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INFANT INDUSTRY AND POLITICAL ECONOMY OF TRADE PROTECTION

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Abstract. This paper introduces infant-industry considerations in political economy determination of trade protection. I build a model where the government cares about both political contributions and national welfare. A potentially beneficial high-tech industry is not viable in the country whose initial human capital is low. In the political economy equilibrium, we find that the tariff schedule will be V-shaped: it decreases initially to maintain the viability of the industry but increases thereafter as the industry expands and gains political power. We use the model to explain both China's tariff offers in WTO negotiations and GATT/WTO rules regarding developing countries.

JEL classification: F13; D72

1. INTRODUCTION

The infant-industry argument, once considered a legitimate exception to the case for free trade by economists and used as a justification for trade protection by policy-makers in developing countries, has lost its popularity, at least among economists, in recent decades. One criticism against the infant-industry argument is that trade polices in developing countries are an outcome of political power plays; infant-industry protection may be justified for reasons of national welfare, but it is not likely to be adopted in the political economy equilibrium.

Few studies have examined formally the empirical relevance of the infant-industry argument. Krueger and Tuncer (1982) is an exception. They attempted a test of the infant-industry argument on Turkish data, and found no evidence that more protected industries in Turkey experienced a higher rate of cost decline than less protected industries, which would be true if trade protection were based on infant-industry considerations. In the literature, economists have often cited the fact that high levels of protection have persisted for long periods as evidence that protection in developing countries generally has not been justified on infant-industry grounds (Krueger, 1984).

Krueger and Tuncer (1982) carefully noted that their findings do not imply that there were no infant industries in Turkey. Indeed, much evidence exists that shows the existence of dynamic economies in modern manufacturing industries.[1] It is also widely observed that politicians in developing countries

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[1] See, for example, Alchian (1963), Lieberman (1984), and Irwin and Klenow (1994).

consider it to be politically important to have these modern manufacturing industries established in their countries. Thus the question does not seem to be the 'existence' of infant-industry consideration in the trade policy decisions of developing countries' governments (politicians), but rather how important the infant-industry consideration is relative to other determinants in the political processes determining trade policy.

This paper focuses on the question of the point at which aiding infant industries weighs heavily in determining trade policies in a developing country. We build a model in which the developing country can produce a low-tech good and a high-tech good that requires specialized skills. Specialized skills are taught in schools and training exhibits economies of scale. The country's human capital determines the varieties of specialized skills it produces in equilibrium, which in turn determine the unit cost of the high-tech good. Human capital accumulates as a by-product of learning specialized skills and producing high-tech goods. This dynamic external learning effect justifies infant-industry tariff protection as a second-best policy if the country has low initial human capital stock.

We incorporate the infant-industry model in the political economy framework of Grossman and Helpman (1994). We assume that the government cares about both political contributions and national welfare. Since the high-tech industry is good for long-term national welfare, the government considers it politically important to establish the high-tech sector. The political equilibrium maximizes the joint welfare of the government and the lobby representing the high-tech sector. The tariff rate in the political equilibrium is found to be declining during the initial period when the lobby is relatively weak, and rising in the latter period as the high-tech sector expands and the lobby becomes stronger. During the latter period, the tariff exceeds that justified by the infant-industry argument because the political support motive dominates the infant-industry motive in the government's calculation.

We use the model to examine the effect of international trade negotiations on politically determined tariff rates. We find that the importance of infant-industry protection is restored when a developing country engages in trade talks with a developed country. Applying the methodology of Grossman and Helpman (1995), we derive the trade policies that will emerge in a trade-talks equilibrium. Trade talks pit the more powerful foreign lobby against the domestic lobby, causing the developing country to retreat to the infant-industry tariff. Our model thus shows that the infant-industry tariff becomes the bottom line of the developing country in trade talks. This may explain the tariff cuts offered by China in its trade negotiations to enter GATT/WTO. Since China began to bid for GATT membership in 1986, its average tariff rate has been cut to 36% in 1993, 23% in 1996, 17% in 1997, 15% in 2000, and 10% in 2005. These tariff cuts offered by China reflect infant-industry protection. In the tariff cuts in 1997, for example, tariffs were reduced to low levels in industries that had become relatively mature, such as televisions (from 50% to 35%) and refrigerators (from 40% to 25%), but were maintained at high levels in nascent industries, such as automobiles (from 120% to 100%).

Our model is an attempt to expand political economy trade policy models to incorporate elements specific to developing countries. Most of the recent political economy models of trade policy focus on developed countries.[2] In this paper we try to integrate the infant-industry considerations for trade protection, which is unique to developing countries, with the political contribution considerations. This formulation provides a new angle for analyzing North–South trade relationships.

The remainder of the paper is organized as follows. Section 2 describes a small open economy that can produce a low-tech good and a high-tech good. Section 3 introduces an external learning effect to characterize the high-tech sector as an infant industry and the country as a less developed economy with low initial human capital. Section 4 derives the political economy tariff schedule chosen by the developing country government non-cooperatively with respect to the rest of the world. Section 5 examines the tariff schedule in a trade-talks equilibrium, and uses the results to explain China's bid for WTO membership and the GATT/WTO rules regarding developing countries. Section 6 concludes.

