Intellectual Property Infringement by Imports and the ITC

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PRELIMINARY AND INCOMPLETE

1. Introduction

Legal disputes over intellectual property (IP) have become an important and highly visible aspect of business activity, and major technology-intensive companies such as Apple and Samsung are engaged in IP litigation on an essentially constant basis. In the United States, the major venue for IP litigation is U.S. district court. However, if an alleged IP infringement is embodied in imports, the "quasi-judicial" U.S. International Trade Commission (ITC) is an alternative forum in which claims can be made. Intellectual property cases at the ITC have increased in frequency and are now arguably more important in economic terms than other types of ITC-administered discretionary protection such as anti-dumping duties or countervailing duties.

One important feature of IP protection by the ITC is that the primary remedy for infringement is the suspension of imports. This approach is sometimes referred to as "injunctive relief" and is typically implemented using "exclusion orders" that exclude imports of the infringing good from the domestic market. Although IP-based discretionary protection by the ITC is important, there is little economic research focussed on providing a theoretical framework for identifying the likely economic effects. Our primary objective in this paper is to provide such a framework, based on what we see as the most important aspects of IP-based discretionary protection.

Specifically, we present an analysis of ITC-style injunctive relief for patent infringement embodied in imports. We also compare injunctive relief with the very different approach used for patent infringement in U.S. district courts (and in the courts of most other countries), which is to impose a license fee (or the equivalent) on the infringing good.

An eligible firm alleging infringement of U.S. intellectual property by an imported good can initiate a case either in court, or with the ITC, or both. This "dual track" approach for addressing IP infringement exists only for imports, not for alleged infringement by domestically produced goods. An obvious question concerns why import-based IP infringement should allow for a dual track legal process while domestic infringement does not. A frequently given answer (as in Chien, 2008) is that allowing IP infringement cases before the ITC is simple protectionism. Even if the administrative law judges who decide ITC cases are no more likely to favor domestic plaintiffs than judges or juries in district court (referred to from now on just as "the courts" or as "court"), it is possible that the structure of the ITC system is designed to favor domestic firms (plaintiffs) on a consistent basis.

One important aspect of patent litigation in both the ITC and the courts is negotiation between the two firms engaged in the dispute. Most cases in both venues are settled by such negotiation before final legal adjudication. And in both legal forums, the normal settlement is based on a license fee or similar financial compensation. Therefore, the comparison between the ITC and the courts depends largely on comparative incentives for settlement.

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We use the simplest plausible model that we think captures the main features of patent enforcement by the ITC and by the courts. One main feature is imperfect competition. Cases normally involve just two firms – a plaintiff and a defendant – who are engaged in oligopolistic competition, although multiple defendants are sometimes involved. While other firms may be in the domestic market, we use the simplifying assumption that the domestic market is served by just these two firms competing as Cournot duopolists.

For convenience, we call the plaintiff the "domestic firm" and the defendant the "foreign firm" although what matters for the ITC is where the product is produced, not the location of the headquarters of the producing company. In practice, both parties are often headquartered in the United States. For example, one interesting recently initiated ITC case is Investigation 337-TA-1093, filed on Nov. 30, 2017. The plaintiff is Qualcomm Inc. and the defendant is Apple, both of which are U.S. companies. The product in question is imported "mobile electronic devices" (primarily iPhones and components used in iPhones) produced outside the United States by Apple that allegedly infringe Qualcomm patents.

We assume that the domestic firm owns a patent giving it rights over intellectual property that may be embodied in the imported product. The domestic firm may file a complaint about the imported product in either the courts or the ITC.

The other main feature of the model concerns the bargaining game played by the two parties. In our analysis, this bargaining game constitutes the first stage in a two-stage game that follows filing of a complaint by the domestic firm. We use the Nash bargaining solution to model this process. If settlement is reached in bargaining, the resulting license fee is imposed. If no settlement is reached, the case is decided in the relevant legal venue (the ITC or in court). If infringement is found by the ITC, then an exclusion order is applied. If infringement is found by the courts, a "fair value" license fee per unit of output is imposed. The second stage is a final output stage in which the firms operate as Cournot duopolists unless imports are excluded by an exclusion order, in which case the domestic firm has a domestic monopoly.

Our principle finding is that the ITC is protectionist. Specifically, its system of injuctive relief not only may exclude offending imports entirely but also tends to generate higher license fees in cases that are settled. This finding is robust to a wide range of variations in how the situation is modeled.

