A, facing a high demand intercept, plays a mixed strategy. Since $k = m$ can only come from high type, $g(a_H|m) = 1$ and $g(a_L|m) = 0$.

If $k = m \Longrightarrow g(a_H|m) = 1$ and $g(a_L|m) = 0$

The Policymaker's problem is $\max_s \left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3} \Rightarrow \rho(m) = \frac{a_H}{4}$

In order to find $\rho(n)$, I will use $\pi_A(\rho(m), a_H) - c = \pi_A(\rho(n), a_H)$

That is; $\frac{\left(a_H+2\frac{a_H}{4}\right)^2}{9} - c = \frac{(a_H+2\rho(n))^2}{9} \Rightarrow \rho(n) = \frac{3\sqrt{a_H^2-4c}-2a_H}{4}$

Now, in order to find Firm A's mixed strategy when facing a high demand intercept, I will use the following equation:

$$\rho(n) = \max_{s\in S}\left\{\begin{array}{c} \left[\left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3}\right] g(a_H|n) + \\ \left[\left(a_L - \frac{2a_L+s}{3}\right)\frac{a_L+2s}{3}\right] g(a_L|n) \end{array}\right\}$$

$FOC: \frac{(a_H-4s)\mu(1-\sigma(m|a_H))+(a_L-4s)(1-\mu)}{\mu(1-\sigma(m|a_H))+(1-\mu)} = 0 \Rightarrow s = \frac{\mu(1-\sigma(m|a_H))a_H+(1-\mu)a_L}{4(\mu(1-\sigma(m|a_H))+(1-\mu))}$

Since $s = \rho(n) \Rightarrow \frac{\mu(1-\sigma(m|a_H))a_H+(1-\mu)a_L}{4(\mu(1-\sigma(m|a_H))+(1-\mu))} = \frac{3\sqrt{a_H^2-4c}-2a_H}{4}$

$\sigma(m|a_H) = 1 - \frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}$, $\sigma(n|a_H) = \frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}$

Then, $g(a_H|n)$ and $g(a_L|n)$ can be easily found.

Case 5.

$$\left\{\begin{array}{c} \pi_A(\rho(m), a_H) - c > \pi_A(\rho(n), a_H) \\ \pi_A(\rho(m), a_L) - c = \pi_A(\rho(n), a_L) \end{array}\right\}$$

$\sigma(m|a_H) = 1,\ \sigma(n|a_H) = 0$

$\sigma(m|a_L) = \frac{\mu}{1-\mu}\frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{3\left(\sqrt{a_L^2+4c}-a_L\right)},\ \sigma(n|a_L) = 1 - \frac{\mu}{1-\mu}\frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{3\left(\sqrt{a_L^2+4c}-a_L\right)}$

$g(a_H|m) = \frac{3\left(\sqrt{a_L^2+4c}-a_L\right)}{a_H-a_L},\ g(a_L|m) = \frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{a_H-a_L}$

$g(a_H|n) = 0,\ g(a_L|n) = 1$

$\rho(m) = \frac{3\sqrt{a_L^2+4c}-2a_L}{4},\ \rho(n) = \frac{a_L}{4}$

This case holds if $Z \leq c \leq X$

Here, Firm A, facing a low demand intercept, plays a mixed strategy. Since $k = n$ can only come from a low type, $g(a_H|n) = 0$ and $g(a_L|m) = 1$.

If $k = n \Longrightarrow g(a_H|n) = 0$ and $g(a_L|n) = 1$

The Policymaker's problem is $\max_s \left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3} \Rightarrow \rho(n) = \frac{a_L}{4}$

In order to find $\rho(m)$, I will use $\pi_A(\rho(m), a_L) - c = \pi_A(\rho(n), a_L)$

That is; $\frac{(a_L+2\rho(m))^2}{9} - c = \frac{\left(a_L+2\frac{a_L}{4}\right)^2}{9} \Rightarrow \rho(m) = \frac{3\sqrt{a_L^2+4c}-2a_L}{4}$

Now, in order to find Firm A's mixed strategy when facing a low demand intercept, I will use the following equation:

$$\rho(m) = \max_{s\in S}\left\{\begin{array}{c}\left[\left(a_H - \frac{2a_H+s}{3}\right)\frac{a_H+2s}{3}\right] g(a_H|m) + \\ \left[\left(a_L - \frac{2a_L+s}{3}\right)\frac{a_L+2s}{3}\right] g(a_L|m)\end{array}\right\}$$

$FOC: \frac{(a_H-4s)\mu+(a_L-4s)(1-\mu)\sigma(m|a_L)}{\mu+(1-\mu)\sigma(m|a_L)} = 0 \Rightarrow s = \frac{\mu a_H+(1-\mu)\sigma(m|a_L)a_L}{4(\mu+(1-\mu)\sigma(m|a_L))}$

Since $s = \rho(m) \Rightarrow \frac{\mu a_H+(1-\mu)\sigma(m|a_L)a_L}{4(\mu+(1-\mu)\sigma(m|a_L))} = \frac{3\sqrt{a_L^2+4c}-2a_L}{4}$

$\sigma(m|a_L) = \frac{\mu}{1-\mu}\frac{\left(a_H+2a_L-3\sqrt{a_L^2+4c}\right)}{3\left(\sqrt{a_L^2+4c}-a_L\right)},\ \sigma(n|a_L) = 1 - \frac{\mu}{1-\mu}\frac{\left(a_H+2a_L-3\sqrt{a_L^2+4c}\right)}{3\left(\sqrt{a_L^2+4c}-a_L\right)}$

Appendix C.

Expected Payoffs.

The first thing to note is that, the expected payoff of the firm under the pooling equilibrium with sending no-message is the same as the expected payoff under the case without signaling. This is important to compare the high demand firm's payoffs with signaling and without signaling.[50]

The policymaker's payoff is higher if the message cost is at least equal to the lower bound of the separating equilibrium. Furthermore, the region where the policymaker benefits from the communication opportunity is bigger than the region where a high demand firm benefits.[51]

In this section, $\pi_A(\rho(k), a, c)$ denotes the profit of the Firm A inclusive of the exogenous lobbying cost.

Case 1.

$$E[W_A(\rho(k), a)] = (1-\lambda)\frac{\mu a_H^2 + (1-\mu)a_L^2}{8} + (2\lambda - 1)\mu c$$

$$E[\pi_A(\rho(k), a_H, c)] = \frac{a_H^2}{4} - c,\ E[\pi_A(\rho(k), a_L, c)] = \frac{a_L^2}{4}$$

Case 2.

$$E[W_A(\rho(k), a)] = (1-\lambda)\frac{\mu(8+\mu)a_H^2 + 2\mu(1-\mu)a_L a_H + (1-\mu)(9-\mu)a_L^2}{72}$$

$$E[\pi_A(\rho(k), a_H, c)] = \frac{[(2+\mu)a_H + (1-\mu)a_L]^2}{36},\ E[\pi_A(\rho(k), a_L, c)] = \frac{[\mu a_H + (3-\mu)a_L]^2}{36}$$

---

[50] See Figure 6 for the case $\lambda = \frac{1}{2}$. One can show that under the Y curve, the separating equilibrium makes the high demand firm better off than without signaling. In addition, in the region between X and T curves, the semi-pooling equilibrium (with low type playing a mixed strategy) is also beneficial for the high type. See appendix B for the definition of Y, X and T.

[51] Compare Figure 6 and Figure 7 for the case $\lambda = \frac{1}{2}$.

Case 3.

$$E\left[W_A(\rho\left(k\right),a)\right] = (1-\lambda)\frac{\mu(8+\mu)a_H^2+2\mu(1-\mu)a_La_H+(1-\mu)(9-\mu)a_L^2}{72} + \left(2\lambda-1\right)c$$

$$E\left[\pi_A\left(\rho\left(k\right),a_H,c\right)\right] = \frac{\left[(2+\mu)a_H+(1-\mu)a_L\right]^2}{36} - c$$

$$E\left[\pi_A\left(\rho\left(k\right),a_L,c\right)\right] = \frac{\left[\mu a_H+(3-\mu)a_L\right]^2}{36} - c$$

Case 4.

$$E\left[W_A(\rho\left(k\right),a)\right] = (1-\lambda)\mu\left[1-\frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}\right]\frac{a_H^2}{8}$$

$$+(1-\lambda)\mu\left[\frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}\right]\bullet$$

$$\left[\frac{8a_H^2+2a_H\left(3\sqrt{a_H^2-4c}-2a_H\right)-\left(3\sqrt{a_H^2-4c}-2a_H\right)^2}{72}\right]$$

$$+(1-\lambda)\left(1-\mu\right)\left[\frac{8a_L^2+2a_L\left(3\sqrt{a_H^2-4c}-2a_H\right)-\left(3\sqrt{a_H^2-4c}-2a_H\right)^2}{72}\right]$$

$$-(2\lambda-1)\mu\left[1-\frac{1-\mu}{\mu}\frac{\left(3\sqrt{a_H^2-4c}-(2a_H+a_L)\right)}{3\left(a_H-\sqrt{a_H^2-4c}\right)}\right]c$$

$$E\left[\pi_A\left(\rho\left(k\right),a_H,c\right)\right] = \frac{a_H^2}{4} - c$$

$$E\left[\pi_A\left(\rho\left(k\right),a_L,c\right)\right] = \frac{\left[3\sqrt{a_H^2-4c}-2(a_H-a_L)\right]^2}{36}$$

Case 5.

$$E\left[W_A(\rho\left(k\right),a)\right]=(1-\lambda)\mu\left[\frac{8a_H^2+2a_H\left(3\sqrt{a_L^2+4c}-2a_L\right)-\left(3\sqrt{a_L^2+4c}-2a_L\right)^2}{72}\right]$$

$$+(1-\lambda)\left(1-\mu\right)\left[\frac{\mu}{1-\mu}\frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{3\left(\sqrt{a_L^2+4c}-a_L\right)}\right]\bullet$$

$$(1-\lambda)\left[\frac{8a_L^2+2a_L\left(3\sqrt{a_L^2+4c}-2a_L\right)-\left(3\sqrt{a_L^2+4c}-2a_L\right)^2}{72}\right]$$

$$+(1-\lambda)\left(1-\mu\right)\left[1-\frac{\mu}{1-\mu}\frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{3\left(\sqrt{a_L^2+4c}-a_L\right)}\right]\frac{a_L^2}{8}$$

$$-\mu\left[1+\frac{a_H+2a_L-3\sqrt{a_L^2+4c}}{3\left(\sqrt{a_L^2+4c}-a_L\right)}\right]c$$

$$E\left[\pi_A\left(\rho\left(k\right),a_H,c\right)\right]=\frac{\left[2(a_H-a_L)+3\sqrt{a_L^2+4c}\right]^2}{36}-c$$

$$E\left[\pi_A\left(\rho\left(k\right),a_L,c\right)\right]=\frac{a_L^2}{4}$$

Appendix D

First, note that $W(s,a) = \frac{a^2+as-2s^2}{9}$, $\pi_A(s,a) = \frac{(a+2s)^2}{9}$. Moreover, $\frac{\partial^2 W}{\partial s^2} < 0$, $\frac{\partial^2 W}{\partial s \partial a} = \frac{\partial^2 W}{\partial a \partial s} > 0$, $\frac{\partial \pi_A}{\partial s} > 0$, $\frac{\partial^2 \pi_A}{\partial s \partial a} = \frac{\partial^2 \pi_A}{\partial a \partial s} > 0$. Let $s(p,q)$ denote the policymaker's best reply given that $p \leq a \leq q$, that is;

$$s(p,q) = \arg\max_s \int_p^q W(s,a) f(a) da if p < q and x(p,p) = x(p)$$

In addition, let $G(a)$ denote the gain for type a from pooling with all higher types rather than lower types, that is;

$$G(a) = \pi_A(s(a_H, a), a) - \pi_A(s(a, a_L), a) > 0$$

Proposition 7. If for some type $a^\star$, $G(a^\star) = c$, then $\sigma(n|a) = 1$ for all $a < a^\star$, $\sigma(m|a) = 1$ for all $a > a^\star$, $\rho(n) = s(a_L, a^\star)$ and $\rho(m) = s(a^\star, a_H)$ is a PBE.