2. ECONOMY

In this section we describe a small open economy. Consider a country populated with a continuum of individuals of measure one. For simplicity we assume no population growth. Each individual is endowed with one unit of labour, but only a fixed fraction α of the population possess human capital, $0 < \alpha < 1$. Each human capital owner has $h(t)$ units of human capital at time t.

Resources have two potential uses. The first use is production of a low-tech good Y. The production requires labour as the sole input and exhibits constant returns to scale. Assume that one unit labour input yields one unit of good Y. The output of good Y is then given by $Y(t) = L_y(t)$, where L_y is the labour employed in the Y sector. The second use is production of a high-tech good X. The production requires labour and a range of specialized skills. Let $n(t)$ be the number of varieties of specialized skills available in the country at time t. Assuming that all specialized skills are imperfect substitutes and they enter the production function symmetrically, we write the production function of the high-tech good as $X(t) = F(L_x(t), [\sum_{i=1}^{n(t)} z_i(t)^{\beta}]^{1/\beta})$, where L_x is the labour employed in the X sector, z_i is the ith specialized skill, and β is a parameter linked to the elasticity of substitution (σ) between any two varieties of specialized skills, $\beta = (\sigma - 1)/\sigma$. The function $F(.)$ is assumed to be linearly homogeneous in labour and the aggregate of the specialized skills. By choosing units we normalize the world prices of both goods to be one. Under free trade, the small open economy faces the world prices.

We consider a symmetric equilibrium in which all varieties of specialized skills are provided at identical quantity and have identical prices. In this case,

[2] See the surveys of Helpman (1995) and Rodrik (1995). Findlay (1990) discusses political economy models of trade policy in developing countries.

the unit cost of good X is given by $\phi(w(t), q(t)n(t)^{-\frac{1}{\sigma-1}})$, where w denotes wage rate and q denotes price of specialized skills. From the zero-profit condition of good Y we obtain $w(t) = 1$. Substituting $w(t) = 1$ into the zero-profit condition of good X, we have

$$\phi(1, q(t)n(t)^{-\frac{1}{\sigma-1}}) = 1. \tag{1}$$

People endowed with human capital can learn specialized skills from 'schools'. Assume that c units of human capital are needed for producing one unit of specialized skills. Let $r(t)$ be the market rate of return to human capital, so the unit cost of training a specialized skill equals $r(t)c$. We assume that the training exhibits increasing returns to scale, so each variety of specialized skills will be trained in a single school. Because of increasing returns to scale, c is an inverse function of the output of the specialized skill, $c = c(z(t))$, $c'(z(t)) < 0$. Schools engage in monopolistic competition. Free entry into the training sector implies zero profit for each school. Therefore, the unit cost of training a specialized skill equals the price of specialized skills,

$$r(t)c(z(t)) = q(t). \tag{2}$$

Profit maximization by each school implies that marginal cost equals marginal revenue, $MC(t) = q(t)(1 - 1/\varepsilon)$, where ε is the demand elasticity. Since total cost $TC(t) = r(t)c(z(t))z(t)$, we have $MC(t) = r(t)[c'(z(t))z(t) + c(z(t))]$. Assuming that $n(t)$ is a large number, we can use the elasticity of substitution σ to approximate ε.[3] Thus, the equality between marginal cost and marginal revenue implies

$$\frac{c(z(t))}{c'(z(t))z(t) + c(z(t))} = \frac{\sigma}{\sigma - 1}. \tag{3}$$

Equation (3) implies that the equilibrium output of each specialized skill is fixed, $z(t) = z$. Thus, any expansion in the total supply of specialized skills must come from an increase in the variety of specialized skills.[4]

Recall that a fraction α of the population possess human capital and is also endowed with labour. They choose between attending schools to become skilled workers and not attending schools to become unskilled workers. Under the conditions specified in the next section, they attend schools for specialized skills. The X sector demands $n(t)z(t)$ units of specialized skills, so the induced demand for human capital is $c(z(t))n(t)z(t)$. Since the country's total supply of human capital is $H(t)$, we have

$$c(z(t))n(t)z(t) = H(t). \tag{4}$$

With α fraction of the population attending schools, the supply of labour equals $1 - \alpha$. Labour is used in both production sectors. The amount of labour employed in the low-tech sector equals $Y(t)$. For the high-tech sector, we can obtain unit labour demand from the partial derivatives of the unit cost function

[3] See Helpman and Krugman (1985; p. 119).

[4] Equation (3) also implies that $\sigma > 1$ must hold for the output of specialized skills to be positive.

of good X with respect to the wage rate. Using subscripts to denote partial derivatives, the labour market clearing condition is

$$\phi_w(1, q(t)n(t)^{-\frac{1}{\sigma-1}})X(t) + Y(t) = 1 - \alpha. \tag{5}$$

Finally, the market for specialized skills clears. We can obtain unit demand for specialized skills from the partial derivative of the unit cost function of good X with respect to the price of specialized skills. Using subscripts to denote partial derivatives, the market equilibrium condition for specialized skills is

$$\phi_q(1, q(t)n(t)^{-\frac{1}{\sigma-1}})X(t) = n(t)z(t). \tag{6}$$

This completes the production structure of the model. The six equations (1)–(6) solve for six endogenous variables: $q(t)$, $n(t)$, $z(t)$, $r(t)$, $X(t)$, and $Y(t)$.[5]

3. INFANT INDUSTRY

In the previous section we described a small open economy that produces both the low-tech good and the high-tech good. In this section, we show that the high-tech sector is viable in the country if and only if the country's human capital stock has reached a threshold level. In a less developed country with insufficient human capital, the high-tech good will not be produced in a free-trade equilibrium. Given that production of the high-tech good generates learning externality, we have an infant-industry argument.