We also show that product differentiation has significant effects on the outcome of settlement negotiations and that induced product differentiation is a particularly important possibility for ITC cases.

Section 2 contains a short literature review and discussion of the institutional background, including stylized facts about the ITC. Section 3 presents a model based on homogeneous products. Section 4 introduces product differentiation and Section 5 contains a welfare analysis. Section 6 is devoted to concluding remarks.

2. Literature Review and Institutional Background

There is a large literature on the economic analysis of litigation, and a substantial part of this literature concerns the determination of when cases are settled out of court rather than proceeding to trial and legal judgment. An excellent review of this literature is provided by Daughety and Reinganum (2012), who note that the Nash bargaining solution has sometimes been used to model settlement outcomes. See, for example, Crampes and Langinier (2002). Most of this work is either very general in nature or is focussed on litigation in areas other than intellectual property. We believe that the first paper to use Nash bargaining to represent bargaining over license fees is Kishimoto and Muto (2012), but it does not deal with international trade or with ITC-like injunctive relief more broadly. We are not aware of previous work of this type that deals with discretionary protection.

Our analysis of patent enforcement by the ITC fits into the broad literature on discretionary protection. Most of the discretionary protection literature focuses on anti-dumping duties and countervailing duties. Standard references on anti-dumping duties include Staiger and Wolak (1992) and Prusa (2001). A recent overview covering much of the relevant literature on anti-dumping is Blonigen and Prusa (2016), and a valuable discussion of the history of anti-dumping policy is Irwin (2005). Countervailing duties are often studied in conjunction with anti-dumping duties as in, for example, Galloway et al. (1999).

The role of intellectual property in international trade has received significant attention from economists. See, for example, a classic paper by Maskus and Penubarti (1995) showing a positive relationship between the strength of patent laws and imports and McCalman's (2005) assessment of gains and losses arising from the Trade Related Intellectual Property Rights (TRIPS) Agreement.

Despite the large literature on discretionary protection and on the relationship between intellectual property and international trade, we have found only a few papers addressing both topics at the same time – dealing with discretionary protection based on intellectual property. One important paper in this area is Aoki and Prusa (1992), which focuses on R&D incentives of such protection and outlines factors that would increase or decrease R&D in this context. In addition, Schwarz (1991) provides a model and some explicit calculations illustrating that costs to consumers from exclusionary protection may be large relative to gains by domestic producers.

Legal scholars, such as Diehl (2011), have written extensively on the legal basis and practice of ITC intellectual property actions. Such actions are based on Section 337 of the Tariff Act of 1930, as subsequently amended, and as articulated as Title 19, Section 1337 of the U.S. Legal Code. This law makes illegal "unfair methods of competition and unfair acts in the importation of articles", which seems rather broad in scope. However, the Act goes on to be very explicit about intellectual property, specifying infringement of patents, copyrights, trademarks and other types of intellectual property as illegal under the Act. Other types of "unfair

competition" can be the basis of Section 337 actions but in practice, almost all Section 337 cases deal with intellectual property, and most are based on patents.[1]

In order to be eligible for Section 337 IP enforcement, a complainant must hold U.S. intellectual property. Traditionally, Section 337 was focused on protecting "domestic industry", which was normally interpreted as requiring that the complainant firm undertake manufacturing in the United States. However, in 1988, Section 337 was amended to include R&D and licensing as eligible activities to satisfy the "domestic industry" requirement, as described in Chien and Lemley (2012).

Mutti and Yeung (1996) undertake a valuable empirical analysis of the effects of Section 337 actions, identifying characteristics of firms that file such actions and the effects of the actions on them. Not surprisingly, they find that successful cases increase the profitability of plaintiff firms relative to peers, while unsuccessful cases have a negative effect on the profitability of plaintiffs. Notably, however, successful cases have no discernible effect on R&D investment relative to non-litigating peers, while unsuccessful cases have a negative effect. Co (2004) assesses the value of the patents underlying Section 337 cases.

An event significantly affecting Section 337 actions was a 2006 U.S. Supreme Court decision in eBay v. MercExchange, as described in Chien and Lemley (2012). This decision made it much more difficult for plaintiffs to obtain injunctive relief in court patent cases. In an opinion supporting this decision, Justice Kennedy raised the issue of patent trolls:[2]

> An industry has developed in which firms use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees. . . . For these firms, an injunction, and the potentially serious sanctions arising from its violation, can be employed as a bargaining tool to charge exorbitant fees to companies that seek to buy licenses to practice the patent.