Proof. Since $\frac{\partial \pi_A(s,a)}{\partial s} > 0$, if $G(a^\star) = c > 0$, then $\rho(m) > \rho(n)$.

Since $\frac{\partial \pi_A(\rho(m),a) - \pi_A(\rho(n),a)}{\partial a} > 0$, if $\pi_A(\rho(m), a^\star) - \pi_A(\rho(n), a^\star) = c$, then

(i) $for\ a > a^\star$, $\pi_A(\rho(m), a) - \pi_A(\rho(n), a) > c \Longrightarrow \sigma(m|a) = 1$, $\sigma(n|a) = 0$

(ii) $for\ a < a^\star$, $\pi_A(\rho(m), a) - \pi_A(\rho(n), a) < c \Longrightarrow \sigma(m|a) = 0$, $\sigma(n|a) = 1$

The Policymaker's problem:

$$\rho(m) = \max_s \int_{a^\star}^{a_H} \left[\left(a - \frac{2a+s}{3}\right)\frac{a+2s}{3}\right] f(a)\, da \Rightarrow \rho(m) = \frac{E(a|a>a^\star)}{4}$$

$$\rho(n) = \max_s \int_{a_L}^{a^\star} \left[\left(a - \frac{2a+s}{3}\right)\frac{a+2s}{3}\right] f(a)\, da \Rightarrow \rho(n) = \frac{E(a|a<a^\star)}{4}$$

Moreover, since $\frac{\partial G}{\partial a} > 0$, separating PBE is the only equilibrium provided that,

$\frac{(a_H - a_L)(a_H + 11a_L)}{144} < c < \frac{(a_H - a_L)(11a_H + a_L)}{144}$.

FIGURES

In this section, for given parameter values ($\lambda = \frac{1}{2}$, $a_H = 16$ and $a_L = 4$), I will show the regions for each equilibrium type as well as the regions in which the policymaker and the firm prefer lobbying to no lobbying.

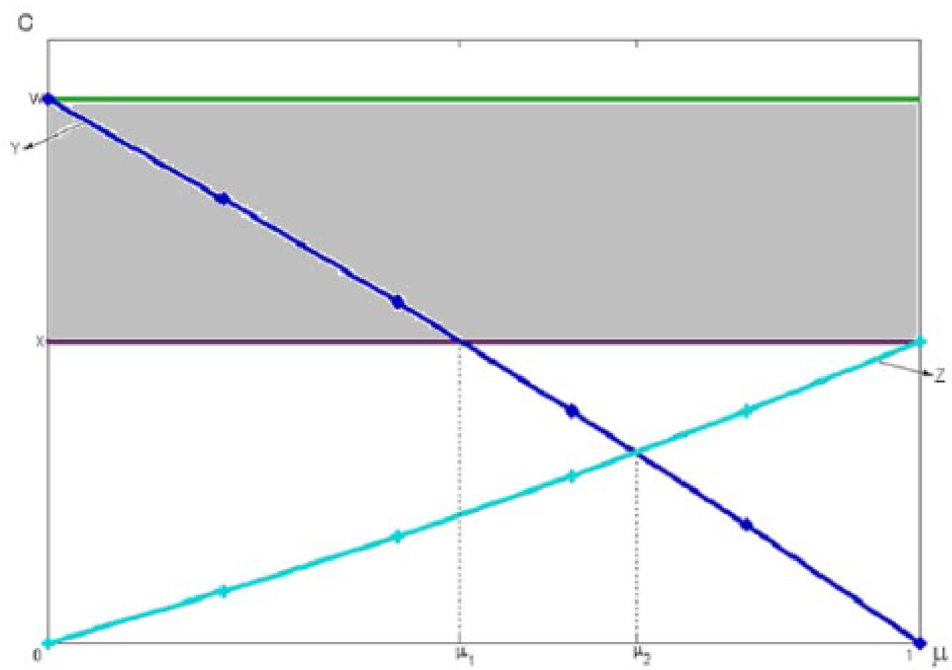

Figure 1. SEPARATING EQUILIBRIA (shaded region)

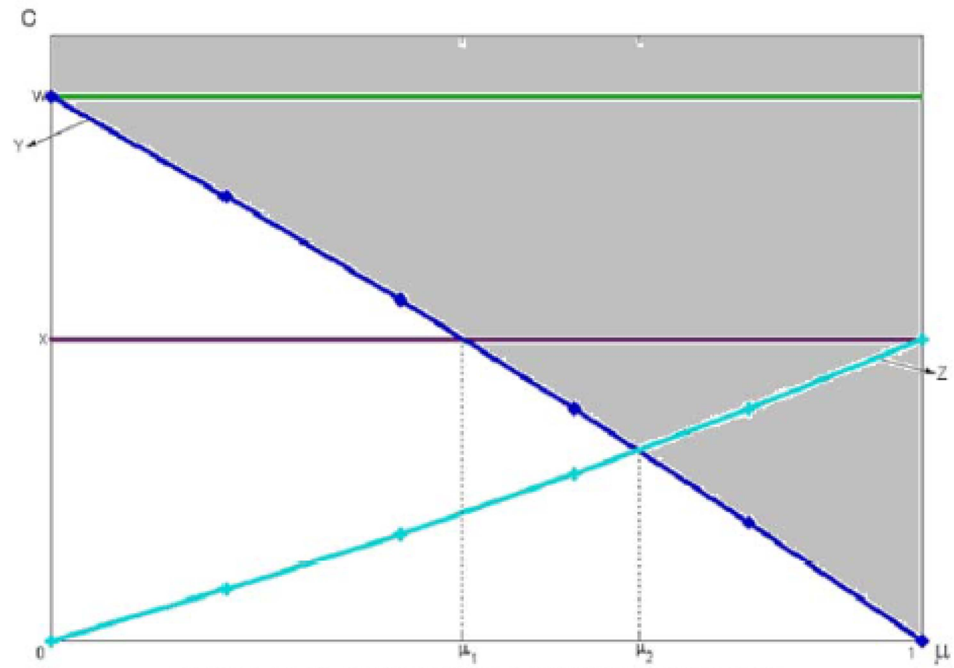

Figure 2. POOLING EQUILIBRIA (shaded region)
(pooling on sending no message)

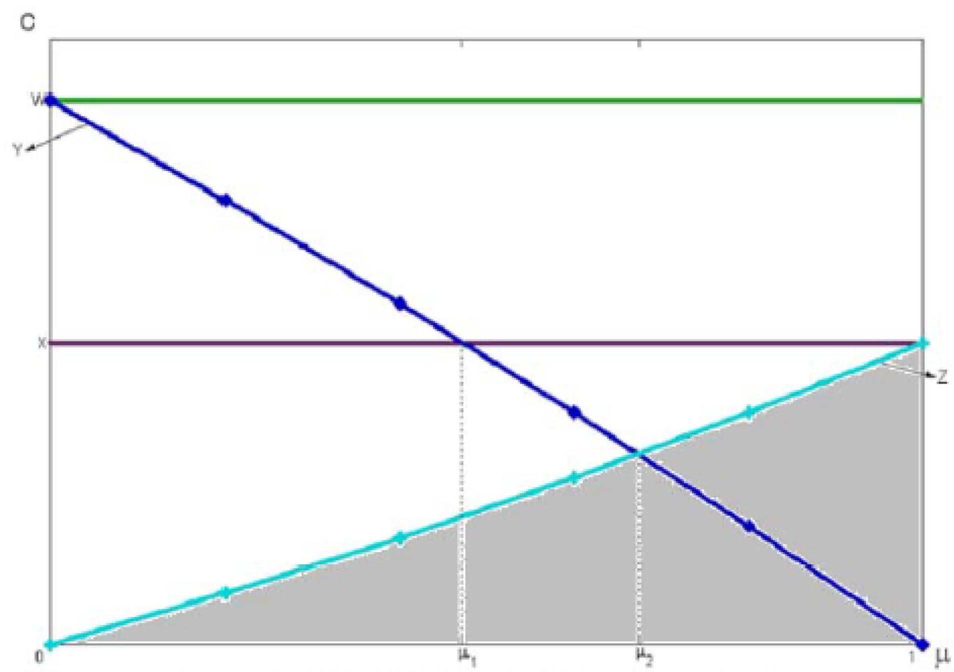

Figure 3. POOLING EQUILIBRIA (shaded region)
(pooling on sending a message)