The establishment of the high-tech sector requires a minimum level of human capital. This is because the high-tech sector must use specialized skills as inputs; such skills can be acquired in schools, but whether to attend schools is an individual choice. An individual can invest her human capital endowment $h(t)$ in training to obtain $h(t)/c$ units of specialized skills, which yield an income of $q(t)h(t)/c = r(t)h(t)$. Alternatively, she can receive $w(t) = 1$ by being a worker. Thus, an individual seeks training if and only if $r(t)h(t) \geq 1$. From equation (3), we know that each specialized skill is produced at a fixed scale, $z(t) = z$, and therefore $c(z(t)) = c$. From equation (2), we have $r(t) = q(t)/c$, that is, the rate of return to human capital increases with the price of specialized skills. From equation (1), we find a positive relationship between $q(t)$ and $n(t)$; the more varieties available to the production of good X, the lower the unit cost of good X, and the higher the rate of return to specialized skills. Turning to equation (4), we have $n(t) = H(t)/cz$, that is, the number of varieties of specialized skills increases with the level of human capital. Since $n(t)$ rises with $H(t)$, the positive relationship between $q(t)$ and $n(t)$ implies a positive relationship between $q(t)$ and $H(t)$. Therefore, the rate of return to human capital, $r(t)$, is a positive function of $H(t)$. Since $r(t)$ is a positive function of $H(t)$ and

[5] The production structure described above is familiar in the international trade literature. Trade models with differentiated intermediate inputs have been developed in Ethier (1982), Helpman and Krugman (1985; chapter 11), and Markusen (1989). Our model interprets intermediate inputs as specialized skills and assumes them to be non-tradable. This interpretation is drawn from Rodrik (1996) who uses a similar model to examine the role of government policy in overcoming a coordination problem.

$h(t) = H(t)/\alpha$, we have $\Phi(t) \equiv r(t)h(t)$ as a positive function of $H(t)$. It follows that there exists a human capital threshold $\hat{H}$ so that $\Phi(\hat{H}) = 1$. This establishes the following.

LEMMA 1. *In a small open economy, the high-tech sector is viable at time t if and only if its human capital,* H(t), *is above a critical human capital level,* Ĥ.

Lemma 1 implies that the high-tech sector will not be established in a less developed country with insufficient human capital. So far the model has provided no justification of government intervention that would help to establish the high-tech sector before the developing country accumulates enough human capital. We now add an element to the model: the existence of a dynamic external learning effect in the training and use of specialized skills. Specifically, we assume that human capital accumulates as a by-product of the training and use of specialized skills:

$$\dot{H}(t) = f(n(t)), \quad f' > 0, f'' < 0. \tag{7}$$

The more varieties of specialized skills that are trained and used in the high-tech sector, the more knowledge will be learned by those individuals who participate.[6] The learning effect is external to the schools that train specialized skills and the firms that produce the high-tech good.

With the presence of the learning effect, the high-tech sector becomes an infant industry in the developing country. Let $H(0)$ be the developing country's human capital stock at time $t = 0$. Given that $H(0) < \hat{H}$, the high-tech sector is not viable in the developing country under free trade (Lemma 1). However, if individuals with $H(0)$ were trained and the high-tech sector were established at $t = 0$, the human capital stock in the developing country would accumulate over time and the critical human capital level $\hat{H}$ would be reached at time $t = \hat{t}$. In other words, the developing country has the potential for a competitive high-tech sector, but this potential can be realized only if the high-tech sector is viable during its infancy period ($0 \leq t < \hat{t}$). Thus, we have a classic infant-industry case.[7] In this case, the establishment of the high-tech sector is good for the long-term welfare of the developing country.

4. POLITICAL ECONOMY OF TRADE PROTECTION

In the previous two sections, we described a small open economy that faces a human capital threshold in building a high-tech industry. Because of a dynamic learning effect, this high-tech industry would be beneficial to the country in the long run. The industry would not be established, however, without government intervention in the initial period. This presents us with an infant-industry case.

[6] Since the fraction of human capital owners in the population is assumed to be fixed at α, the learning effect occurs completely within the group of individuals endowed with human capital.

[7] See Corden (1997; chapter 8) for discussions of various infant-industry cases.

The policy prescriptions for this classic infant-industry case are well known. First, trade policy is not the first-best policy to internalize the dynamic externality that causes the infant-industry problem; an output subsidy would be better. Baldwin (1969) has forcefully shown that tariff protection is not the optimal policy to help an infant industry. Secondly, when the government's choice of policy instruments is limited to trade taxes and subsidies, a tariff on the high-tech good can help the establishment of the industry. However, the tariff should decline over time during the infancy period of the industry and become zero when the country's human capital level reaches the threshold.

