

National patents, innovation and international agreements

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Abstract

One of the most contentious issues arising from the Uruguay Round of trade negotiations was the attempt to harmonize patent policy. However, previous theoretical models have failed to provide a clear rationale for the coordination of patent policy, indeed they imply that world welfare may decline as a result of coordination. This paper argues that the conclusions of previous studies have been derived from definitions of patents that neglect to specify their duration. As a consequence, the monopoly distortion associated with patents has been overemphasized. In contrast, this paper models the choice of the hazard of imitation under a patent as a policy variable. This allows for a more detailed analysis of the determinants of patent policy in an international context, and isolates two externalities when countries set patent policy independently. These externalities arise from a free-riding incentive (policy competition) and the international spillovers from an innovation. Since these considerations influence the patent strength in both developed and developing countries, patents set on a national basis are inefficient from a global perspective. This provides an economic rationale for international coordination of patent policy.

Keywords

Intellectual property rights, patents, trade, World Trade Organization

1. INTRODUCTION

One of the most contentious issues arising from the Uruguay Round of trade negotiations was the attempt to harmonize policy on intellectual property rights (IPR). Developed countries (the North) claimed that low standards of intellectual property protection in less developed countries (the South) allowed northern intellectual property to be pirated by the South and that such unauthorized use of intellectual property was undermining the incentive of firms to devote resources to innovative activity (USITC, 1988). In opposition, the South pointed to the already extensive market power enjoyed by large northern firms in their markets, and that a further strengthening of intellectual property rights would only serve to increase the monopoly power

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of these companies and further add to the inefficiencies in the trading system.

Despite these contrasting views, the Uruguay Round concluded with an agreement that sets minimum standards for IPR enshrined in the Trade Related Aspects of Intellectual Property Rights (TRIPs).¹ National patents are among the many legal instruments this agreement covers, with the agreement resulting in a higher standard of protection for all countries. This attempt to coordinate IPR is the latest in a series of efforts to gain international agreement on patents, beginning with the Paris Convention in 1883.²

In response to these recent efforts, a number of authors have attempted to assess the implications of raising IPR standards in the south. To gain some insight into the distribution of the costs and benefits, Chin and Grossman (1990) and Deardorff (1992) have analysed the implications of harmonization in static North–South models. The general set-up characterizes the North as containing an innovative firm and recognizing the IPR of this firm. In contrast, the South is assumed not to be capable of innovation, but does have the ability to costlessly imitate the technology developed in the North. Both models begin by assuming that the South disregards the IPR of the North. In this context, the consequences of the South recognizing the IPR of the North are assessed.

In these models, such a policy change has two competing effects. On the one hand, the recognition of IPR in the South provides a greater incentive for northern firms to innovate.³ This greater innovation benefits the South through lower prices (Chin and Grossman) or a greater product range (Deardorff). Against this benefit is set the cost of monopoly power associated with recognizing northern IPR: either southern firms are put at a competitive disadvantage (Chin and Grossman) or monopoly is installed in markets that were previously competitive (Deardorff). Both models conclude that the South typically experiences a greater loss from the monopoly distortion than they gain from the additional innovation induced by the higher IPR standards. Thus, the best policy for the South is completely to free-ride on the intellectual property (IP) protection of the North. Indeed, world welfare may even be higher under the free-riding scenario than when the South does recognize northern IPR.⁴ Moreover, these general conclusions are preserved in a dynamic general equilibrium setting (Helpman, 1993).⁵

Such conclusions have led to the widespread sentiment that the TRIPs agreement is essentially concerned with distributional issues and is not based on efficiency considerations. The following quote from Rodrik (1994) is typical of such a view, ‘irrespective of assumptions made with respect to market structure or dynamic response, the impact effect of enhanced IPR in LDCs will be a transfer of wealth from LDC consumers and firms to foreign, mostly industrial-country firms . . . The important message is that this is an

area where the main issue is one of splitting rents rather than enhancing global efficiency.' Furthermore, estimates of the transfers of income implied by the TRIPs are sizeable (McCalman, 2001). However, viewing the TRIPs agreement merely as a redistributive device neglects the fact that the granting of IPR is associated with a monopoly distortion making the extension of IPR an inefficient way to transfer income. This suggests that for the TRIPs agreement to be feasible it must be primarily about achieving efficiency gains.