In its 2006 e-Bay decision, the Court decided that several criteria must apply before injunctive relief can be used, including a determination that other remedies, such as monetary damages, are inadequate. As described in Valencia (2012, p. 274), the ITC concluded that this decision was not relevant to ITC remedy practice and this view has been supported by U.S. courts. Therefore, in the post-2006 world, the ITC has become a more attractive venue for patent cases for firms seeking injunctive relief (i.e. an exclusion order), especially as filing a case at the ITC does not preclude filing a corresponding case in U.S. court.

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[1] For example, in fiscal 2016, the ITC lists 117 intellectual property cases under active investigation at some point in the year. Of those 117 cases, 111 dealt either purely with patent infringement (97 cases) or with patents and other forms of intellectual property as well (14 cases). In addition, 3 cases dealt purely with trademark infringement and 3 purely with trade secrets.

[2] eBay Inc. 126 S. Ct. 1842 (Kennedy, J. concurring). Joined by Justices Stevens, Souter, and Breyer.

Intellectual property cases at the ITC have attracted a substantial amount of criticism in the legal literature. An influential critique is made by Chien and Lemley (2012), who write favorably of the Supreme Court *eBay* decision but argue (p. 104) that "the ITC's practices have undone many of the desirable consequences of *eBay*". In particular, they argue that the exclusion order remedy gives complainant firms too much power to "hold up" productive firms and extract concessions from them, to the detriment of the public interest. Another useful legal critique and suggestion for reform of the ITC approach to intellectual property is Duescher (2014).

Our approach to modelling patent-based discretionary protection is related to the strategic trade policy literature as reviewed in Brander (1996) and, in particular, uses a structure that builds on Brander and Spencer (1985) and Brander (2007). We also draw on the large literature on patent licensing. Much of the licensing literature addresses the optimal structure of license fee contracts, focusing particularly on the choice between fixed fees and per-unit fees. In practice, the vast majority of license arrangement include a per-unit component, possibly in combination with a fixed fee. We follow Gallini and Winter (1985), along with many others, in assuming that license fees are of the per-unit form. Licensing in a Cournot model has been analyzed by several authors, following Wang (1998).

Relative to the previous literature, our paper is original in several important respects. We believe this is the first paper to combine Nash bargaining over IP license fees with the possibility of litigation, and is the first application of such a model to international trade policy. The possible protectionist role of the ITC has been frequently raised by legal scholars but, to our knowledge, has not previously been analyzed in an economic model of litigation, bargaining, and output competition between domestic complainants and imports.

3. The Model

We seek to keep the analysis as simple as possible while focusing on the main points of interest. Although significant generalization is possible, we therefore start by assuming that demand derives from a quadratic utility function

$$U = a(x+y) - (b/2)(x^2 + y^2) - sxy + M \tag{1}$$

where M denotes consumption of a numeraire good. As U is additively separable in M, there are no income effects of demand and standard surplus measures can be used to determine changes in utility. Variables x and y represent domestic consumption of the domestically produced good and the imported good respectively. Utility function (1) allows for x and y to be differentiated goods. However, we initially make the further simplification of assuming that the goods are homogeneous. Algebraically, this means that $s = b$ in equation (1) and we can represent domestic consumption by the aggregate $X = x + y$. The utility function simplifies to:

$$U = aX - (bX^2/2) + M \tag{2}$$

The inverse demand function is linear. Using p to denote price, this function is:

$$p(X) = u'(X) = a - bX = a - b(x + y). \tag{3}$$

It follows that $p'(X) = -b < 0$.

Our overall equilibrium concept is the sequentially rational equilibrium in the two-stage game in which firms play a Cournot game in the second stage (if both are in the market) and engage in Nash bargaining in the first stage. Following standard practice, we consider the two stages in reverse order, starting with the final stage.

3.1 The second stage output game

In the second stage there are two possibilities. It is possible that the domestic firm might have a monopoly. This outcome arises if the case was filed in the ITC, the two firms do not reach a settlement in Nash bargaining, and the ITC finds patent infringement, in which case it issues an exclusion order terminating imports. In all other cases both firms will be in the market.