The traditional infant-industry tariff argument assumes that the government maximizes national welfare. In this section, we follow the recent literature (e.g. Grossman & Helpman, 1994) to assume that the government maximizes a weighted sum of the political contribution from organized interest groups and the welfare of an average voter. We limit our attention to trade policies.[8]

We assume that there is an organized interest group representing the owners of human capital, but no organized interest group representing the owners of labour. Let $D(t)$ be the political contribution and $W(t)$ be the total welfare of the population, we define the government's objective function as

$$G \equiv \int_0^{\bar{t}} G(t)dt = \int_0^{\bar{t}} [D(t) + aW(t)]dt, \tag{8}$$

where $[0, \bar{t}]$ is assumed to be the time horizon of the government, and $a \geq 0$ is the weight placed by the government on the welfare of the average voter.[9]

We assume that individuals have identical additive separable preferences. Each individual maximizes a quasilinear utility function:[10]

$$U(t) = C_y(t) + U_x(C_x(t)), \tag{9}$$

where C_y and C_x denote consumption of good Y and good X, respectively. The sub-utility function $U_x(.)$ is differentiable, increasing, and strictly concave. Utility maximization implies that the demand for good X, $C_x(p(t))$, is the inverse of $U_x'(C_x(t))$. The consumer spends $p(t)C_x(t)$ on good X, and devotes the remainder of her total spending of $E(t)$ to good Y. Thus, indirect utility takes the form:

$$V(p(t), E(t)) = E(t) + S(p(t)), \tag{10}$$

where $S(p(t)) = U_x(C_x(p(t))) - p(t)C_x(p(t))$ is the consumer surplus derived from good X at time t.

[8] There are arguments that tariffs may be preferred to output subsidies because the distortions that endogenously emerge in the former may be smaller than those in the latter (Rodrik, 1986; Wilson, 1990), or because tariffs are more politically desirable than output subsidies (Grossman & Helpman, 1994).

[9] Assuming the weight on $D(t)$ to be one is not essential. See footnote 5 of Grossman and Helpman (1994) for an explanation.

[10] The assumption of a quasilinear utility function is widely adopted in political economy trade models such as Grossman and Helpman (1994, 1995); it facilitates the use of consumer surplus in welfare calculation.

The total welfare of the population, expressed according to the indirect utility function (10), is given by

$$W(t) = (1 - \alpha) + \alpha r(t)h(t) + (p(t) - 1)M(t) + S(t). \tag{11}$$

The first two terms in (11) are total income received by labour and human capital owners, respectively. The third term is the tariff revenue; $M(t) = C_x(t) - X(t)$. The last term is the consumer surplus, $S(t) = U_x(C_x(p(t))) - p(t)C_x(p(t))$.

Define $\tau^I(t)$ as the infant-industry tariff that makes the X sector viable during the period $t \in [0, \hat{t}]$. Because of the dynamic learning effect, $\tau^I(t)$ declines over time and becomes zero at time $t = \hat{t}$ when $H = \hat{H}$. Let G^0 be the value of G if there is no infant-industry tariff protection, and G^1 be the value of G if there is. The government adopts the infant-industry tariff if and only if $G^1 > G^0$.

If there is no tariff, the country would not have the X industry, so $G^0 = \int_0^{\hat{t}} a(1 + S^0(t))dt$. If the government adopts the infant-industry tariff, then $G^1 = \int_0^{\hat{t}} [D(t) + a(1 - \alpha + \alpha r(t)h(t) + \tau^I(t)M(t) + S^1(t))]dt$. Thus, $G^1 > G^0$ if and only if

$$\int_0^{\hat{t}} [D(t) + a(\alpha(r(t)h(t) - 1) + \tau^I(t)M(t) + S^1(t) - S^0(t))]dt > 0.$$

Recall that there is dynamic learning effect in the X sector, $\dot{H}(t) = f(n(t))$. If the infant industry is potentially beneficial to the country, the long-term dynamic learning effect must exceed the short-term loss caused by the tariff distortion, which implies that $\int_0^{\hat{t}} [\alpha(r(t)h(t) - 1) + \tau^I(t)M(t) + S^1(t) - S^0(t)]dt > 0$. Therefore, as long as the government cares about the long-term national welfare gain from having the high-tech sector, it will adopt a tariff rate no lower than the infant-industry tariff rate. We state this result in the following.

LEMMA 2. *Given the model assumptions, the tariff rate in the small open economy will be no lower than the infant-industry tariff rate,* $\tau(t) \geq \tau^I(t)$.

The government, however, also considers the gain from political contribution, $D(t)$. The first-order condition for maximizing $G(t)$ with respect to $p(t)$ is given by[11]

$$G_p(t) = D_p(t) + a(p(t) - 1)M'(p(t)) = 0, \tag{12}$$

where subscripts denote partial derivatives.

Knowing the government's objective function, human capital owners coordinate their political activities so as to maximize their joint welfare $V^H(t) = W^H(t) - D(t)$, where $W^H(t)$ is the gross-of-contribution welfare of the human capital owners and is given by

$$W^H(t) = R(t) + \alpha[(p(t) - 1)M(t) + S(t)]. \tag{13}$$

[11] In deriving (12), we use $R'(p(t)) = X(p(t))$ which holds since the marginal revenue function of good X is identical to its supply function.