In contrast to previous studies, this paper finds that there are efficiency gains from the international coordination of national patents. Furthermore, the reason previous studies failed to identify these efficiency gains is because they did not adequately model the protection offered by a patent. In both Chin and Grossman (1990) and Deardorff (1992), patents are characterized as the exclusive right to use a new technology in a static setting. Contrasting this type of patent policy with one where a southern country does not protect IP, amounts to comparing two extreme situations: no patents versus infinite patents. Hence, by neglecting to model the duration of a patent, the monopoly distortion associated with enhanced protection of IP is overstated.⁶ However, focusing on the legal duration of a patent may also overstate the degree of protection offered by a patent, since most patents lapse prior to their legal limit. Since the maximum duration of a patent is not always binding, this paper will model patent protection by analysing the impact of a patent on the hazard of imitation.

To examine the optimal national patent the framework set out in Nordhaus (1969), Scherer (1972) and De Brock (1985) is followed. In this framework, the government is assumed to move first and commit to a patent policy. After observing the choice of the government, an innovator devotes resources to researching a cost-reducing innovation. Once the invention is discovered, the patent holder can then further develop the invention to realize its commercial worth. To determine the optimal patent in this setting, the government trades off the future increase in consumer surplus against the static monopoly distortion necessary to induce a larger innovation. Extending the analysis to an international setting adds two further influences on the patent policy decision:

- the distribution of the dynamic gains and the static losses across countries; and
- the existence of patents in other countries.

The question is then whether countries acting independently will pick patents that are not only nationally optimal, but also globally efficient.

Typically, the answer is no. The distribution of dynamic gains and static losses across countries means that no single country captures the whole surplus from an innovation. If a country benefits from an innovation located

elsewhere in the world, it ignores the profits accruing to the inventor when determining its national patent.

Similarly, when an innovation is globally applicable, the country containing the innovator ignores the benefits arising in other countries. By ignoring the benefits accruing elsewhere in the world, there exists a tendency to set national patents below the standard that would be globally efficient.

The existence of patents in other countries also generates an externality in the patent setting process. In such a situation, a country anticipates that some innovation will be induced regardless of its own patent policy. As a consequence, a country now faces a higher cost when granting a patent since it must cover the entire innovation rather than just that part of the innovation induced by its national patent. The higher cost arises since by free-riding (not granting a patent) a country gains immediately. However, by granting a patent it defers both the benefits from free-riding and from any additional innovation it induces. This higher cost tends to reduce the standard of the optimal patent chosen by a national government. Since all countries face similar incentives, the outcome is a set of national patents that do not achieve global efficiency.

The set of patents that are globally efficient have some interesting characteristics. First, if international lump sum transfers are feasible, then the optimal policy generally involves only one country setting patents. Following the logic of cost minimization, the country selected to grant patents necessarily is the one with the lowest propensity to incur dead-weight loss and is compensated for this policy through lump sum transfers from abroad. Clearly, this is not the structure of the TRIPs agreement, hence it is of interest to isolate when policy harmonization is efficient. This emerges in the knife-edge case when all countries experience the same dead-weight loss. An alternative scenario is one where international lump sum payments are not feasible, consequently all countries are required to grant patents. Constrained efficient patents have the characteristic that they involve a higher standard of protection than the non-cooperative national patents. However, patents of the same strength in all countries are not necessarily part of the core.

The paper proceeds as follows. Section 2 sets out the model and analyses the nature of policy competition in a North–South setting. Section 3 considers the set of globally efficient patents, while Section 4 concludes.