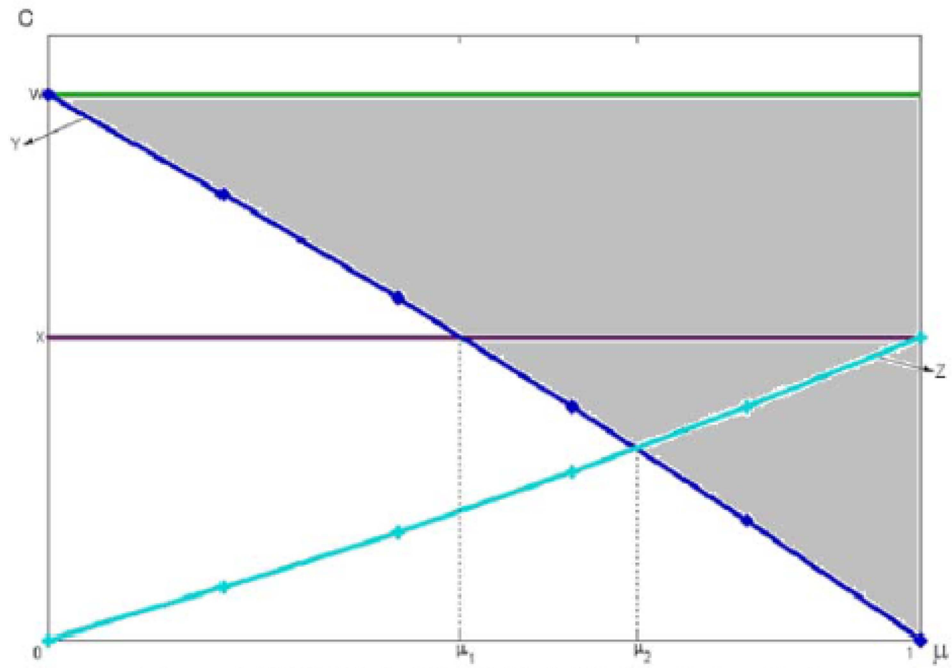

Figure 4. SEMI-POOLING EQUILIBRIA (shaded region)
(only high type plays a mixed strategy)

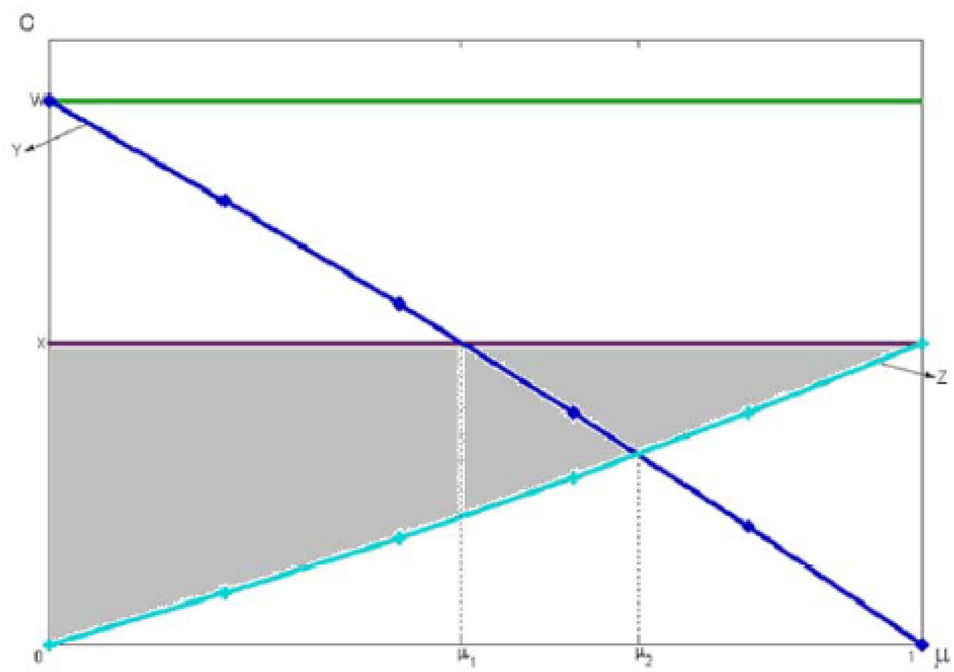

Figure 5. SEMI-POOLING EQUILIBRIA (shaded region)
(only low type plays a mixed strategy)

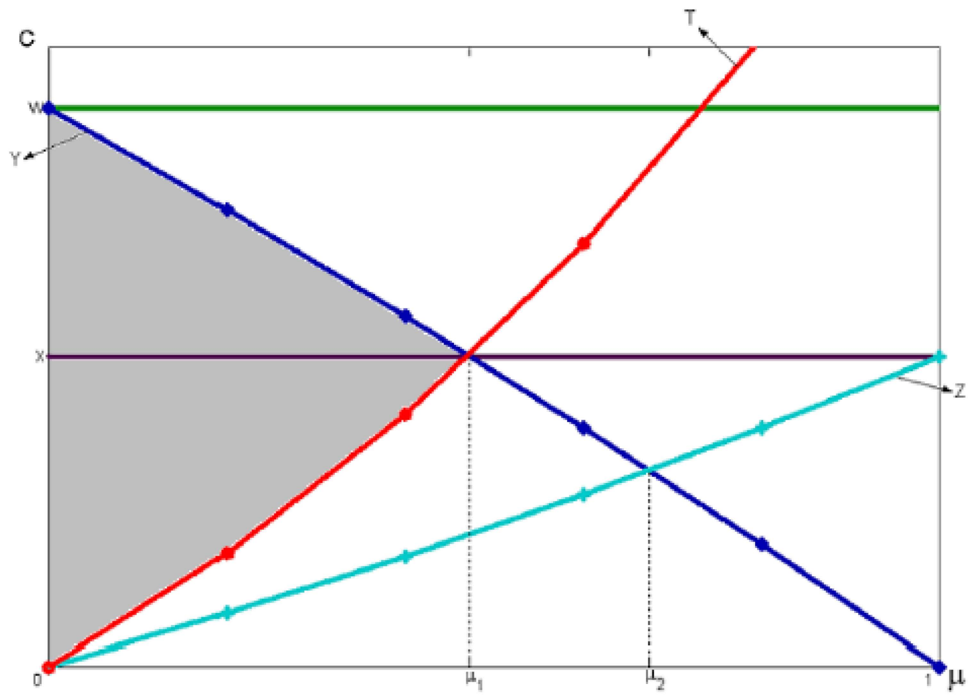

Figure 6. High type benefits (shaded region)

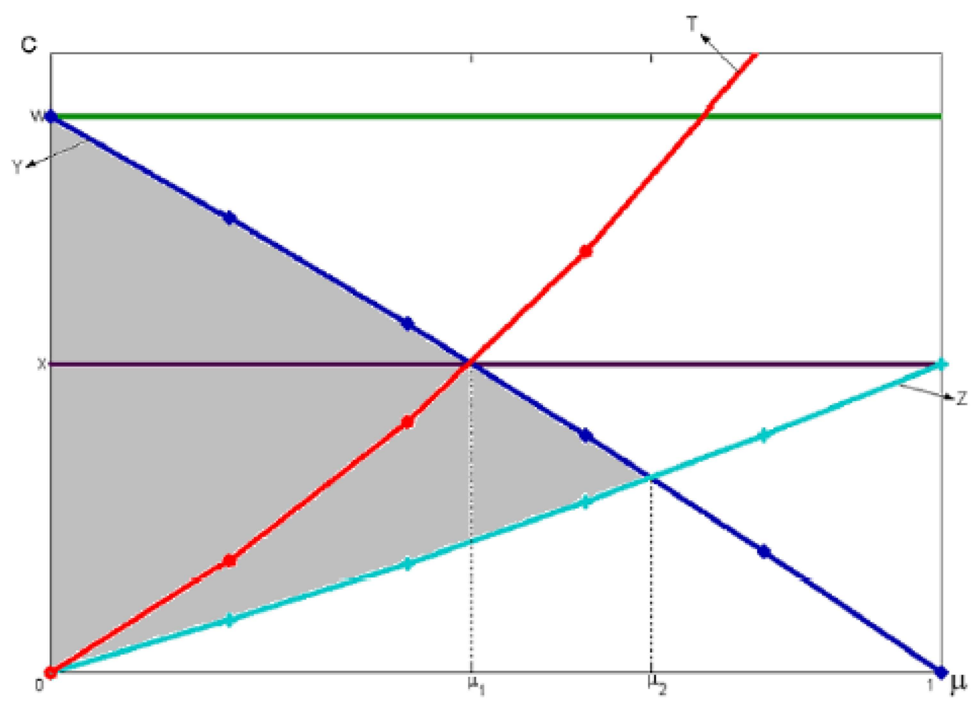

Figure 7. Policymaker benefits (shaded region)

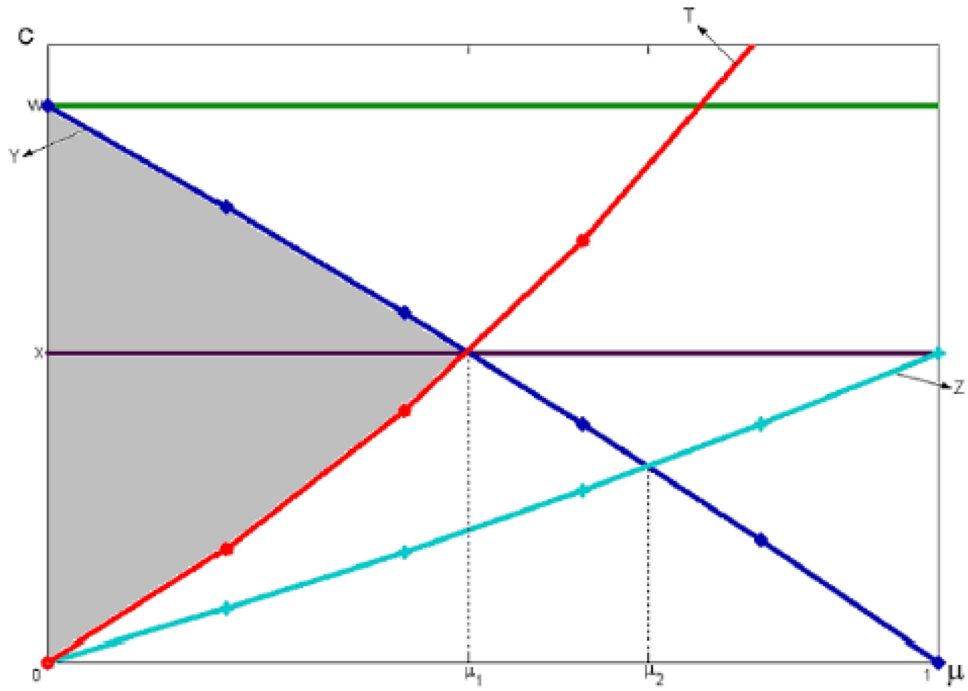

Figure 8. Policymaker and high type both benefit (shaded region)

Chapter 4

Trade Policy Making by an Assembly

Co-authored with John McLaren

4.1 Introduction.

Increasingly, trade economists have shown an interest in understanding the *determinants* of trade policies as well as their effects. Influential examples include Mayer's (1984) electoral model of trade policy formation, Findlay and Wellisz's (1982) model of tariff lobbying and Grossman and Helpman's (1994) influence-peddling model of tariff-setting. The literature has grown quite dense in recent years; see Nelson (2002) for an interpretative survey.

Despite the research interest, the theoretical literature has remained strikingly unidimensional in an important respect: The assumption of a unitary government. If Mayer's model is interpreted as a contest between candidates for office (who commit to policy decisions in advance of elections), then once the winning candidate takes office she sets the tariff without any need for consultation. In lobbying and influence-peddling models, an interest group influences a decision-maker who is assumed to have unimpeded power to set trade policy within the country. These assumptions have become standard practice.