The first term on the right-hand side of (13) is the return to human capital, while the second term is the human capital owners' share of tariff revenue and consumer surplus. The first-order condition of maximizing $V^H(t)$ with respect to $p(t)$ is given by

$$V_p^H(t) = X(t) + \alpha[(p(t) - 1)M'(p(t)) - X(t)] - D_p(t) = 0. \tag{14}$$

The tariff rate agreeable to both parties must satisfy both the first-order condition of the government's maximization problem, (12), and the first-order condition of the lobby group's maximization problem, (14). The solution is given by

$$\tau^P(t) = p(t) - 1 = \frac{1-\alpha}{a+\alpha}\frac{X(t)}{-M'(p(t))}. \tag{15}$$

The politically-driven tariff rate $\tau^P(t)$ is higher the larger the high-tech sector, the less elastic the import demand function (which implies lower excess burden of a tariff), the less weight placed by the government on national welfare, and the more concentrated is the ownership of human capital. We state this result in the following.

LEMMA 3. *Given that the high-tech sector is viable, the tariff rate in the small open economy will be* $\tau(t) = \tau^P(t)$.

Lemmas 2 and 3 jointly determine the tariff rate in equilibrium. Because of the dynamic learning effect, $\tau^I(t)$ decreases in time t. Figure 1 illustrates the schedule of $\tau^I(t)$ as the downward sloping AA curve. Assuming that the import demand elasticity stays relatively stable over time, equation (15) implies that $\tau^P(t)$ increases in time t as the high-tech sector expands. The tariff rate rises with the size of the X sector because human capital owners have a greater stake in the sector as it becomes larger and therefore they bid more in terms of political support. As human capital accumulates, the varieties of specialized skills increase and the domestic high-tech sector expands. In Figure 1, we depict the schedule of $\tau^P(t)$ as the upward sloping PP curve.

Assuming $\tau^P(0) < \tau^I(0)$, the AA curve and the PP curve intersect at time $t = \tilde{t}$.[12] When $t < \tilde{t}$, the government adopts the infant-industry tariff rate $\tau^I(t)$ as driven by the long-term national welfare consideration, and the lobby group would be happy to accept it since $\tau^I(t) > \tau^P(t)$. When $t > \tilde{t}$, the lobby effort gets stronger as the industry grows bigger. The infant-industry tariff rate becomes not binding and the government adopts $\tau^P(t) > \tau^I(t)$. We summarize this result in the following.

PROPOSITION 1. *In a country where a high-tech sector has a potential comparative advantage but is initially not viable, a politically driven government will adopt a tariff schedule that is V-shaped. Initially the tariff rates equal the infant-industry tariff rates and decline over time. As the high-tech sector expands, the tariff rates exceed the infant-industry tariff rates and rise over time.*

[12] We assume that $\tilde{t} \in [0, \hat{t}]$.

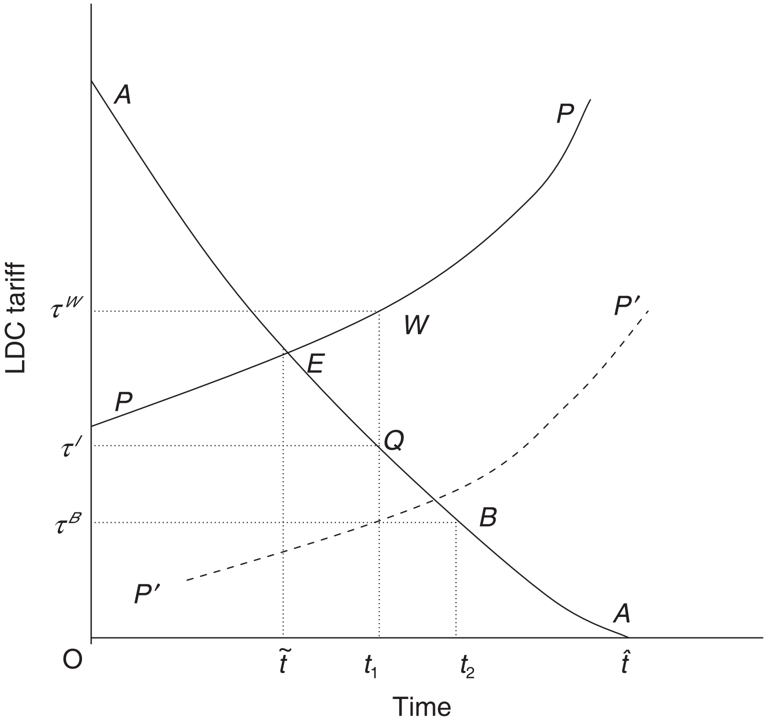

Figure 1. Determination of tariff rates

Proposition 1 shows a time path of the developing country tariff. In Figure 1, the kinked curve labeled *AEP* depicts this path. When $t < \tilde{t}$, the high-tech sector is relatively small and thereby human capital owners have a relatively small stake in the industry. As a result, the political contribution of the lobby group of human capital owners is relatively small. If the government did not adopt infant-industry protection in this period, the lobby-driven tariff would be too small to result in a viable high-tech industry. When $t \geq \tilde{t}$, the influence of the lobby group dominates the infant-industry consideration; hence the government adopts the lobby-driven tariff rate $\tau^P(t)$. It is worth noting that although the infant-industry tariff is not binding in this latter period, the lobby would not be in place without the infant-industry tariff in the initial period. In this sense, the infant-industry protection nurtures the politically driven protection.[13]