2. PATENT POLICY AND IN A GLOBAL SETTING

In this section, consider a market for invention with no rivalry; a firm proceeds with certainty towards some cost-reducing inventive goal, secure in the knowledge that it has no competition for this goal. The good manufactured by the firm is sold in a competitive market. Firms selling in this market are distributed across two countries. Call the country where

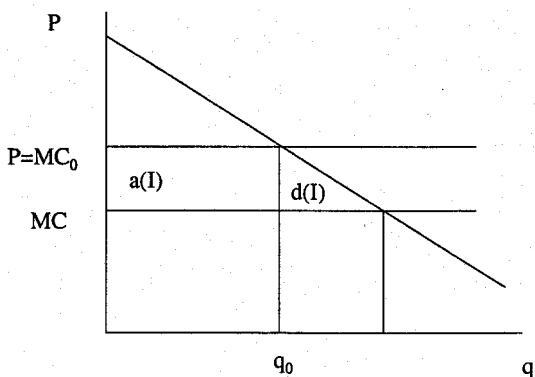


Figure 1 Static Equilibrium

the innovative firm is located the North (n) and the other country the South (s).

Figure 1 illustrates the static demand and cost conditions for a typical country. The firm can invest in R&D expenditures to introduce a process innovation that lowers the unit costs of production according to a *known* production function. Let I denote the process innovation arising from patent-induced R&D expenditures, for example in Figure 1, $I = MC_0 - MC$. Following the optimal patent literature, assume that the innovation is of the 'run of the mill' variety (Nordhaus, 1969). This means that the innovation is not so major as to result in a profit maximizing patent monopolist setting a price below MC_0 . Therefore, before the innovation, and while the patent is in force, the quantity traded is the same, q_0 . To simplify the analysis, normalize this quantity to equal unity for the South, while the analogous quantity in the north is equal to θ .

In this framework, any patented innovation generates instantaneous profits of $a(I)$ for the inventor but is also associated with a static dead-weight loss of $d(I)$, as Figure 1 illustrates. Due to the structure imposed, this dead-weight loss is an increasing function of the level of innovation. In addition, since the focus is on 'run of the mill' innovations, the functional form for instantaneous profits is linear, $a^n(I) = I\theta$ for the North and $a^s(I) = I$ for the south.

Using these instantaneous profit functions, the full reward stream for the monopoly inventor can now be determined. The patent-induced R&D will result in a process innovation yielding a present discounted value of extra profits of R when developed at time $t = 0$. The exact amount of extra revenue depends on both the level of innovation, I , and the standard of patent protection. Let h_i represent the hazard of imitation faced by an innovator in possession of a patent in country i . The discounted value of the extra profits from the innovation is then given by:

$$\begin{aligned}
 R(I, T) &= \int_{[0, \infty]} a^s(I) e^{-(r+h_s)t} dt + \int_{[0, \infty]} a^n(I) e^{-(r+h_n)t} dt \\
 &= I/(r+h_s) + I\theta/(r+h_n)
 \end{aligned} \tag{1}$$

where r is the discount rate. Since r is assumed to be a constant, the analysis can be made more transparent by defining $H_i = 1/(r+h_i)$. Therefore, an increase in the standard of protection in country i is associated with an increase in H_i . The revenue function can now be written as:

$$R(I, T) = IH_s + IH_n$$

The following properties of this function can be directly verified:

$$R_I > 0, R_{II} = 0, R_H > 0, R_{HH} = 0, R_{IH} > 0$$

The cost of development depends directly on the size of the reduction in marginal cost (i.e. the invention). Let $C(I)$ denote the discounted cost function from expenditure on the invention. Assume that $C(\cdot)$ has the following properties:

$$C_I > 0, C_{II} > 0, C_{III} \leq 0$$

To solve for the patent policies of each country, assume that the following game is played. In the first stage, both countries simultaneously and independently announce their patent policies. After observing these policies, the inventive firm decides on the level of development of the innovation. It is assumed that a country can commit to its patent policy and that the inventive firm is aware of this commitment power. The appropriate solution concept for this policy game is subgame perfection. Therefore, we begin by considering the monopoly inventor's problem.