The unreality of these assumptions is revealed by a glance at trade policy history. With the possible exception of pure administered protection such as anti-dumping, trade policy in democracies is normally the product of multiple decision-makers, often with sharply differing interests. In most countries trade policy is set by a parliament and is therefore the outcome of legislative bargaining and cooperative or non-cooperative voting. In the United States, it is set by two houses that must come to mutual agreement, and is then subject to presidential veto. In all democracies, a trade treaty is negotiated by the executive branch and must then be ratified by a domestic assembly.

This all requires that we think of trade policy as being set by an *organization*, not by a single individual endowed with authority. Many details of trade policy making in practice cannot even be addressed without such considerations, such as the battles for ratification of the NAFTA and Uruguay round in the United States and the central issue of "fast-track" authority, which is meaningless in a pure presidential model.

In this paper, we extend one standard model of trade policy formation (specifically the median-voter framework most associated with Mayer, 1984) to a rudimentary model of a government by assembly in which political parties compete for control of seats by making binding election promises. We focus on the simplest possible example in the hopes that it will make some of the key issues as clear as possible. This exercise reveals a number of sharp predictions. First, import-competing interests are more likely to receive protection if they are moderately geographically concentrated. If import-competing interests are concentrated in a few locations in the country, they may dominate those areas politically but will control too few seats to be able to control the assembly. If they are too disperse, they will not be politically dominant anywhere and will thus control no seats. Only with a moderate level of geographical concentration can they secure enough political clout for protection. This non-monotonic relationship should be readily testable.

Second, an assembly system will be less likely to secure protection than a presidential system if import-competing interests are in the majority nationally, and more likely if they are a national minority. If we interpret the second case as more likely in practice, this argues for a presumption that assemblies tend to be more protectionist than presidential systems.

Third, the unique equilibrium tariff is the optimal tariff of the median voter in the median congressional district, rather than the national median voter. This results in a dramatic break with the familiar models: For a given national distribution of trade policy preferences, depending on the way voters are allocated to voting districts, the equilibrium tariff can be anywhere from the 25th percentile voter's most preferred level to the 75th percentile voter's most preferred. Thus, moving from a single district (the unitary model) to two districts changes the range of outcomes dramatically, while a subsequent increase in the number of districts does not change the range at all. This indicates that the median voter results are actually quite fragile.

This paper is related to a number of strains of existing literature. Political science has, of course, no habit of assuming a unitary government. There is a long history of political scholarship on the behavior of Congress; influential studies include Krehbiel (1991) and Poole and Rosenthal (1997). In recent years, many political scholars have focused on intra-governmental complications in the formation of trade policy. Putnam (1988), for example, studies 'two-level games,' in which one branch of government must negotiate with a foreign government and then present the agreement to domestic agents for ratification. Trade treaties are naturally a prime example. Lohmann and O'Halloran (1994) and Bailey, Goldstein and Weingast (1997) look at congressional behavior in setting trade policy, focusing on the relationship between executive and legislative branch behavior and the interpretation of such institutions as the Reciprocal Trade Agreements Act (RTAA) and the 'fast track' authority, both of which were acts of congress that at different times have constrained Congress' ability to amend trade treaties.

A number of authors have looked closely at the behavior of congressional voting on trade policy. For example, Baily and Brady (1998) and Dennis et. al. (2000) both study the importance of constituency characteristics including voter heterogeneity for explaining how senators voted on various recent trade bills. Economists studying congressional voting behavior include Peltzman (1985) (who showed that economic interest variables matter much more in explaining votes on taxation once state fixed effects are controlled for), Irwin and Krozner (1999) (who study the postwar changes in Republican congressional voting on trade), and Baldwin and Magee (2000) (who study congressional log-rolling on trade policy).

Most of this work focuses on fine details of political institutions such as the RTAA or fast-track authority, or analyzes empirically how individual senators or representatives choose to vote. The present paper, in the spirit of the theoretical papers listed at the outset, begins with a very simple, abstract model, to ask the question: How do economic fundamentals affect trade policy outcomes? And how does that mapping change if we move from a unitary government model to a government by assembly?

The next section describes the easiest form of assembly model, the 'specific factors' model in which each worker is qualified to work in only one sector. The following section presents a version with Heckscher-Ohlin features, which is in fact a generalization of the main model in Mayer (1984). The following section shows how the model can be adapted to analyze the effect of the 'electoral college' system in the United States. The final section offers some questions for future research.

4.2 A Specific-Factors Model.

4.2.1 Basic Structure.

Consider an economy called Home with two sectors, X and Y, each producing a homogeneous good under competitive conditions. Good Y is the numeraire. The only factor of production is labor, and each worker is either a 'type X,' who can produce X only, or a 'type Y,' who can produce Y only. There is a continuum of workers of type X, with measure L_X , and a continuum of type Y workers with measure L_Y. These supplies are exogenously given and $L_Y + L_X = L$. A worker of type j can produce 1 unit of good j per hour.

All Home citizens have identical and homothetic preferences, with indirect utility given by $v(I, p) = I/\varphi(p)$, where I denotes income, p denotes the price of good X, and φ is a price index, an increasing function of p.

The world relative price of good X is denoted p^W and is exogenous, since Home is a small open economy. Assume that $\frac{\varphi'(p^W)}{\varphi - \varphi'(p^W)p^W} > \frac{L_X}{L_Y}$. The left-hand side of this expression is (by Shephard's lemma) the ratio of Home demand for X to home demand for Y at world prices, and the right-hand side is the corresponding ratio of supplies. Thus, this condition ensures that Home has a comparative advantage in Y.

Every worker is a voter, and every voter is a worker. There are n districts, each with the same number of voters. Each district will send a representative to an assembly, which we will call the 'congress,' and which will determine trade policy. There are two parties, and all candidates for congress must be a member of one of these parties. Majority rule applies: The candidate with the largest number of votes wins the seat (with coin flips to break a tie). Further, the party with the larger number of seats can propose a trade policy; it goes up for a vote; and if it collects a majority of votes, it becomes law. Otherwise, the default of free trade remains in effect. We assume that party leadership can impose loyalty on its members, so that the majority party in congress effectively determines trade policy. (If there is an exact tie in congress, a coin toss determines which party can propose the trade policy, and it then goes up for a vote as before.)

An election is held to determine the representatives to congress. In each district, each party fields exactly one candidate. The national leadership of each party announces before the election what policy it will enact if it attains a majority in congress. These announcements are made simultaneously. In each district, then, each voter votes for the representative of the party whose announced policy that voter prefers. (All voters vote, and there is no strategic voting; voters simply vote their policy preferences, flipping a coin in the event of a tie.) Each party has an objective function that is simply increasing in its expected number of seats in congress.

4.2.2 Voters' Preferences and Equilibrium.

The X- and Y-voters are distributed to the various districts in an exogenous pattern. Denote the fraction of voters in district i who are of type X by ρ^i (so that $\sum_i \rho^i = \frac{nL_X}{L}$ and $\sum_i (1-\rho^i) = \frac{nL_Y}{L}$. Suppose that the only trade policy instrument available is a tariff on good X, denoted in *ad valorem* terms by τ, and that the tariff cannot be negative (say, because an import subsidy would create incentives for export and immediate re-import, which would be difficult to police). Suppose further that the tariff revenues are distributed lump-sum to all workers equally. We can now show that the preferred policy of the Y workers is free trade, while the preferred policy of the X workers is a strictly positive tariff .

Letting M denote aggregate imports of X, the utility of an X-worker is:

$$v^i(I_X, p) = \frac{I_X}{\varphi(p)},$$

where $I_x = p + \tau p^W \frac{M}{L}$, the marginal value product of X labor plus the typical X-worker's share of tariff revenue. Recalling that $p = (1+\tau)p^W$, we can write:

$$\frac{\partial v(I_X, p)}{\partial \tau} = \frac{p^W}{\varphi(p)} \left[1 + \frac{M}{L} + \frac{\tau \frac{\partial M}{\partial \tau}}{L} - \left(1 + \tau + \tau \frac{M}{L} \right) p^W \frac{\varphi'(p^W)}{\varphi(p)} \right].$$

If we evaluate this derivative at $\tau = 0$, we get:

$$\frac{\partial v(I_X, p)}{\partial \tau} |_{\tau=0} \frac{p^W}{\varphi(p)} \left[1 + \frac{M}{L} + p^W \frac{\varphi'(p^W)}{\varphi(p)} \right].$$

Note that by Shephard's lemma $p^W \frac{\varphi'(p^W)}{\varphi(p)}$ represents the share of the X-worker's expenditure that is spent on good X when $\tau = 0$. It is therefore between zero and unity, yielding:

$$\frac{\partial v(I_X, p)}{\partial \tau} |_{\tau=0} > 0.$$

Therefore, the X-worker's most preferred tariff is strictly positive.

Depending on parameters, this most-preferred tariff could be prohibitive. Let $\overline{\tau}$ denote the prohibitive tariff, or the tariff rate such that $M = 0$. Evaluating the

X-workers' welfare derivative at that point:

$$\frac{\partial v(I_X,p)}{\partial \tau}|_{M=0} = \frac{p^W}{\varphi(p)}\left[1+\frac{\tau\frac{\partial M}{\partial \tau}}{L}-(1+\tau)\,p^W\frac{\varphi'(p^W)}{\varphi(p)}\right]$$
$$= \frac{p^W}{\varphi(p)}\left[1+\frac{\tau\frac{\partial M}{\partial \tau}}{L}-\alpha\,(p)\right],$$

where $\alpha\,(p)$ denotes the share of consumer income spent on good X. (Strictly speaking, this needs to be interpreted as a left-hand derivative.) Since $\frac{\partial M}{\partial \tau} < 0$, clearly, if good X has a sufficiently large budget share, the derivative will be negative at the prohibitive tariff, and X workers will prefer a non-prohibitive tariff, defined by $\frac{\partial v(I_X,p)}{\partial \tau} = 0$. Either way, denote the X-workers' most preferred tariff level by $\tau = \tau^X$.