If both firms are in the market, they produce identical goods and engage in Cournot competition. The patent owned by the domestic firm is a property right over a cost-reducing innovation. If the technology embodied in the patent is not used, the marginal cost of production is a constant, c, and is the same for both firms. If the patented technology is used, the marginal cost of production is $c - v$, where v is the value of the patent in reducing per-unit cost. This value might be zero (i.e. the innovation is not useful) or it might be positive.

We assume that the value of patent is exogenous to the current game in the sense that it is pre-determined. Possibly the patent was purchased by the domestic firm, or possibly it is the result of some prior R&D process. We also assume that the foreign firm has previously made the decision of whether to use the patented technology in its own production, so that too is pre-determined. Furthermore, we make the natural assumption that if the patent has no cost-reducing value ($v = 0$), then the foreign firm would not use the patented technology. However, we initially also make the significant simplifying assumption that if the patent has value ($v > 0$), the foreign firm has previously made the decision to incorporate that technology in its production. The domestic firm will always use the patented technology if $v > 0$. The foreign firm pays a non-negative license fee, denoted r (for "royalty"), where $r \geq 0$. Note that not paying for the rights to use the patented technology is captured by the possibility that $r = 0$.

Imports y, total consumption X, and price p depend on r and v. As just noted, the cost-reducing value of the patent, v, is exogenous. The license fee, r, is determined either by bargaining or by legal judgment prior to the output stage. For court cases, a legal judgment can set r equal to any non-negative value. For ITC cases, a negative finding by the ITC (i.e. the plaintiff loses the case) means that $r = 0$ in the output stage. A positive finding leads to an injunction against imports so that $y = 0$ in the output stage and the domestic firm has a monopoly.

The monopoly case is straightforward and we do not report the associated algebra here. We denote the monopoly profit of the domestic firm as π^m.

If both firms are in the market in the second stage, they interact as Cournot duopolists. As the foreign firm uses the patent and pays a license fee, r (which may be zero) profit functions π and π^* for the domestic and foreign firms respectively can be written as

$$\pi = [p(X) - (c - v)]\,x + ry$$

$$\pi^* = [p(X) - (c - v)]y - ry \tag{4}$$

Profit for the domestic firm includes revenue ry from the license fee, while ry is a deduction from profit for the foreign firm. Using subscripts to denote (partial) derivatives and assuming an interior solution, the first order conditions for profit maximization by the domestic and foreign firms are, respectively

$$\pi_x = a - 2bx - by - c + v = 0$$

$$\pi^*_y = a - bx - 2by - c + v - r = 0 \tag{5}$$

The corresponding second order conditions are satisfied.

$$\pi_{xx} = -2b < 0\ ;\ \pi^*_{yy} = -2b < 0. \tag{6}$$

It also follows that $D \equiv \pi_{xx}\pi^*_{yy} - \pi_{xy}\pi^*_{yx} = 3b^2 > 0$, which means that x and y are strategic substitutes, best-response functions are downward-sloping, and standard stability conditions are satisfied. Solving the equations in (5) yields solutions for x and y (and X) as follows.

$$x = (a - c + v + r)/3b \tag{7}$$

$$y = (a - c + v - 2r)/3b \tag{8}$$

$$X = x + y = [2(a - c + v) - r]/(3b) \tag{9}$$

These solutions are meaningful only if they are non-negative, as output would never be negative. Output will be strictly positive for the domestic firm and therefore for the industry overall if $a > c - v$. However, even if this condition is satisfied, it is possible that the foreign firm will not produce if license fee r is too high, in which case the market structure would revert to simple monopoly. We define r^M as the minimum license fee that reduces imports to 0. It follows that

$$r^M = (a - c + v) \tag{10}$$

For any license fee equal to or exceeding r^M, imports will be zero. Proposition 1 examines the comparative static effects of a change in r for values of r less than r^M.

Proposition 1: For $r < r^M$, an increase in r causes domestic output x to rise, imports y to fall, total output X to fall, and price p to rise.