Given that demand is distributed across both countries, the monopoly inventor will generate revenue from each source. The following profit function reflects this multiplicity of markets:

$$\pi = R^n(I, H^n) + R^s(I, H^s) - C(I)$$

where R^n is the gross profit from the domestic market and R^s is the gross profit from the foreign market. Taking both H^n and H^s as given, the first-order condition is:

$$R^n_I + R^s_I - C_I = 0$$

The notational convention employed above uses superscripts to denote the country from which the additional revenue flows arise and subscripts denote the argument with which the derivative is taken. This condition implicitly defines the profit maximizing level of innovation given the patent policies in both countries, $I^*(H^n, H^s)$.

Consider next the policy setting stage. In solving the policy game, both countries correctly anticipate the behaviour of the inventive firm as set out above. Starting with the inventive country, its welfare function is specified as:

$$W^n = CS^n(I^*(.), H^n) + R^n(I^*(.), H^n) + R^s(I^*(.), H^s) - C(I^*(.)) \quad (2)$$

where $CS^i(I^*(.), .) = (a^i(I) + d^i(I))(1/r - H^i)$ and is the additional consumer surplus associated with the innovation for country i . The following properties of CS^i can be directly verified:

$$CS_I > 0, CS_H < 0, CS_{IH} < 0, CS_{HH} = 0$$

Using this welfare function, the iso-welfare contours can be constructed and the slope of a representative curve is calculated to be:

$$dH^n / dH^s = - (CS^n_I I_{H^n}^* + R^n_{H^n}) / (CS^n_I I_{H^n}^* + R^n_{H^n} + CS^n_{H^n}) \quad (3)$$

Since the numerator is positive, the sign of (3) is determined by the sign of the denominator. The denominator will take on both positive and negative values depending on whether H^n is a best response to a given level of H^s . The best response patent standard, H^{n*} , is implicitly defined by:

$$dW^n/dH^n = CS^n_I I_{H^n}^* + R^n_{H^n} + CS^n_{H^n} = 0 \quad (4)$$

Therefore the slope of the iso-welfare curve will behave as follows:

$$\begin{aligned} dH^n/dH^s &> 0 && \text{when } H^n < H^{n*} \\ dH^n/dH^s &< 0 && \text{when } H^n > H^{n*} \end{aligned}$$

The appendix shows that the slope of the best response function for the North is negative. Figure 2 depicts both the best response function and the iso-welfare contours for the inventive country.

To gain some intuition for why the slope of the best response function is negative, consider how incentives are altered for the inventive country when the non-inventive country moves from a patent policy with zero protection to one with some protection. Consider first the case where the non-inventive country does not protect IP. The inventive country is then in the world analysed by Nordhaus, and any innovation that occurs is induced solely in

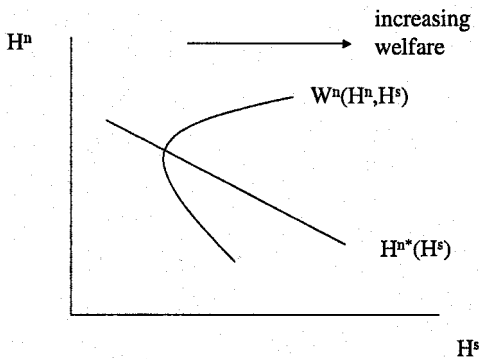


Figure 2 Best Response Function

response to the patent that the inventive country sets. On the other hand, if the non-inventive country adopts a patent strength greater than zero then *some* innovation is going to be induced regardless of the policy of the inventive country. This reduces the incentive to provide patent protection since the domestic dead-weight loss is going to be greater for any given level of patent protection. Furthermore, the extent of innovation will be less responsive to any given patent of the inventive country due to the concave nature of the innovation function.

Turning to the behaviour of the non-inventive country, the following welfare function represents its interests:

$$W^s = CS^s(I^*(.), H^s)$$

Using this function, the set of iso-welfare contours is obtained, with the slope of a representative contour given by:

$$dH^n/dH^s = -(CS^s_{I_H^*} + CS^s_{H^s})/CS^s_{I_H^*} \quad (5)$$

Since the denominator of (5) is always positive, its sign will depend on the numerator. Again, setting the numerator equal to zero implicitly defines the best response patent strength, H^{s*} . From this, (5) is evaluated as:

$$\begin{aligned} dH^n/dH^s &> 0 && \text{when } H^s > H^{s*} \\ dH^n/dH^s &< 0 && \text{when } H^s < H^{s*} \end{aligned}$$

Furthermore, by applying techniques similar to those used above, it can be shown that the slope of the best response function, dH^n/dH^{s*} , is negative.