Treating the Y-workers in the same way, noting that the income of each Y-worker is equal to $I_Y = 1+\tau p^W \frac{M}{L}$, we obtain:

$$\frac{\partial v(I_Y,p)}{\partial \tau} = \frac{p^W}{\varphi(p)}\left[\frac{M}{L}+\frac{\tau\frac{\partial M}{\partial \tau}}{L}-\left(1+\tau p^W\frac{M}{L}\right)\frac{\varphi'(p^W)}{\varphi(p)}\right]$$
$$= \frac{p^W}{\varphi(p)}\left[\frac{M}{L}+\frac{\tau\frac{\partial M}{\partial \tau}}{L}-I_Y\frac{\varphi'(p^W)}{\varphi(p)}\right].$$

Note that $I_Y\frac{\varphi'(p^W)}{\varphi(p)}$ is each Y-worker's consumption of good X, by Shephard's lemma. Further, using the same logic, $\frac{M}{L} = \frac{(L_X I_X + L_Y I_Y)\frac{\varphi'(p)}{\varphi(p)} - L_X}{L}$. Since X-workers cannot consume more of good X than they produce, this cannot exceed $\frac{L_Y I_Y}{L}\frac{\varphi'(p)}{\varphi(p)}$. Since $L_Y < L$, we conclude that $M/L < I_Y\frac{\varphi'(p^W)}{\varphi(p)}$. Since $\frac{\partial M}{\partial \tau} < 0$, we conclude that Y-

workers' welfare is always decreasing in the tariff, so their most preferred tariff is $\tau^Y = 0$.

Before analyzing equilibrium in this model, let us consider what equilibrium would be like in a more familiar, unitary government model, in other words, what the equilibrium would be like if $n = 1$. This is essentially the case of Mayer (1981) (although the assumed structure of the economy is different), and it is well known that the unique equilibrium in that case is that the median voter's most preferred tariff will be implemented. Thus, $L_X > L_Y$ implies $\tau = \tau^X$, and $L_X < L_Y$ implies free trade.

However, the outcome is different if $n > 1$, as the following indicates.

Proposition 1. If there is an odd number of districts, then if they are ranked by ρ^i, if the median district has $\rho^i < \frac{1}{2}$, then the unique equilibrium in pure strategies is one in which both parties commit to $\tau = 0$, or free trade. If the median district has $\rho^i > \frac{1}{2}$, then the equilibrium is $\tau = \tau^X$.

The proof is straightforward. Suppose that for the median district $\rho^i < \frac{1}{2}$. Then if in equilibrium any party committed to a strictly positive tariff, the other party's best response would be a strictly lower tariff, ensuring a strict majority of votes in a strict majority of districts. But then the first party's tariff choice is sub-optimal, since it could achieve an expected number of seats equal to $\frac{n}{2}$ by committing itself to the same tariff as the other party. Thus, the only possible Nash equilibrium involves both parties choosing a zero tariff. Further, since any deviation from the zero tariff will only reduce the number of seats (to a certain minority rather than an expected value of $\frac{n}{2}$), this is itself a Nash equilibrium. The proof for the case in which $\rho^i > \frac{1}{2}$ is parallel.

It is easy to deal with the cases in which the median-of-medians is not unambiguously defined. Where n is odd, if $\rho^i = \frac{1}{2}$, then any pair of tariffs in the range $\left[0, \tau^X\right]$ is an equilibrium. If n is even, and if i and $i+1$ are the middle two districts in the ranking, then if ρ^i, $\rho^{i+1} > \frac{1}{2}$, the equilibrium is $\tau = \tau^X$; if ρ^i, $\rho^{i+1} < \frac{1}{2}$, the equilibrium is free trade; and if $\rho^i \leq \frac{1}{2} \leq \rho^{i+1}$, any pair of tariffs in the range $\left[0, \tau^X\right]$ is an equilibrium. These are all just generalizations of the median-of-medians. We will henceforth ignore these knife-edge cases.

Although this is clearly a simple generalization of the median voter theory, it should be pointed out that the difference in outcomes between the two models can be large. Consider the following two polar cases. First, suppose that $\frac{L_X}{L}$ has a value slightly larger than $\frac{1}{4}$, so that an X-worker would be nowhere near the median voter and so under the unitary model we would clearly have free trade. Now, in the congressional model suppose that n is fairly large and odd, and that the X-workers are distributed evenly among $\frac{n+1}{2}$ of the districts, with $\rho^i = 0$ in the other districts. Now, a bare majority of the voters in those $\frac{n+1}{2}$ districts is of type X, and since this is the majority of the districts, the equilibrium is now $\tau = \tau^X$.

Second, suppose that $\frac{L_X}{L}$ has a value slightly smaller than $\frac{3}{4}$, so that a Y-worker would be nowhere near the median voter and under the unitary model we would clearly have $\tau = \tau^X$. Now, in the congressional model suppose that the Y-workers are distributed evenly among $\frac{n+1}{2}$ of the districts, with $\rho^i = 1$ in the other districts. Now, a bare majority of the voters in those $\frac{n+1}{2}$ districts is of type Y, and since this is the majority of the districts, the equilibrium is now free trade.

In both of these cases, the median voter is very different from the median-median voter, and so the congressional model gives the opposite of the answer given by the unitary model.

4.2.3 Comparative Statics.

The following special case can help illustrate the role of intra-national geographic distribution of industry on trade policy in this model. Suppose that there are two kinds of district: There are m districts that have some X workers and some Y workers, and there are $n-m$ districts that have only Y workers. For all of the mixed districts, $\rho^i = \overline{\rho} \equiv \frac{L_X}{L}\frac{n}{m}$. As m ranges from 1 to n, the distribution of import-competing workers becomes less concentrated and the number of import-competing workers in each mixed district falls. To clear away some taxonomy, assume that n is odd. Clearly, if m is less than $\frac{n+1}{2}$, the outcome will be free trade (because the median voter of the median district will be a Y worker). At the same time, if $\frac{L_X}{L} > \frac{1}{2}$ and $m \geq \frac{n+1}{2}$ the equilibrium will be $\tau = \tau^X$, because even if the X-workers are spread as thinly as possible with $m = n$, the median voter in each district will be an X worker. If $\frac{2n}{n+1}\frac{L_X}{L} < \frac{1}{2}$, or $\frac{L_X}{L} < \frac{n+1}{4n}$, the outcome will be free trade regardless of m, since even if the X workers are as concentrated as possible subject to the constraint that the median district be mixed (in other words, even if $m = \frac{n+1}{2}$), the median voter in mixed districts will be a Y worker. Finally, if $\frac{n+1}{4n} < \frac{L_X}{L} < \frac{1}{2}$, then if $m < \frac{n+1}{2}$, the outcome will be free trade; if $m = n$, the outcome will be free trade; and for a range for m in between these extremes the equilibrium will be $\tau = \tau^X$.

To summarize, for this special case with homogeneous workers and homogeneous capitalists, if import-competing workers are found in a majority of districts and the import-competing sector is neither so large that it dominates the economy nor so small as to be politically negligible, then a protectionist policy will emerge *only if 'm' is in a middle range*, or only if the import-competing workers are moderately geographically concentrated.

4.3 A Mayer-Heckscher-Ohlin Model.

Now consider a different economy with the same political institutions. Here, we study a version of the Mayer (1984) model, with the national assembly described in the previous section grafted onto it.

Consider an economy that produces two goods, X and Y, using capital and labor with constant-returns-to-scale technology. Both factors are homogeneous, and can be transferred from production of one good to another instantly and costlessly. There are therefore a single price w for labor and a singe price r for capital services throughout the economy. The aggregate amount of labor available is denoted by L, and the aggregate amount of capital is denoted by K. Each citizen i has K^i units of capital and 1 unit of labor. Capital endowments vary from person to person, and the distribution can be summarized by a cumulative distribution function F. We number the citizens in increasing order of wealth (so that a higher value of i indicates a higher value of K^i).

Good Y is the numeraire, p^W is the world price of X, which is taken as given because the economy in question is small, and p is the domestic price of X. Assume that X is labor intensive and that there are no factor-intensity reversals. For now, we will assume for concreteness that X is the imported good (which is, of course, the same as assuming that the country under consideration is capital abundant compared to the rest of the world). The only trade policy available is an *ad valorem* tariff τ on imports of X, so that $p = (1+\tau)p^W$. All tariff revenue is distributed to the citizens in proportion to each citizen's factor income. Thus, if T is the aggregate tariff revenue, then citizen i receives a tariff revenue payment of $T^i = \alpha^i T$, where $\alpha^i = \frac{w+rK^i}{wL+rK}$. All citizens have identical and homothetic preferences summarized by the indirect utility function $v(p, I^i)$, where I^i represents the income of citizen i, including both factor income $(w + rK^i\ )$ and redistributed tariff revenue T^i.

Mayer (1984) shows that in this framework, under weak conditions on utility each citizen has strictly quasiconcave preferences over tariffs. We can thus speak of the unique most-preferred tariff level τ^i for each citizen i. Mayer shows that for a citizen i for whom $K^i = \frac{K}{L}$, $\tau^i = 0$. We can call this person the *average* citizen, denoted $\bar{i}$. Further, if $K^i > K$, $\tau^i < 0$, while if $K^i < K$, $\tau^i > 0$. Essentially, the poor want labor to be expensive, and thus want labor-intensive imports to be expensive, and hence desire trade protection. On the other hand, the rich want capital to be expensive, and thus want labor-intensive imports to be cheap, and hence desire *subsidized* imports if that is feasible. In addition, a citizen with a higher value of K^i will have a lower most preferred tariff, so by ranking the citizens in increasing wealth, we rank them in decreasing order of desired protection. (Of course, for a capital-poor economy, for which good X would be an export good, these preferences and rankings would be reversed; the poor would desire open trade, the rich protection, and ranking citizens by wealth would rank them in *increasing* order of desired tariff.)

Now, to address the question of how tariffs are determined, we add to this model the political structure as described in the previous section. Once again, we have n equally-sized districts, in each of which two candidates will compete for a seat in the assembly. Each candidate belongs to one of the two national parties, which can enforce national party discipline and can commit themselves in the election campaign to future policy, where the majority party establishes the agenda and determines the national tariff. The model studied by Mayer is essentially the special case in which $n = 1$, and the unique equilibrium is the implementation of the most preferred tariff of the median voter (that is, the voter i such that $F(K^i) = \frac{1}{2}$). All workers are voters (whether or not they own capital), so the total number of voters equals L.

Some additional notation is necessary to characterize equilibrium in the case with $n > 2$. Let the cumulative distribution function for the K^i's for the citizens in district j be denoted by F^j. (Thus, of course, $\frac{1}{n} \sum_j F^j(y) = F(y)\ \forall y$.) Let the most preferred tariff of the national median voter be denoted by τ^{med}, and the most preferred tariff of the median voter in district j be denoted by $\tau^{med,\, j}$. Without loss of generality, let us number the districts in increasing order of $\tau^{med,\, j}$, and if n is odd so that the median district is well-defined (that is, district $\frac{n+1}{2}$), then label the most preferred tariff of the median voter of the median district $\tau^{med,\, med}$.

It is straightforward, following the logic of the proposition of the previous section, to see the following.

Proposition 2. If n is odd, then the unique equilibrium is for the medium voter of the median district to be announced by both parties and to be implemented. If n is even, then any pair of tariffs in the range $\left[\tau^{med,\, \frac{n}{2}}, \tau^{med,\, \frac{n}{2}+1}\right]$ is an equilibrium.