Proof: Differentiating (7) and (8) with respect to r yields

$$dx/dr = 1/(3b) < 0 \text{ and } dy/dr = -2/(3b) > 0. \tag{11}$$

It follows that $dX/dr = dx/dr + dy/dr = -1/(3b) < 0$ and $dp/dr = p'(X)dX/dr) = -bdX/dr = 1/3 > 0$. ***

One interesting implication of Proposition 1 is that increasing the license fee is not just a simple transfer from the foreign firm to the domestic firm. Increasing the license fee also has the effect of reducing output and raising price toward the monopoly level, reducing the utility of domestic consumers. Using (4) and substituting in first order conditions (5), it follows that the equilibrium solutions for profit are:

$$\pi = bx^2 + ry; \ \pi^* = by^2 \tag{12}$$

It is of some interest to ask whether the domestic firm always prefers a higher license fee even up to the point at which the foreign firm leaves the market. The answer is yes, as stated in Proposition 2.

Proposition 2: For all $r < r^M$, an increase in the license fee always causes domestic profit to increase and foreign profit to fall. Therefore, the domestic firm would always prefer to drive the foreign firm out of the market rather than earn license fee revenue from the foreign firm's operations.

Proof: Differentiating (12) with respect to r yields $\pi'(r) = 2bx(r)x'(r) + (y(r) + ry'(r))$ and $\pi^{*\prime}(r) = 2by(r)y'(r)$. From (12) and using $by(r) = bx(r) - r$ as can be inferred from (7) and (8), we obtain $\pi'(r) = 5y(r)/3 > 0$; $\pi^{*\prime}(r) = -4y(r)/3 < 0$. ***

Domestic profit reaches its maximum where r becomes prohibitive in that $y = 0$ and the domestic firm acts as a domestic monopolist, which is the best it can do if products are homogenous. However, as we later show, if products are differentiated, it is quite possible that the domestic firm might prefer a non-prohibitive license fee.

3.2 First stage Nash Bargaining

In the first stage of the game, firms anticipate the outcome of the second stage as a function of the license fee to be determined in the first stage. This license fee determination may arise from a settlement, or it may arise from legal adjudication. Based on this understanding, firms bargain over the license fee.

One widely used solution concept for two-person bargaining games is the Nash bargaining solution, introduced by Nash (1950). This solution was viewed as the solution to a

"cooperative" two-person game and can be derived from a set of intuitively appealing axioms, as shown in Nash (1953). Rubinstein (1982) showed that the Nash bargaining solution is also the solution to a class of non-cooperative bargaining games in which players make alternating offers.

Operationally, the Nash bargaining solution is obtained by maximizing the Nash product, which is the product of the payoffs obtained by the two players net of what they would get if no agreement were reached. We denote the profits to the domestic and foreign firms if no agreement is reached as π^d and π^{*d} respectively. The superscript "d" stands for "disagreement" as these payoffs are typically called the disagreement payoffs. The Nash product is therefore

$$NP = (\pi(r) - \pi^d)(\pi^*(r) - \pi^{*d}) \tag{13}$$

The Nash bargaining solution is the value of r that maximizes NP. This solution has a number of plausible and appealing properties. In particular, it satisfies the Pareto principle in that, given the net payoff to any one player, the net payoff to the other is maximized. It also implies that both players share in any gains and, if they are symmetric, they share equally.

A Nash bargain is sometimes called "trivial" if the best the players can do is agree that each will get the disagreement payoff. In this paper we treat the trivial outcome as failure to reach a settlement. A settlement must therefore be a non-trivial Nash bargaining solution and implies that each party obtains positive surplus. If either player gets as much or more at the disagreement point than from any feasible settlement, that player is assumed to veto any settlement so no settlement would occur.

The primary difference between the ITC process and court is due to a difference in the disagreement point. Under the ITC, if no agreement is reached and infringement is found then the foreign firm gets nothing and the domestic firm gets the maximum possible return of the monopoly profit. In court, if no agreement is reached and infringement is found, then a fair value license fee is determined and the two firms get corresponding payoffs.

We initially consider the base case of full information and no litigation costs (court costs). In this case v is known by all parties, including the ITC and the courts, and all parties know whether the foreign firm is using the patented technology. Furthermore, this information is common knowledge – known by all parties and known to be known, etc. In this case, the outcome of legal adjudication is known with certainty.

In both the ITC and in court, there are two possibilities, depending on the patent's value, v. If $v = 0$, the patent is of no value. The foreign firm would, in this case, not use the patented technology and both the court and the ITC would find no infringement. In the event that no settlement is reached, the ITC would not grant an injunction against imports and the court would not impose any license fee.