Figure 3 combines the information derived in this section and depicts the Nash equilibrium of the patent setting game. It is clear from the diagram that the Nash Equilibrium is not efficient. This is due to two externalities. The freerider effect: all countries benefit from the policies of a single country. Accordingly, countries reduce the strength of their own patents to reflect this spill-over. In addition, no one country appropriates all the gains from an

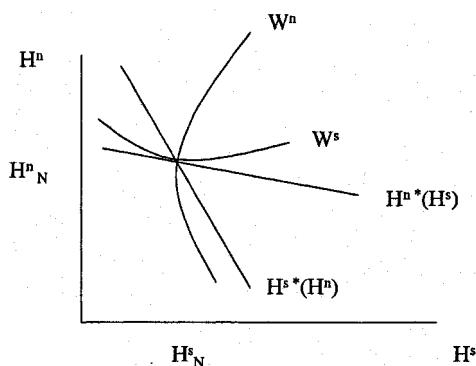


Figure 3 Nash Equilibrium

innovation, therefore the policy chosen by an individual country neglects to take into account the surplus that accrues elsewhere. Given that all countries face the same incentives, and each country ignores the impact of its actions on the other country, the result is a set of patents that are inefficient from a global perspective. These conclusions are summarized in the following proposition.

Proposition 1

If both the North and the South consume the innovation good and each sets patent policy independently, then the national patents are not efficient from a global perspective.

3. GLOBALLY EFFICIENT PATENTS

The previous section identified two externalities that undermined the efficiency of patents when countries act independently in setting policy. It is the presence of these externalities that may explain the recurring interest in efforts to gain an international agreement on patent protection. Therefore, it is of interest to ask what the set of patents that are associated with global efficiency look like.

In order to maximize global welfare it is necessary to choose the set of patents that minimize the global dead-weight loss for any given level of innovation. Inspection of the cost minimization problem provides insights into the nature of the efficient set of patents:

$$\max_{\substack{H^n \geq 0 \\ H^s \geq 0}} -(d^n H^n + d^s H^s) \quad \text{subject to } I = I^*$$

The first-order conditions from the Lagrangian problem are:

$$\begin{aligned} \partial L / \partial H^n: & -d^n + \lambda I_{H^n}^* \leq 0, H^n \geq 0 \text{ and } H^n \partial L / \partial H^n = 0 \\ \partial L / \partial H^s: & -d^s + \lambda I_{H^s}^* \leq 0, H^s \geq 0 \text{ and } H^s \partial L / \partial H^s = 0 \end{aligned}$$

Assuming an interior solution and eliminating the Lagrange multiplier gives:

$$d^n / I_{H^n}^* = d^s / I_{H^s}^*$$

Upon noting that $I_{H^n}^* = \theta / C_{II}$ and $I_{H^s}^* = / C_{Ii}$, this condition reduces to $\theta d^s = d^n$. This says that an interior solution will only exist if both countries have the same propensity to incur dead-weight loss from granting patents. In this situation, the set of efficient patents is not uniquely defined, with any set of patents consistent with I^* minimizing the global dead-weight loss. The intuition for this result is straightforward, when countries experience the same proportional dead-weight loss, the global planner is not concerned with the source of funds. Instead, the global planner just concerns him/herself

with generating sufficient funds to induce the inventor to undertake the optimal level of innovation.

However, more generally it is the case that $d^s \neq d^n$, implying that one of the two following cases holds:

- (1) $H^n = 0$ and $H^s > 0$
- (2) $H^n > 0$ and $H^s = 0$

The intuition for this result follows directly from that given above. In an effort to minimize the dead-weight loss associated with using patents to induce innovation, the global planner will simply choose to grant patents in the country with the lowest dead-weight loss. Hence, a global planner who maximizes welfare based on a utilitarian welfare function will find it optimal for only one country to set patents in general, with distributional objectives achieved through lump sum compensation. This leads to the following proposition.