The median-of-medians formula with $n > 1$ is clearly different from the simple median of the $n = 1$ case, but we need to be able to identify how different it is, and especially how its empirically measurable properties differ. The first piece of information to provide is a bound on how far from the simple median the median-of-medians can be. Consider the case in which n is odd. Note that one-half of the $\frac{L}{n}$ voters in the median district $\frac{n+1}{2}$ have a higher K^i, and hence desire a lower tariff, than the median voter of that district. In addition, since $\tau^{med,\, \frac{n-1}{2}} \leq \tau^{med,\, \frac{n+1}{2}} = \tau^{med,\, med}$, at least one half of voters in district $\frac{n-1}{2}$ prefer a lower tariff than the median-of-medians. Following this logic through all the way down to district 1, we find that at least $\frac{n+1}{2}\frac{L}{2n} = \frac{L(n+1)}{4n}$ voters prefer a lower tariff than the equilibrium. This same expression also gives a lower limit on the number of voters who prefer a higher tariff.

For the case with n even, at least $\sum_{j=1,\ \frac{n}{2}} \frac{L}{2n} = \frac{L}{4}$ voters prefer a lower tariff, and at least that many prefer a lower tariff, than the equilibrium. Thus, although we know that the equilibrium tariff may differ from the median voter's optimum, at least we know that it cannot be lower than the 25^{th} percentile voter's optimum, or higher than the 75^{th} percentile voter's.

Second, in a well-defined sense these bounds are minimal. Consider an arbitrary distribution F and let n be odd. It is easy to see that we can divide up the population among the n districts in such a way that the equilibrium tariff comes arbitrarily close to the 25^{th} percentile voter's optimum. Give each district an index number j from 1 to n and normalize the population size to unity. Take the richest half of the population and divide it evenly among the n districts. (It does not matter exactly which voters within this set are allocated to which districts). Now, for some small positive ε, move a mass $\left(\frac{n+1}{n-1}\right)\varepsilon$ of voters into each district with an index j strictly greater than $\frac{n+1}{2}$ and move ε out of each district with an index less than or equal to $\frac{n+1}{2}$. Now, each district with an index j between 1 and $\frac{n+1}{2}$ has a mass of $\left(\frac{1}{2n} - \varepsilon\right)$ voters. Fill out district 1 by adding the poorest $\left(\frac{1}{2n} + \varepsilon\right)$ voters, then fill out district 2 by adding the poorest $\left(\frac{1}{2n} + \varepsilon\right)$ voters not yet allocated, and so on until all districts have been filled (and hence all voters have been allocated). Each district 1 through $\frac{n+1}{2}$ will have a median voter drawn from the bottom half of the population, with the median voter for district $j+1$ richer than that from j, while each district with a higher index will have a median voter drawn from the top half of the population. Therefore, district

$\frac{n+1}{2}$ is the median district. In addition, the median voter of that district will be richer than $\left(\frac{n-1}{2}\right)\left(\frac{1}{2n}+\varepsilon\right)+\frac{1}{2n}=\frac{n+1}{4n}+\left(\frac{n-1}{2}\right)\varepsilon$ voters. By appropriate choice of ε, this can be made as close to $\frac{n+1}{4n}$ as one wants. The even case and the case for the upper limits are parallel.

This can be summarized in the following.

Proposition 3. Fix a national wealth distribution, F.

(i) In the case $n = 1$, the unique equilibrium tariff outcome is the most preferred tariff of the median voter.

(ii) In the case $n > 1$ with n even, the least upper bound of equilibrium tariff outcomes sustainable by appropriate allocation of voters to districts is the most preferred tariff of the 75^{th} percentile voter, and the greatest lower bound is the most preferred tariff of the 25^{th} percentile voter in the case in which n is even. In the odd case, the limits are $\frac{n+1}{4n}$ and $\left(1-\frac{n+1}{4n}\right)$ respectively.

It is, then, clear that the Mayer $n = 1$ case is really quite special. This is the only case in which the set of equilibria is a point. Indeed, the case $n = 2$ looks much more like the case $n = 500$ than like the case $n = 1$; both of the latter cases have the same range of possible outcomes. Clearly, since the parliamentary model is much more like what real-world political institutions look like, this suggests that empirical work needs to address somehow the importance of *inter-regional, intra-national distribution of wealth* for the determination of trade policy.

One difference that this implies from the Mayer model involves the international pattern of trade policies. The Mayer model predicts that if in each country median income is below mean income, which is generally the case in practice, all capital-abundant (rich) countries should use a tariff and all labor-abundant (poor) countries should have free trade or subsidize their imports. Of course, this is empirically absurd; all countries, rich or poor, have historically had positive protection rates with very few exceptions. However, the assembly model makes no such prediction. For example, if allocations of voters to districts are such that in rich countries the 30^{th} percentile voter is the one whose optimal tariff is implemented, but in poor countries it is the 65^{th} percentile, it is quite possible that the tariff will be the most preferred of a below-average-income voter in the rich country and an above-average-income voter in the poor countries, leading to positive tariffs everywhere. Whether or not this is the case in practice is, of course, a tricky empirical question.

The empirical implementation of the Mayer model by Dutt and Mitra (2002) suggests a convenient way of summarizing the differences between the unitary government case and the assembly case. They summarize the empirical implications of the $n = 1$ model with an estimating equation whose essence can be summarized (if over-simplified) as follows:

$$t_i = \alpha + \beta \left(\overline{Y}_i - Y_i^{med} \right) + \gamma \left(\overline{Y}_i - Y_i^{med} \right) \overline{Y}_i + \varepsilon_i,$$

where t_i denotes the average tariff recorded for country i, Y_i^{med} is the median income in country i, and i denotes the average per capita income for country i, while ε_i is a disturbance term. Dutt and Mitra use this as a regression equation to explain differences in levels of protection across countries. The explanation is that, under the Mayer model, $\left(\overline{Y}_i - Y_i^{med}\right)$ is a measure of the political distortion away from free trade in country i (since if this is equal to zero the equilibrium is free trade), but the direction in which that distortion acts depends on the overall level of capital per worker in that country. In rich countries, rich voters want free trade and vice versa in poor countries, so the sign of the interaction term γ must be positive. Dutt and Mitra (2002) show that this is supported in the data. In the assembly model a similar logic is valid, but the political distortion is captured by the term $\left(\overline{Y}_i - Y_i^{med,\ med}\right)$, where $Y_i^{med,\ med}$ indicates the income of the median voter in the median district, as discussed above.

Two ways of writing this political distortion variable can help clarify the relationship between the Mayer model and the assembly model. The first is:

$$\left(\overline{Y}_i - Y_i^{med,\ med}\right) = \left(\overline{Y}_i - Y_i^{med}\right) + \left(Y_i^{med} - Y_i^{med,\ med}\right).$$

The first term is the explanatory variable used in Dutt and Mitra (2002), and measures the difference between the mean and median income in country i. The second term measures the difference between the population median and the median of the median district. Under the assembly model, this would be an omitted variable that could bias the Dutt and Mitra regression. Clearly, if all districts have the same distribution of wealth, the second term can be ignored and the Mayer model will predict well, so one interpretation is that the omitted variable is a measure of inter-district heterogeneity. The second way of writing the political distortion term is:

$$\left(\overline{Y}_i - Y_i^{med,\ med}\right) = \left(\overline{Y}_i - \overline{Y}_i^{med}\right) + \left(\overline{Y}_i^{med} - Y_i^{med,\ med}\right),$$

where $\overline{Y}_i^{med}$ is the average income in the median district. The first term measures the difference between average income in the median district and average income countrywide, and the second term measures the difference between mean and median income in the median district. One can take the first term to be a measure of *inter*-regional income inequality and the second to be a measure of *intra*-regional income inequality (or skew, more precisely). An interesting empirical question is: Which is a more important determinant of trade protection in practice?

Special cases. A handful of special cases of the inter-district distribution of voters illustrate the behavior of the assembly model. First, clearly, if all districts are identical ($F^j = F \forall j$), the predictions are exactly as for the Mayer model. Second, if the districts are completely different, so that the support of F^j and the support of F^k do not intersect for $j \neq k$, then if n is large enough the tariff under the assembly model will closely approximate the tariff under the Mayer model. The reason is that the national median voter will in that case necessarily be contained in the median district (recalling that all districts contains the same population mass), and with n large the range of support for the median district will be small. Therefore, the difference between the median of the median district and the national median will be small.

These two examples illustrate the point that heterogeneity of districts is a necessary, but not a sufficient, condition, for the predictions of the Mayer and assembly models to differ.

A final special case is a parallel to the special case discussed at the end of the specific factors model. Fix the aggregate endowments L of labor and K of capital, and let n be odd for concreteness (of course, L is also the number of voters). Suppose that there are two kinds of voter: Those with no capital ('workers') and those with k^* units of capital ('capitalists'). In addition, there are two kinds of district: There are m districts that have some workers and some capitalists, and there are $n-m$ districts that have only workers. For all of the mixed districts, the number of capitalists in the district is equal to $\frac{K}{mk^*}$. As m ranges from 1 to n, the geographic distribution of capitalists becomes less concentrated and the number of capitalists in each mixed district falls. Clearly, if m is less than $\frac{n+1}{2}$, there will be a positive tariff (because the median voter of the median district will be a worker with no capital). At the same time, if $\frac{K}{nk^*} > \frac{L}{2n}$, or $\frac{K}{L} > \frac{k^*}{2}$ and $m \geq \frac{n+1}{2}$, there will be free trade in equilibrium, because even if the capitalists are spread as thinly as possible with $m = n$, the median voter in each district will be a capitalist. If $\frac{2K}{(n+1)k^*} < \frac{L}{2n}$, or $\frac{K}{L} < \frac{(n+1)k^*}{4n}$, there will be a positive tariff regardless of m, since even if the capitalists are as concentrated as possible subject to the constraint that the median district be mixed (in other words, even if $m = \frac{n+1}{2}$), the median voter in mixed districts will be a worker. Finally, if $\frac{(n+1)k^*}{4n} < \frac{K}{L} < \frac{k^*}{2}$, then if $m < \frac{n+1}{2}$, there will be a tariff; if $m = n$, there will be a tariff; and for a range for m in between these extremes, free trade will obtain in equilibrium.

To summarize, for this special case with homogeneous workers and homogeneous capitalists, if capitalists are found in a majority of districts, then if there is a large enough endowment of capital, capitalists will have their preferred trade policy; if the endowment is very small, the workers will have their preferred trade policy; and if there is a moderate endowment of capital, then capitalists will have their preferred trade policy *only if 'm' is in a middle range*, or only if the capitalists are moderately geographically concentrated.