In this base case with full information and no litigation costs, no non-trivial Nash bargains arise, as expressed in Proposition 3.

Proposition 3: If there are no litigation costs and there is full information, then no (non-trivial) settlements occur. ***

Proof: i) ITC. If $v = 0$ (no infringement), the ITC would decide against the plaintiff. The foreign firm would earn the standard duopoly profit with no license fee, as would the domestic firm. In this case $\pi^{*d} = \pi^*(0)$ which must exceed $\pi^*(r)$ for any positive license fee. Therefore, the net profit for the foreign firm from any settlement, $\pi^*(r) - \pi^{*d}$ would be negative, so the foreign firm would veto any settlement. If $v > 0$, then the ITC would issue an injunction against imports if it decides the case. This provides the domestic firm with its highest possible payoff, the monopoly profit. Therefore the domestic firm would refuse to settle as it gets the highest possible payoff by not settling.

ii) Court. In this case the court knows the patent's true value, v, and will assign it as a license fee if no settlement is reached. The domestic firm would never settle for less than v and the foreign firm would never settle for a license fee exceeding v. Therefore, no non-trivial settlement is possible. As with the ITC venue, each firm receives its disagreement profit and the Nash product has a maximum value of 0.***

Proposition 4: In the base case a) the ITC and court are no different if the patent has no value ($v = 0$) and b) the ITC is more protectionist (imports are lower) if the patent has value.

Proof: a) If $v = 0$ the foreign firm does not use the patented technology, and neither the ITC nor the court would impose any sanction. And the patent is of no value to the domestic firm. In both cases, the output stage is the standard Cournot duopoly outcome.

b) If $v > 0$, the foreign firm does use the patented technology (previously assumed). In this case, the ITC venue would always result in exclusion as the domestic firm would never agree to a settlement with a license fee below the prohibitive level. The court, on the other hand, would impose a license fee equal to patent's actual cost-reducing the actual value, v. The foreign firm would pay the license fee and operate in the domestic market. In this sense the court is less protectionist than the ITC.

Proposition 4 establishes the base case expectation that the ITC is more protectionist than court. However, the base case is an extreme case in which settlements never occur (in sharp contrast to actual events). In order for non-trivial settlements to occur it is necessary to extend or modify the model in some way. One realistic extension would be to introduce post-negotiation litigation costs that can avoided if settlement is reached. In the presence of common knowledge, this extension would imply that settlements are always reached. By settling, the firms would avoid these litigation costs and can share the gain. This applies whether only one firm experiences litigation costs or both firms do. This is expressed in Proposition 5.

Proposition 5: Nash Bargaining with Litigation Costs and Common Knowledge

If the extent of infringement is common knowledge and there are post-negotiation litigation costs, then a non-trivial settlement always occurs in which each firm receives positive surplus relative to the disagreement outcome.***

Proposition 5 expresses the starting point for much of the economic analysis of litigation. Given that litigations costs are substantial, if the facts of the case are common knowledge and the parties are rational, then settlements should always occurs. The fact that settlements often do not occur, or occur only after long and costly delay, requires the introduction of some additional factor. The important additional extension is usual taken to be some form of uncertainty, which is fundamental in the economic theory of litigation as described, for example, in the review article by Spier (2007). In the following we abstract from post-negotiation litigation costs so as to focus on the role of uncertainty.

3.3 The Role of Simple Uncertainty

We now introduce the (very plausible) assumption that ITC decisions are uncertain. There are several different types of uncertainty that might be introduced. The first step is to consider what we call "simple uncertainty", which is defined as follows.

Simple uncertainty means: i) The decision of ITC or the court is uncertain in that a positive finding (that infringement has occurred) occurs with some probability α. ii) This probability α is an increasing function of v, the true cost-reducing value of the patent, and $\alpha(v) = 0$. This function is the same for both the ITC and the court. iii) The function $\alpha(v)$ is common knowledge in that both firms know it. As they also both know v, they agree on the probabilities in any given case.

For the ITC, if infringement is found, then exclusion occurs. For the courts, the situation is more complicated, as the court must decide on the license fee if infringement is found. The simplest treatment is to assume that the court selects the license fee from some distribution with expected value v. And both firms know this distribution.

Simple uncertainty does not change the results of the base case as, in essence, firms just replace specific values with expected values. As they are risk neutral, that has no effect on their decisions.