Proposition 2

- (a) If countries have the same propensity to incur dead-weight loss from granting patents, then the set of patents that induce the globally efficient level of innovation is not unique and harmonization is an element of this set.
- (b) If a country has a relatively high propensity to incur dead-weight loss from granting patents, then global efficiency is achieved by that country not granting patents, and the other country setting a patent that induces the globally efficient level of innovation.

However, the types of lump sum compensation scheme required to implement this outcome are typically not available. In the absence of a lump sum transfer mechanism, the global planner will be constrained to select a set of patents that do not minimize global dead-weight loss. Nonetheless, a constrained efficiency locus can still be constructed by solving the following program:

$$\begin{array}{l} \max W^s \text{ subject to } W^n = W^* \\ H^s \geq 0 \\ H^n \geq 0 \end{array}$$

The characteristics of the solution to this program are summarized in the following Proposition.⁷

Proposition 3

An efficient outcome, given no lump sum transfers, involves each country setting a higher standard of patent protection than in the Nash Equilibrium.

Figure 4 illustrates this proposition. The efficient outcome requires all countries to raise their standard of protection beyond that set in the Nash

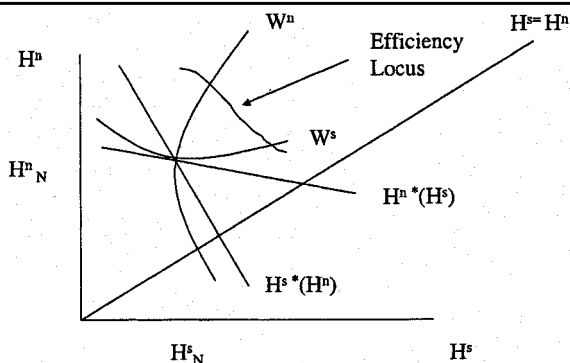


Figure 4 Global Efficiency

equilibrium. This universal raising of standards is a characteristic of the TRIPs agreement. This outcome is intuitive given the externalities identified in Section 1, if no lump sum transfers are available. Another characteristic of the TRIPs agreement is that all countries adopt uniform standards. By incorporating the Nash welfare levels, the core of the game can be defined. As is clear from the diagram, the more asymmetric the size of the countries the less likely is harmonization of patent policy to be in the core. This highlights the need for linking patents with other issues in order to achieve harmonization of patent standards (McCalman, 2001).

4. CONCLUSIONS

The agreement covering the Trade Related Aspects of Intellectual Property Rights (TRIPs) is seen as one of the major achievements of the Uruguay round of trade negotiations. By setting minimum standards of intellectual property protection, firms in developed countries have gained a safeguard against the piracy of their new technology. However, from a global perspective, the net benefits of such an agreement remain unclear. Indeed, the theoretical models developed to date suggest that not only is it likely that developing countries will suffer from a move to high standards of intellectual property protection, but that world welfare may also be reduced. Such conclusions carry serious implications both for the desirability of a TRIPs style agreement and also the stability of the global trading system.

This paper argues that the conclusions of previous studies have been derived from definitions of patents that do not adequately capture the characteristics of this policy instrument. As a consequence, the monopoly distortion associated with patents has been overemphasized. In contrast, this paper models a patent as effecting the hazard of imitation, with this rate being a policy variable. This allows for a more detailed analysis of the determinants of patent policy in an international context, and isolates two

externalities when countries set patent policy independently. These externalities arise from a free-riding incentive (policy competition) and the international spillovers from an innovation. Since these considerations influence the patent strength in both developed and developing countries, patents set on a national basis are inefficient from a global perspective. This provides an economic rationale for international coordination of patent policy.