4.4 The Electoral College.

As a side benefit to pursuing this assembly model, it is easy to see that it is almost isomorphic to a straightforward model of presidential electioneering under the electoral college system of the United States. Under that system, each state receives a certain number of 'electoral college votes,' based on the state's population. The candidate who receives the largest number of ballots cast by voters in a state receives all of that state's votes in the electoral college; the candidate with the largest number of electoral college votes is named president. To keep the argument simple, assume (in contrast to the previous sections) that the president has sole decision-making power over trade policy. For example, this could be the case if the presidential veto power gives all of the bargaining power to the president in his dealings with congress. Of course, for the US case, both the models in the previous sections with no president at all, and the present model with a president possessing unchecked powers, are extremes posited in order to focus on one issue at a time. A point that will emerge in this discussion is how similar the behavior of the two models are, despite their polar-opposite assumptions, once the effect of the electoral college is taken into account.

For concreteness, let us adapt the Mayer model of the previous section. If there are two nationwide candidates who campaign by making credible nationwide commitments to subsequent trade policy, then the unique equilibrium tariff policy will be characterized as follows. Denote the number of electoral college votes of state j by w_j, and assume that the w_j's are proportional to the number of voters in each state. Order the states from 1 to 50 by the most preferred tariff of the median voter of each state. Define the cumulative electoral votes of state J by $C(J) \equiv \sum_{j=1}^{J} w_j$. Define the weighted-median state J^* by $C(J^*-1) < \frac{C(50)}{2}$ and $C\left(J^*\right) > \frac{C(50)}{2}$. This exists unless a state J' has $C(J') = \frac{C(50)}{2}$ exactly, which is of course unlikely in practice.

Then, if the weighted-median state exists, the unique equilibrium outcome is the most preferred tariff of that state's median voter. If no weighted-median state exists, any tariff between the most preferred tariff of state J' just defined and that of state $J'+1$ is an equilibrium outcome.

Thus, we are back to the same outcome as under the assembly model, the median-of-medians rule, with the exception that the states are not of equal size. We have the same 25-75 bounding rule as before (the realized tariff cannot be below the most preferred level of the 25^{th}-percentile voter, or above that of the 75^{th}-percentile voter), although these are not tight bounds in the greatest-lower-bound and least-upper-bound sense of the assembly model (Proposition 3), owing to the differences in size between states. (Clearly, if one state has 99% of the population in it, that state will always be the weighted-median state, and the equilibrium tariff will always be between the 49^{th} and 51^{st} percentiles of the national distribution.) With that one qualification, the analysis of the assembly case applies to this case.

It should perhaps not be surprising that the logic of an elected assembly applies to the case of an electoral-college system, since originally the electoral college was a real elected assembly, elected with the power to choose the president through due deliberation. However, the point seems to be underappreciated in the economic literature on this subject. This is surprising, since casual evidence of the effects of the electoral college system on US trade policy appears to be abundant. A sharp example is the 1888 presidential election that brought Benjamin Harrison to power.[52] In that election, the free-trader Grover Cleveland won the popular vote but the protectionist Harrison won in the electoral college. Tariffs were a major issue in the campaign, with Harrison promising to raise them and Cleveland proposing to lower them. Thus, a model of

[52] We are grateful to Doug Irwin for pointing out this example to us.

the median-voter type would have predicted a liberal trade regime, but instead the country received a protectionist president who signed the notorious McKinley tariff into law two years later. More recently, the 2002 executive order to levy tariffs on a variety of steel products appears to be motivated by the fact that Pennsylvania is a swing state in presidential elections with a generous number of electoral college votes, and Pennsylvania steel workers could be expected to feel grateful for the protection. The relationship between the electoral college and US trade policy appears to be ripe for research.

4.5 Conclusions and Open Questions.

The principal conclusions can be summarized as follows.

1. There is a large difference between the outcomes predicted by a unitary model and by a model of government by assembly. In the simple, standard version studied here, the former predicts a median-voter rule (the most-preferred tariff of the national median voter is implemented), while the latter predicts a median-of-medians rule in which the most-preferred tariff of the median voter of the median district is implemented. This can result in large differences in the level of the tariff.

2. Perhaps surprisingly, the range of possible equilibria does not depend on the number of districts, as long as there are more than one. Under the unitary model, for a given distribution of trade policy preferences, the range of possible outcomes is a singleton (namely, the 50^{th} percentile most-preferred tariff). Under the assembly model, the range is from the 25^{th} to the 75^{th} percentile most-preferred tariff, depend-

ing on how voters are divided up between districts. Thus, there is a large qualitative difference between the unitary and assembly models, even if there are as few as two districts.

3. *Ceteris paribus*, we are more likely to see protection the more abundant are factors intensive in import-competing sectors (subject, of course, to the constraint that they are not so abundant that they become export sectors).

4. On the other hand, the likelihood of protection is non-monotonically related to within-country geographic concentration of import-competing factors. If they are too concentrated, they can never command a majority in parliament, while if they are too disperse, they will not dominate any one district, and thus will control *no* seats in parliament.

5. Thus, not only national income distribution should matter for trade policy (as in Mayer, 1984 and Dutt and Mitra, 2002), but within-country inter-regional distribution of income should matter as well.

6. The electoral college system of presidential elections has similar properties to the government-by-assembly model.

This all raises a number of empirical questions far beyond the scope of this paper.

1. In the specific-factors model, the degree of concentration of the import-competing *industry* across the country was important for determining the degree of protection obtained, a variable that has no role in standard models of unitary government. How much explanatory power does it have for tariff levels internationally?

2. In the Heckscher-Ohlin-Mayer model, the degree of concentration of the import-competing-intensive *factor* across the country was important for determining the degree of protection obtained. The same question arises as in the previous point, with the further question of how the geographic industry concentration compares with geographic factor concentration as an explanatory variable.

3. The assembly model also makes clear that within-country *inter*-regional income inequality and *intra*-regional income inequality have separate important roles in tariff determination (see the discussion following Proposition 3). What is the relative importance of these two variables in the determination of trade policy?

4. One of the great perplexing features of modern trade policy is the propensity of rich countries to protect their agricultural sectors, despite the fairly small minority who derive their living from the sector. Is it possible to explain this using the assembly model, without recourse to treating agriculture as an organized interest group? Put differently, is the control of representatives from farm states a valuable enough prize to risk antagonizing all other voters by maintaining agricultural protection?

More generally, we have seen that the assembly model shows one mechanism by which the power of a minority can be magnified (in that as small a group as one-quarter of the population can receive its desired policy at the expense of the majority). This is a mechanism completely separate from the more familiar mechanism of organized interest groups. It would be desirable to identify which of these two mechanisms is more important in practice, but how to do that is not obvious.

Finally, we can speculate about additions to the model that have the potential to move the equilibrium even farther away from the median voter. First, it seems natural to add a non-policy element to voters' preferences, as in Lindbeck and Weibull (1993). Suppose that each voter has a preference for one candidate over another even if they commit to the same policy, because of charisma, ethnic identity, or some other exogenous reason. Then, if these non-policy preferences are correlated for voters within a district, it is possible, for example, that the median district will be so biased in favor of one of the parties that neither party enters that district into its calculations of its optimal policy stand: That district is assumed to be locked-up for one of the parties no matter what policies are announced. In that case, the equilibrium policy will not be the most preferred of the median voter of the median district, and could lie outside of the 25-75 bounds established for this model. Second, in some legislatures committees that draft legislation seem to be very influential (see Krehbiel, 1991 for an exhaustive study). To the degree that a committee structure confers disproportionate power over legislation on a small number of members of the assembly, it seems reasonable to ask if they might permit movements of policy farther away from the median. Both of these extensions are, however, beyond the scope of this paper.

References

[1] Al-Saadon, Y. and Das, S. P., "Host-country policy, transfer pricing and ownership distribution in international joint ventures: A theoretical analysis," International Journal of Industrial Organization, 14, 345-364, 1996.

[2] Antràs, P., Garicano, L. and Rossi-Hansberg, E., "Offshoring in a Knowledge Economy," Quarterly Journal of Economics, 121, 31-77, 2006.

[3] Asiedu, E. and Esfahani, H. S., "Ownership Structure in Foreign Direct Investment Projects," The Review of Economics and Statistics, 83, 647-662, 2001.

[4] Austen-Smith, D., "Campaign Contributions and Access," American Political Science Review, 89, 566-581, 1995.

[5] Baily, M. and Brady D. W., "Heterogeneity and Representation: The Senate and Free Trade," American Journal of Political Science, 42, 524-544, 1998.

[6] Bailey, M., Goldstein J. and Weingast, B. R., "The Institutional Roots of American Trade Policy: Politics, Coalitions and International Trade," World Politics, 49, 309-338, 1997.

[7] Baldwin, R. and Magee, C., "Is Trade Policy for Sale? Congressional Voting on Recent Trade Bills," Public Choice, 105, 79-101, 2000.

[8] Ball, R., "Interest Groups, Influence and Welfare," Economics and Politics, 7, 119-146, 1995.

[9] Banks, J. and Sobel, J., "Equilibrium selection in signaling games," Econometrica, 55, 647-662, 1987.

[10] Baron, D. and Myerson, R., "Regulating a firm with unknown cost," Econometrica, 50, 911-930, 1982.

[11] Becker, G., "A theory of competition among pressure groups for political influence," Quarterly Journal of Economics, 98, 371-400, 1983.

[12] ———, "Public policies, pressure groups and dead weight costs," Journal of Public Economics, 28, 329-347, 1985.

[13] Bertrand, M., "From the Invisible Handshake to the Invisible Hand? How Import Competition Changes the Employment Relationship," Journal of Labor Economics, 22, 723-765, 2004.

[14] Blonigen, B. A. and Feenstra, R. C., "Protectionist threat and foreign direct investment," in R. C. Feenstra (ed.), The Effects of U.S. Trade Protection and Promotion Policies, Chicago: University of Chicago Press, 55-80, 1997.

[15] Brainard, S. L. and Martimort, D., "Strategic Trade Policy with Incompletely Informed Policymakers," Journal of International Economics, 42, 33-65, 1997.

[16] Brander, J. A. and Spencer, B. J., "Export Subsidies and International Market Share Rivalry," Journal of International Economics, 18, 83-100, 1985.

[17] Caves, R. E., "Multinational Enterprise and Economic analysis," New York: University Press, 1982.

[18] Celik, G., "Counter Marginalization of Information Rents under Collusion," Discussion Paper, University of British Columbia, 2005.

[19] Cho, I. K. and Kreps, D., "Signaling Games and Stable Equilibria," Quarterly Journal of Economics, 102, 179-221, 1987.

[20] Collie, D. and Hviid, M., "Export subsidies as Signals of Competitiveness," Scandinavian Journal of Economics, 95, 327-339, 1993.