Proposition 6: Under simple uncertainty with no litigation costs, no non-trivial settlements occur for the ITC or for the courts and, as with the base case, the ITC is more protectionist than the courts in that the expected reduction in imports is higher under the ITC.

Proof: See Appendix.

In order for a model to have any claim to reasonable consistency with the data, it must generate both settlement and litigation as frequent outcomes. Both our base case model and our

base case with simple uncertainty generate no settlements. However, it is easy to generate settlements by introducing litigation costs, as shown in Proposition 5, in which case settlement also occurs. The same result, although not shown here, applies to the base case with simple uncertainty. Similar results can be obtained by introducing risk aversion instead of litigation costs.

The question of how to generate both settlements and litigation in the same model is a central question in the general economic literature on litigation and is addressed at some length in Daughety and Reinganum (2012). With litigation costs providing an incentive for settlement, a countervailing incentives for litigation can be generated by "inconsistent priors" – the firms disagree on their likelihood of winning the case. For example, if both the plaintiff and defendant believe they have a 70% of winning the case, there is a good chance they will not settle and the case will be decided by legal judgment in court or in the ITC. However, sufficiently high litigation costs or sufficiently extreme risk aversion could still induce a settlement. Thus both settlements and legal judgments could be generated by variations in the specific level of litigation cost, the degree of risk aversion, and extent of inconsistency in the probability assessments.

An alternative to inconsistent priors, preferred by many, is to introduce private information ("type" uncertainty or incomplete information). For example, each firm might not know the other's litigation costs, its disagreement payoff, of some other relevant consideration. In such a situation, as with the classic "chain store paradox", firms might wish to occasionally litigate in order to create a reputation advantageous in future situations.

Any of these approaches can be adapted to our situation and used to compare the ITC with court. Preliminary investigation indicates that in any of these cases the principle that the ITC is more protectionist than court continues to hold.

However, our framework allows for a different foundation for mixed outcomes (i.e. observing both litigation and settlement). Specifically, if products can be differentiated, then it is possible that firms might wish to settle rather than litigate, even without litigation costs or risk aversion.

4. Product Differentiation

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There are two types of differentiation to consider. First, the extent of differentiation may be exogenous (predetermined). If so, the extent of differentiation has an important effect of incentives for settlement. We believe that the ITC will, however, continue to be more protectionist in this case.

Second, differentiation may be endogenous in that one or both firms may have the ability to modify its product to increase or reduce differentiation. Incentives for differentiation will vary depending on whether the ITC regime or the courts are being used as the venue for litigation. In this case, the ITC will induce more product differentiation than the courts and we conjecture that the net effect could be higher imports under the ITC regime due to settlements with relatively low license fees.

5. Welfare Analysis

Increases in license fees or in patent protection generally reduce competition. Such measures taken by themselves would normally be welfare-reducing, at least on a global basis. However, such protection is also intended to create a benefit arising from enhanced innovation, mitigating the market failure problem created by patent-based market power. Therefore, in assessing the welfare effects of ITC protection or court protection of intellectual property, it is important to consider possible benefits of such protection as well as the costs arising from reduced competition.

In international economics it is normally assumed that strong patent protection generates more innovation. However, considerable recent work on innovation and intellectual property raises questions about that view. It is quite possible that high levels of patent protection (and the expectation of high license fees) hamper rather than encourage innovation. In particular, patents that are very broad (or that are interpreted broadly by the courts) may deter other firms from engaging in related innovation.

We incorporate benefits from patent protection is a very simple way. We introduce a benefit function, denoted $b(r)$ which captures the present value of any domestic innovation benefits arising from license fee r. The function $b(r)$ is not necessarily increasing in r for all values of r and is not necessarily positive for all values of r. And $b(r)$ would equal 0 if the imported good in question did not infringe on the patent at issue. We can think of $b(r)$ as contributing to M in equation (1). Domestic profit also contributes to M and domestic expenditure on good X is a subtraction from M. We revert to the assumption of homogeneous products but do not need to rely on quadratic utility. The net domestic surplus from this industry, denoted S, can be written as

$$S(r) = u(X) - pX + \pi(r) + b(r) \tag{14}$$

Domestic surplus includes domestic profit but does not include foreign profit. It is possible in practice that some shareholders in the foreign firm may be domestic residents and some shareholders in the domestic firm may be foreign residents. It is even possible that the importing firm may be domestic (as in the Qualcomm v. Apple case). However, in general, most plaintiffs are domestic firms and most defendants are foreign. We could assign appropriate weights to the profits of the domestic and "foreign" firms reflecting relative contributions to domestic surplus. However, we abstract from these issues here to keep the algebra as simple as possible.