5. TRADE PROTECTION AND TRADE TALKS

In the previous section we derived the developing country's tariff schedule in the political economy equilibrium, under the assumption that the developing

[13] We have focused on trade policy in the high-tech sector. Note that in this model the human capital lobby would want an export subsidy in the low-tech sector.

country chooses the tariff rate non-cooperatively with respect to the rest of the world. In this section, we examine the effects of global trade talks on tariff determination in the developing country.[14]

To analyze the trade-talks equilibrium, we consider the developing country as part of a large country group 'South' that negotiates with a large country group 'North'. At time t, the North produces the high-tech good at the scale $X^*(t)$ at which learning is already exhausted,[15] and the North exports the high-tech good to the South. The world market for the high-tech good clears when

$$M(p(t)) + M^*(p^*(t)) = 0, \tag{16}$$

where $M(p(t))$ is the South's import demand for good X, and $(-M^*(p^*(t)))$ is the North's export supply of good X. Let $s^*(t)$ be the trade policy (export subsidy or tax) of the North. Choose good Y as the numeraire and denote $\pi(t)$ as the relative price of good X in the world market. Since $p(t) = \pi(t)(1 + \tau(t))$ and $p^*(t) = \pi(t)(1 + s^*(t))$, equation (16) solves the world price $\pi(t)$ as a function of the trade policies imposed by the two regions.

For large countries, there is a terms of trade motive to trade policy. In the South, the equilibrium tariff rate is given by $\tau(t) = \max(\tau^I(t), \tau^P(t))$, where

$$\tau^P(t) = \frac{p(t) - \pi(t)}{\pi(t)} = \frac{1-\alpha}{a+\alpha}\frac{X(t)}{(-M'(p(t))\pi(t))} + \frac{1}{e^*(t)}. \tag{17}$$

Compared with equation (15) for a small country, equation (17) has an additional 'optimal tariff' term equal to $1/e^*(t)$, where $e^*(t)$ is the North's export supply elasticity.[16]

In the North, human capital owners are organized to lobby for an export subsidy on the high-tech good. The North government maximizes the weighted sum of political contribution from the lobby, $D^*(t)$, and national welfare, $W^*(t)$. As before, we can derive the first-order conditions of both the government's and the lobby's maximization problems and solve for the trade policy of the North in the political economy equilibrium. The solution in the form of an export subsidy (or tax) is given by

$$s^*(t) = \frac{p^*(t) - \pi(t)}{\pi(t)} = \frac{1-\alpha^*}{a^*+\alpha^*}\frac{X^*(t)}{(-M^{*\prime}(p^*(t))\pi(t))} - \frac{1}{-e(t)}, \tag{18}$$

where $(-e(t)) > 0$ is the South's import demand elasticity. The first term on the right-hand side of (18) shows a lobby-driven export subsidy, and the second term reflects the familiar 'optimum export tax' motive for trade intervention.

[14] We treat the government's decision to engage in trade talks as exogenous. Maggi and Rodriguez-Clare (1998) examined the motives of the government in using trade agreements against domestic lobbies.

[15] We use an asterisk to denote variables of the North.

[16] The derivation of equation (17) is similar to that in Grossman and Helpman (1995) and is omitted here.

Equations (17) and (18) define trade policies chosen by the two regions non-cooperatively. In the trade-war equilibrium, the Southern government imposes an import tariff that is driven by both the political contribution motive and the terms of trade (optimal tariff) motive, and the Northern government imposes an export tax (or subsidy) that is driven by both the political contribution motive (which calls for an export subsidy) and the terms of trade motive (which calls for an export tax).

It is well-established in the literature that international trade negotiations will result in national welfare gains due to the elimination of terms of trade inefficiencies (Mayer, 1981; Bagwell & Staiger, 1999) and the increased competition of lobbies (Grossman & Helpman, 1995). We follow Grossman and Helpman (1995) to consider a two-stage game in which lobbies set contribution schedules in the first stage and governments bargain over trade policy schedules $\tau(t)$ and $s^*(t)$ in the second stage, and we focus on the equilibrium in which the politicians settle on an outcome that is efficient from their own selfish perspectives. The trade policies that emerge from the negotiation are such that the welfare of the Southern government, $G(t)$, could not be further improved without lowering the welfare of the Northern government, $G^*(t)$. Grossman and Helpman (1995) show that the solution of such a game is the same that arising if a 'world government' maximized the weighted sum $a^*G(t) + aG^*(t)$ and interest groups of both countries would bid to influence this world government. Thus, the trade policies in a trade-talks equilibrium satisfy both the first-order condition of the maximization problem of the world government and that of the Southern lobby and the Northern lobby. Let $\tau^N(t)$ and $s^{*N}(t)$ be the Southern tariff and the North export subsidy that would be agreed upon by both regions in trade negotiations. Similar to Grossman and Helpman (1995), we find that the first-order conditions of the maximization problems of the two lobbies are linearly dependent and hence $\tau^N(t)$ and $s^{*N}(t)$ cannot be solved separately. We can obtain the difference between $\tau^N(t)$ and $s^{*N}(t)$ as given by

$$\tau^N(t) - s^{*N}(t) = \frac{1-\alpha}{a+\alpha}\frac{X(t)}{(-M'(p(t))\pi(t))} - \frac{1-\alpha^*}{a^*+\alpha^*}\frac{X^*(t)}{(-M^{*\prime}(p^*(t))\pi(t))}. \quad (19)$$