APPENDIX

To determine the slope of the best response function for country n , totally differentiate (4) to obtain:

$$dH^{n*} / dH^s = - W_{H^s H^s}^n / W_{H^n H^n}^n$$

Since the denominator is negative, by the second-order condition for a maximum, the sign of this derivative is decided by the numerator. Calculation of this expression reveals:

$$W_{H^s H^s}^n = CS_I^n I_{H^s H^s}^* + R_{H^s H^s}^s + CS_{H^s H^s}^n$$

It proves informative to use the functions implied by a ‘run of the mill’ innovation:

$$\begin{aligned} CS_I^n &> 0 \\ I_{H^s H^s}^* &= C_{III} I_{H^s} / (C_{II})^2 \leq 0 \\ CS_{H^s H^s}^n + R_{H^s H^s}^s &= -d_I^n I_{H^s} < 0 \end{aligned}$$

The signs of these quantities imply that dH^{n*}/dH^s is negative.

Proof of Proposition 3

$$\max_{\substack{H^n \geq 0 \\ H^s \geq 0}} W^s \text{ subject to } W^n = W^*$$

Forming the constrained optimal program gives:

$$L = W^s - \lambda(W^n - W^*)$$

The first-order conditions yield:

$$\frac{\partial L}{\partial H^n} = CS_I^n I_{H^n} - \lambda[CS_I^n I_{H^n} + CS_{H^n}^n + R_{H^n}^n + R_I^s I_{H^n} + R_I^n I_{H^n} - C_I I_{H^n}] = 0 \text{ (A1)}$$

$$\frac{\partial L}{\partial H^s} = CS_I^s I_{H^s} + CS_{H^s}^n + \lambda[CS_I^n I_{H^s} + R_{H^s}^s + R_I^s I_{H^s} + R_I^n I_{H^s} - C_I I_{H^s}] = 0 \text{ (A2)}$$

Using $R_I^n + R_I^s - C_I = 0$, (A1) and (A2) simplify to

$$\frac{\partial L}{\partial H^n} = CS_I^n I_{H^n} - \lambda[CS_I^n I_{H^n} + CS_{H^n}^n + R_{H^n}^n] = 0$$

$$\frac{\partial L}{\partial H^s} = CS_I^s I_{H^s} + CS_{H^s}^n - \lambda[CS_I^n I_{H^s} + R_{H^s}^s] = 0$$

To show that each of these conditions implies stronger protection than associated at the Nash Equilibrium, evaluate each at the Nash levels:

$$\left. \frac{\partial L}{\partial H^n} \right|_{H^n} = CS_I^s I_{H^n}^n > 0$$

$$\left. \frac{\partial L}{\partial H^s} \right|_{H^s} = -\lambda [CS_I^n I_{H^s}^n + R_{H^s}^s] > 0$$

NOTES

- 1 See Maskus and Penubarti (1995) for empirical evidence on the link between IPR and trade.
- 2 For a detailed treatment of the history of international agreements on IPR see Penrose (1951), Maskus (1998, 2000).
- 3 The discussion in this section concentrates on models with a link between innovation and IPR. However, another strand of literature on the TRIPs agreement exists that ignores this link and concentrates on assessing the size of the distortion associated with the South raising its standard IP protection (see Maskus and Eby-Konan 1994).
- 4 These strong results are weakened somewhat if the North and South are assumed to have different technological needs. In such a situation Diwan and Rodrik (1991) have shown that the South does have an incentive to recognize northern IPR, and that the free-riding motive may even be completely reversed with the South over-protecting northern IPR.
- 5 Helpman (1993) builds on the work of Grossman and Helpman (1991, ch. 11) by providing a welfare analysis of exogenous changes in the South's imitation rate. Helpman finds that the South always loses from a decrease in the imitation rate (interpreted as a raising of standards of IP protection), while the North is more likely to gain if the rate of imitation was initially high. However, if the imitation rate is initially low then both regions lose from a raising of standards in the South.
- 6 In Helpman (1993), due to the assumptions relating to market structure, the North does not need to provide patent protection to induce innovation. By ignoring patents in the North, Helpman's model cannot be used to analyse policy interaction, which is a source of inefficiency emphasized below.
- 7 The proof of this proposition is given in the appendix.

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