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Proposition 7: The license fee that maximizes domestic surplus is higher if the infringing firm is foreign than if it is domestic.

Proof: If production of *y* is carried out by a foreign firm, the license fee that maximizes domestic surplus requires first order condition d*S*/d*r* = 0. If good *y* were produced by a domestic firm instead of a foreign firm, domestic surplus would be $S(r) + \pi^*(r)$. At the value of *r* that sets d*S*/d*r* = 0 the derivative of domestic surplus with respect to *r* would therefore be dπ^*/d*r*, which is negative by Proposition 2. It follows that domestic surplus, inclusive of π^*, would increase if *r* were reduced in this case. Therefore, as (5) holds globally, it follows that the license fee that maximizes domestic surplus is lower if good y is produced by a domestic firm. ***

The logic of Proposition 8 is clear. License fees have a profit shifting effect similar to the profit shifting effect of subsidies in Brander and Spencer (1985). This profit-shifting effect implies that domestic welfare is enhanced if license fees are used to shift profit from the foreign firm to the domestic firm. Therefore, the domestic country has a unilateral incentive to raise license fees on foreign users of patents (or other intellectual property) over and above the efficient level. This principle applies regardless of the domestic benefit arising from any pro-innovation effect of higher license fees.

We now characterize the level of *r* that would maximize domestic surplus as given by (16). Using (3) to substitute for π and setting d*S*/d*r* = 0 yields $u'(X)\mathrm{d}X/\mathrm{d}r - p\mathrm{d}X/\mathrm{d}r - X\mathrm{d}p/\mathrm{d}r + \mathrm{d}\pi/\mathrm{d}r + \mathrm{d}b/\mathrm{d}r = 0$, or

$$\mathrm{d}\pi/\mathrm{d}r + \mathrm{d}b/\mathrm{d}r = X\mathrm{d}p/\mathrm{d}r. \tag{15}$$

Equation (17) combines two standard tradeoffs. The loss in consumer surplus $X\mathrm{d}p/\mathrm{d}r$ from higher values of *r* must be balanced against the combined effect of increased profit for the domestic firm (the standard strategic trade policy tradeoff) and any increased benefit from the present value of additional induced innovation (the standard innovation vs. market power tradeoff).

If the license fee had no effect on induced innovation, then use of the license fee would be strictly protectionist and a domestic government seeking to maximize domestic surplus would unambiguously want the license fee above the level that would maximize global surplus. However, if a higher license fee increases the present value of induced innovation it is possible that the domestically preferred license fee might equal or even fall short of the level that maximizes global surplus.

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The key point of this section is that a country, such as the United States, has an incentive to design an institution, such as the ITC, than generates higher license fees in settlements than the courts do. Indeed, the United States has a much stronger incentive for such an institution than any other country as it is by far the largest owner of intellectual property – both in total and

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relative to GDP (as implied by the analysis in McCalman, 2005) Thus the existence and structure of the ITC is consisting with a standard "profit-shifting motive for protection.

6. Concluding Remarks

One objective of this paper is to provide a formal characterization of the ITC approach to discretionary protection based on intellectual property. We also wish to compare such protection with the protection that would arise from using the standard court system for patent cases. As the ITC uses injunctive relief, shutting off imports entirely, when infringement is found it would seem to be much more protectionist on a prima facie basis than courts, which normal select a license fee when infringement is found and would not shut down imports entirely.

However, in both venues (the ITC and court), most cases are settled "out of court" between the parties before they are decided by the court or the ITC. And the settlement normally involves a license fee. However, we show that even in settled cases, those going through the ITC would, other things equal, normally end up with higher license fees (and lower imports) than those going through court. Therefore, we show that the intuition that the ITC is more protectionist than courts is robust.

We also ask how the ITC interacts with product differentiation, whether it is exogenous or whether we explicitly consider the differentiation decision. Unlike the homogeneous product case, with differentiation, the domestic plaintiff does not necessarily want to raise license fees paid by the defendant as much as possible and does not necessarily want to foreclose imports entirely.

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