Equation (19) shows that the degree of trade protection in the South relative to trade promotion in the North is determined by the political strength of the lobby in the South relative to its Northern counterpart. In the negotiation game, the lobby ties its contribution to the trade policies of both countries that would emerge from the trade talks. The foreign trade policy affects the domestic lobby through the world price $\pi(t)$. For example, an export subsidy on good X imposed by the North reduces $\pi(t)$ and thereby reduces the rate of return to human capital in the South; this effect is taken into account when the Southern lobby decides the amount to contribute to 'buy' a tariff from the Southern government.

We now examine the role of infant-industry consideration in determining the tariff when the South engages in trade talks. Suppose North and South choose trade policies non-cooperatively at time $t = t_1$. In this trade-war equilibrium, the South imposes a tariff τ^W on Northern exports, while the North implements an export tax.[17] When the two regions engage in trade talks at time t_1, the power of the Southern lobby is partially offset by the Northern lobby, which causes the PP curve to shift down to the $P'P'$ curve in Figure 1, implying that the South must reduce the tariff from τ^W to τ^B in order to reach an agreement with the North. In the case shown in Figure 1, the trade-talks tariff τ^B is lower than the infant-industry tariff τ^I at time t_1; hence trade talks do not lead to an agreement as the South would lose the high-tech sector should it reduce the tariff rate to τ^B. The above analysis establishes the following.

PROPOSITION 2. *Infant-industry tariff rates place a constraint on the tariff rates developing countries would accept in international trade negotiations.*

Proposition 2 highlights the importance of infant-industry protection when developing countries engage in trade talks. It is clear from Figure 1 that a trade agreement between the two countries will not be reached until time t_2 when the trade-talks tariff rate τ^B equals the infant-industry tariff rate τ^I. Note that although trade negotiations will not be successful until time t_2, the participation of the Southern government in trade talks weakens the power of the domestic lobby, shifting the PP curve to the $P'P'$ curve. As the South produces more of good X, the learning effect causes the infant-industry tariff rate to decline over time, eventually reaching the trade-talks tariff rate.

The model described above can be applied to trade negotiations between the United States and China regarding the entry of China into the World Trade Organization (WTO). A trade agreement between the two countries is mutually beneficial as it would avoid the trade-war equilibrium. In the trade-talks equilibrium, the USA demands that China reduce its tariff rate to the rate $\tau^B(t)$. The Chinese government considers it politically important to have a domestic high-tech sector; hence its negotiation bottom line is the infant-industry tariff $\tau^I(t)$. Because $\tau^I(t) > \tau^B(t)$ during the negotiation period, the two countries were not able to reach an agreement. Our model interprets this as a result that the Chinese government was still facing a binding infant-industry protection constraint.

The infant-industry protection consideration is evident in the tariff cuts offered by China. Since China began to bid for GATT membership in 1986, its average tariff rate had been cut to 36% in 1993, 23% in 1996, 17% in 1997, 15% in 2000, and 10% in 2005. The declining tariff rates that China has been able to offer are made possible by the rapid expansion of China's manufacturing sector over the period. This evidence is consistent with the prediction of our model and shows that infant-industry tariffs are the 'bottom line' tariffs of developing countries in trade talks.

[17] The equilibrium trade policy in the North is an export tax when the terms of trade consideration dominates the political contribution consideration; otherwise it is an export subsidy.

The model developed above helps to explain GATT/WTO rules regarding developing countries. The fact that developing countries face binding infant-industry protection constraints has long been recognized in international trade negotiations. The GATT had provisions that allowed special and differential treatment for developing country members.[18] Many such rules were designed based on infant-industry considerations. For example, Article 18-A allows developing countries to renegotiate tariff arrangements in order to promote the establishment of a particular industry; Article 18-C permits a developing country to apply quantitative import restrictions for infant-industry purposes.

In recent international trade negotiations, the United States and other developed countries have placed much emphasis on the so-called graduation issue. Graduation refers to the removal of a country from special and differential treatment eligibility with respect to specific individual products based on the degree of competitiveness the developing country has achieved with the products (Jackson, 1997; p. 422).[19] Our model shows that the political power of the Southern lobby increases as the high-tech sector in the South expands. Because the increase in the political power of the Southern lobby is perceived by both the Northern lobby and the Northern government and is taken into account in their decisions, the Southern government will be able to negotiate higher tariff rates. Given that trade policies in developed countries are restricted by WTO rules, the special and differential treatment granted to developing countries would enable them to maintain relatively high levels of tariffs, implying a biased distribution of the benefits from trade talks in their favour. Our model predicts that the North will demand the graduation provision to be implemented at time $\hat{t}$ when the infant-industry tariff rate in the developing country becomes zero.