[21] Contractor, F., "Government Policies and Foreign Direct Investment," United Nations Center on Transnational Corporations (UNCTC) Current Studies, Series A No. 17, New York: United Nations Publication, 1991.

[22] Crawford, V. P. and Sobel, J., "Strategic Information Transmission," Econometrica, 6, 1431-1451, 1982.

[23] Das, S. P. and Katayama, S., "International Joint Venture and Host-Country Policies," Japanese Economic Review, 54, 381-394, 2003.

[24] Dasgupta P., Hammond, P. and Maskin, E., "The implementation of social choice rules," Review of Economic Studies, 46, 185-216, 1979.

[25] Dasgupta, S. and Sengupta, K., "Optimal regulation of MNEs and government revenues," Journal of Public Economics, 58, 215-234, 1995.

[26] Dennis, C., Bishin, B. and Nicolaou, P., "Constituent Diversity and Congress: The Case of NAFTA," Journal of Socio-Economics, 29, 349–360, 2000.

[27] Diaw, K. M., "Ownership Restrictions, Tax Competition and Transfer Pricing Policy," Center Discussion Paper, Tilburg University, January 2004.

[28] Doyle, C. and van Wijnbergen, S., "Taxation of Foreign Multinationals: A sequential Bargaining Approach to Tax Holidays," International Tax and Public Finance 1, 211-225, 1994.

[29] Dutt, P. and Mitra, D., "Endogenous Trade Policy Through Majority Voting: An Empirical Investigation," Journal of International Economics, 58, 107-134, 2002.

[30] Eaton, J. and Grossman, G. M., "Optimal Trade and Industrial Policy under Oligopoly," Quarterly Journal of Economics, 101, 383-406, 1986.

[31] Falvey, R. E. and Fried, H. O., "National Ownership Requirements and Transfer Pricing," Journal of Development Economics, 24, 249-254, 1986.

[32] Feenstra, R. C. and Gordon H. H., "Foreign Investment, Outsourcing and Relative Wages," in R.C. Feenstra, G.M. Grossman and D.A. Irwin, (ed.), The Political Economy of Trade Policy: Papers in Honor of Jagdish Bhagwati, Cambridge: MIT Press, 89-127, 1996.

[33] Findlay, R., Wellisz, S., "Endogenous Tariffs, the Political Economy of Trade Restrictions, and Welfare," in Bhagwati, J. (ed.), Import Competition and Response, Chicago: University of Chicago Press, 1982.

[34] Fudenberg D. and Tirole, J., "Game Theory," MIT Press, Cambridge, MA, 1991.

[35] Glass, A. J., "Selective Promotion of Industries under Imperfect Information," Texas A&M University Working Paper, 2004.

[36] Gosselin, P. G., "If America Is Richer, Why Are Its Families So Much Less Secure?" Los Angeles Times, October 24, 2004.

[37] Gottschalk, P., Moffitt R., Katz, L. F. and Dickens, W. T., "The Growth of Earnings Instability in the U.S. Labor Market," Brookings Papers on Economic Activity, 2, 217-272, 1994.

[38] Grossman, G. M., "Strategic Export Promotion: A Critique," in P.R. Krugman (ed.), Strategic Trade Policy and the New International Economics, Cambridge: MIT Press, 47-68, 1986.

[39] ——— and Helpman E., “Protection for Sale,” American Economic Review, 84, 833-850, 1994.

[40] ——— and ———, “Special Interest Politics,” The MIT Press, Cambridge, MA, 2001.

[41] Hart, O. D. and Moore, J., “Property Rights and Nature of the Firm,” Journal of Political Economy, 98, 1119-1158, 1990.

[42] Holstein, W. J., “Job Insecurity, From the Chief Down,” New York Times March 27, 2005.

[43] Irwin, D. A. and Krozner, R. S., “Interests, Institutions, and Ideology in Securing Policy Change: The Republican Conversion to Trade Liberalization after Smoot-Hawley,” Journal of Law and Economics, 42, 643–673, 1999.

[44] Karabay, B., ”Foreign Direct Investment and The Host Country Policy,” Working Paper, University of Virginia, 2004.

[45] Katrak, H., “Multinational Firms’ Global Strategies, Host Country Indigenization of Ownership and Welfare,” Journal of Development Economics, 13, 331-348, 1983.

[46] Kocherlakota, N. R., “Implications of Efficient Risk Sharing without Commitment,” The Review of Economic Studies, 63, 595-609, 1996.

[47] Kolev, D. R. and Prusa, T. J., “Tariff Policy for a monopolist in a signaling game,” Journal of International Economics, 49, 51-76, 1999.

[48] Konrad, K. A. and Lommerud, K. E., “Foreign Direct investment, intra-firm trade and ownership structure,” European Economic Review, 45, 475-494, 2001.

[49] Krehbiel, K., “Information and Legislative Organization,” University of Michigan Press, Ann Arbor, 1991.

[50] Lewis, T. R. and Sappington, D. E. M., “Regulating a Monopolist with Unknown Demand,” American Economic Review, 78, 986-998, 1988.

[51] Lindbeck, A., Weibull, J. W., 1993. A model of political equilibrium in a representative democracy. Journal of Public Economics 51, 195–209.

[52] Lohmann, S., “Information, access, and contributions: a signaling model of lobbying,” Public Choice, 85, 267-284, 1995.

[53] ——— and O’Halloran, S., “Divided Government and U.S. Trade Policy: Theory and Evidence,” International Organization, 48, 595–632, 1994.

[54] MacLeod, W. B. and Malcomson, J. M., “Implicit Contracts, Incentive Compatibility, and Involuntary Unemployment,” Econometrica, 57, 447-480, 1989.

[55] Mailath, G. J., “Simultaneous Signaling in an Oligopoly Model,” Quarterly Journal of Economics, 104, 417-427, 1989.

[56] Mattoo, A., Olarreaga, M. and Saggi, K., "Mode of Foreign Entry, technology transfer, and FDI policy," Journal of Development Economics, 75, 95-111, 2004.

[57] Mayer, W., "Endogenous Tariff Formation," American Economic Review, 74, 970–985, 1984.

[58] McLaren, J. and Newman, A., "Globalization and Insecurity," Mimeo: University of Virginia, 2004.

[59] Milliyet Gazetesi, "Yabancıya yüzde 20 sınırı," May 12, 2005.

[60] Milner, H. V., "The Political Economy of International Trade," Annual Review of Political Science, 2, 91–114, 1999.

[61] Mukherjee, A., "Foreign Market Entry and host-country welfare: a theoretical analysis," Working Paper, August 2003.

[62] Nelson, D. R., "The Political Economy of Trade Policy Reform: Social Complexity and Methodological Pluralism," Working Paper, Tulane University, 2002.

[63] Olson, M., "The rise and decline of nations," Yale University Press, New Haven, CT, 1982.

[64] Organization for Economic Co-operation and Development (OECD), "Financial Market Trends," June 2001.

[65] ———, "National Treatment for Foreign-Controlled Enterprises," 2004.

[66] ———, "International Investment Perspectives," 2005.

[67] Peltzman, S., "An Economic Interpretation of the History of Congressional Voting in the Twentieth Century," American Economic Review, 75, 656–675, 1985.

[68] Pissarides, C., "Equilibrium Unemployment Theory (2nd edition)," Cambridge, MA: MIT Press, 2000.

[69] Poole, K. T. and Rosenthal, H., "Congress: A Political-Economic History of Roll Call Voting," Oxford University Press, New York, 1997.

[70] Potters, J., "Fixed Cost Messages," Economics Letters, 38, 43-47, 1992.

[71] ——— and van Winden, F., "Modelling political pressure as transmission of information," European Journal of Political Economy, 6, 61-88, 1990.

[72] ——— and ———, "Lobbying and asymmetric information," Public Choice, 74, 269-292, 1992.

[73] Putnam, R., "Diplomacy and Domestic Politics: The Logic of Two-Level Games," International Organization, 42, 427–460, 1988.

[74] Qiu, L. D., "Optimal Strategic Trade Under Asymmetric Information," Journal of International Economics, 36, 333-354, 1994.

[75] Quesada, L., "Collusion as an Informed Principal Problem," Working Paper, University of Wisconsin-Madison, 2004.

[76] Ramey, G. and Watson, J., "Bilateral Trade and Opportunism in a Matching Market," Contributions to Theoretical Economics, 1:1, 2001.

[77] Saqib, M., "A overview of the economic reform policy and FDI in India with special reference to the USA," in S.P. Gupta et al, (ed.), Prospects of Foreign Direct Investment in India in Post Liberalization Era, New Delhi: Indian Council for Research on International Economic Relations, 81-99, 1995.

[78] Scheve, K. F. and Slaughter, M., "Economic Insecurity and the Globalization of Production," American Journal of Political Science, 48, 662-674, 2004.

[79] Schnitzer, M., "Expropriation and control rights: A dynamic model of foreign direct investment," International Journal of Industrial Organization, 17, 1113-1137, 1999.

[80] Shleifer, A. and Summers, L. H., "Breach of Trust in Hostile Takeovers," in Alan J. Auerbach (ed.), Corporate Takeovers: Causes and Consequences, Chicago: The University of Chicago Press, 33-56, 1988.

[81] Shy, O. and Lee, F. C., "A welfare evaluation of technology transfer to joint ventures in the developing countries," The International Trade Journal, 7, 205-220, 1992.

[82] Sloof, R., "Game-theoretic Models of the Political Influence of Interest Groups," Kluwer Academic Publishers, Norwell, MA, 1998.

[83] Stoughton, N. M. and Talmor, E., "A mechanism design approach to transfer pricing by the multinational firm," European Economic Review, 38, 143-170, 1994.

[84] Svejnar, J. and Smith, S. C., "The economics of Joint Ventures in Less Developed Countries," Quarterly Journal of Economics, 99, 149-168, 1984.

[85] Thomas, J. and Worrall, T., "Self-enforcing Wage Contracts," Review of Economic Studies, 55, 541-554, 1988.

[86] Tullock, G., "The Welfare Costs of Tariffs, Monopolies and Theft," Western Economic Journal, 5, 224-232, 1967.

[87] United Nations Center for Trade and Development (UNTCD), "Liberalizing International Transactions in Services: A Handbook," New York: United Nations Publication, 1995.

[88] Valletta, R. G., "Declining Job Security," Journal of Labor Economics, 17, pt.2, S170-S197, 1999.

[89] Wilson, G. K., "Interest groups in the United States," Clarendon Press, Oxford, 1981.

[90] Wong, K., "Incentive incompatible, immiserizing export subsidies," University of Washington Discussion Paper 9020, 1990.

[91] World Bank, World Development Finance, CD-ROM, 2000.

[92] Wright, D. J., "Strategic Trade Policy and Signaling with Unobservable Costs," Review of International Economics, 6, 105-119, 1998.