6. CONCLUSION

This paper develops a model to examine the importance of infant-industry considerations in determining trade policies in developing countries. In the model, the government cares about both political contributions and national welfare. There is a high-tech good whose unit cost declines over time due to an external learning effect. The high-tech industry is potentially beneficial in the country but lack of human capital prevents it from being viable under free trade. In the political economy equilibrium, we show that the tariff schedule will be V-shaped: it decreases initially to maintain a viable industry but increases thereafter as the industry expands and gains political power. The tariff schedule will change when the country participates in international trade negotiations. We show that trade talks would pit the foreign lobby against the domestic lobby, causing the country to retreat to the infant-industry

[18] See Whalley (1990) for a discussion of special and differential treatment under the GATT for developing countries.

[19] For example, the United States graduated South Korea, Taiwan, Hong Kong and Singapore in the 1980s (Whalley, 1990; p. 1324).

tariff. In trade talks, the infant-industry tariff becomes the country's 'bottom line' tariff.

The model is used to explain China's tariff offers in WTO negotiations. China is observed to have been offering lower and lower tariff rates since 1986 in order to reach an agreement with the U.S. and other developed countries regarding its entry into GATT/WTO. Our model interprets this declining tariff schedule as reflecting the infant-industry tariffs needed by China to protect its manufacturing sector. This evidence supports the conclusion that trade talks make infant-industry protection an important part of trade policy determination in developing countries.

The model provides some justification for the WTO's graduation rule applying to advanced developing countries. As the manufacturing sector develops in a developing country, its lobby group becomes powerful and the tariff rate emerging from trade talks will be high. Given that developed countries are restricted by WTO rules while less developed countries are allowed special and differential treatment, this asymmetry would imply that the developing country obtains an increasingly large share of the benefits from trade talks. It is thus not surprising that developed countries insist that advanced developing countries graduate from the preferential programmes designed for them.

REFERENCES

Alchian, A. A. (1963) 'Reliability of progress curves in airframe production', *Econometrica* 60, 323–51.

Bagwell, K. and R. W. Staiger (1999) 'An economic theory of GATT', *American Economic Review* 89, 215–48.

Baldwin, R. E. (1969) 'The case against infant-industry tariff protection', *Journal of Political Economy* 77, 295–305.

Corden, W. M. (1997) *Trade Policy and Economic Welfare.* New York: Oxford University Press.

Ethier, W. (1982) 'National and international returns to scale in the modern theory of international trade', *American Economic Review* 72, 389–405.

Findlay, R. (1990) 'The new political economy: Its explanatory power for LDCs', *Economics and Politics* 2, 193–221.

Grossman, G. M. and E. Helpman (1994) 'Protection for sale', *American Economic Review* 84, 833–50.

Grossman, G. M. and E. Helpman (1995) 'Trade wars and trade talks', *Journal of Political Economy* 103, 675–708.

Helpman, E. (1995) *Politics and trade policy*, NBER Working Paper No. 5309, National Bureau of Economic Research, Cambridge, MA.

Helpman, E. and P. Krugman (1985) *Market Structure and Foreign Trade.* Cambridge, MA: MIT Press.

Irwin, D. A. and P. J. Klenow (1994) 'Learning by doing spillovers in the semiconductor industry', *Journal of Political Economy* 102, 1200–27.

Jackson, J. H. (1997) *The World Trading System.* Cambridge, MA: MIT Press.

Krueger, A. O. (1984) 'Trade policies in developing countries', in R. Jones and P. Kenen (eds), *Handbook of International Economics*, Vol. 1, 519–69.

Krueger, A. O. and B. Tuncer (1982) 'An empirical test of the infant industry argument', *American Economic Review* 72, 1142–52.

Lieberman, M. B. (1984) 'The learning curve and pricing in the chemical processing industries', *Rand Journal of Economics* 15, 213–28.

Maggi, G. and A. Rodriguez-Clare (1998) 'The value of trade agreements in the presence of political pressures', *Journal of Political Economy* 106, 574–601.

Markusen, J. R. (1989) 'Trade in producer services and other specialized intermediate inputs', *American Economic Review* 79, 85–95.

Mayer, W. (1981) 'Theoretical considerations on negotiated tariff adjustments', *Oxford Economic Papers* 33, 135–53.

Rodrik, D. (1986) 'Tariffs, subsidies, and welfare with endogenous policy', *Journal of International Economics* 21, 285–96.

Rodrik, D. (1995) 'Political economy of trade policy', in G. M. Grossman and K. Rogoff (eds), *Handbook of International Economics* 3, 1457–94.

Rodrik, D. (1996) 'Coordination failures and government policy: a model with applications to East Asia and Eastern Europe', *Journal of International Economics* 40, 1–22.

Whalley, J. (1990) 'Non-discriminatory discrimination: Special and differential treatment under the GATT for developing countries', *Economic Journal* 100, 1318–28.

Wilson, J. D. (1990) 'Are efficiency improvements in government transfer policies self-defeating in political equilibrium'? *Economics and Politics* 2, 241–58.