CROSS-BORDER INTELLECTUAL PROPERTY RIGHTS LITIGATION AND INTERNATIONAL MARKET COMPETITION

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ABSTRACT

The use of court litigation is a costly, yet popular means of enforcing intellectual property rights (IPR) across national borders. This paper analyzes litigation patterns and identifies factors influencing IPR litigation between four regions. We test whether firms within similar industries use litigation as an avenue to protect market share in the face of competition. The results suggest that IPR litigation, when controlled for asymmetries in laws, increases as competition rises from both domestic and foreign sources. In addition, recent reduction of barriers to cross-jurisdictional court proceedings has increased litigation.

Keywords: Intellectual Property, Cross-border Litigation, International Market Competition

1. INTRODUCTION

In recent decades, the competition for market share in knowledge-intensive goods rapidly intensified throughout the global economy. These goods rely on innovative characteristics that are protected via intellectual property rights (IPR). The protection of IPR, particularly those that protect innovations that are widely used and therefore prone to imitation, entails large costs. Many firms and individuals seek prosecution of alleged violations by engaging in court litigation to redeem monetary damages caused by alleged violators. This form of enforcement is common between entities within a single country where each party is generally subject to the same laws and courts. However, in an increasing global economy, alleged IPR violations frequently occur outside of the innovator's country or by firms based in a foreign country. In such multi-country cases, the ability to enforce IPR becomes more difficult.

This paper analyzes the decision to pursue litigation involving more than one country in a simplified framework. A model focusing on a single market, the United Kingdom (U.K.), is introduced to characterize the actions of both U.K.-based firms and firms that are affiliates or subsidiaries of foreign-based parent firms. Each firm, regardless of origin, has a common interest of gaining market share in the U.K. within its respective industry. However, allegations of IPR violations frequently occur as competition rises. Using a unique dataset of IPR litigation cases, this paper attempts to identify determinants of IPR litigation between firms from different countries within the jurisdiction of the U.K. courts.

The literature on cross-border IPR litigation largely consists of policy papers and legal studies. Pooley (1999) provided a conceptual basis for filing cross-border litigation based on cost-benefit analyses, logistics and procedures, and political risks. Arnold (1999) examines jurisdictional validity of cross-border litigation using examples from actual cases, while Dutson (1998) and Maskus (2000) study the difficulties of enforcing IPR across borders in the Internet age where jurisdiction is often undefined. These studies and others all allude to common concerns regarding the enforcement of IPR between firms in different countries: the interpretation of jurisdictional boundaries, and asymmetries in IPR law and their enforcement. Over the past decade, greater efforts have been implemented to facilitate cross-border actions by reducing the barriers caused by national borders; these efforts include the TRIPS agreement and Lugano Convention. However, the literature does not empirically investigate how different obstacles (or the resolution thereof) facing cross-border litigation affect the willingness of firms to pursue litigation. In this paper, we build upon existing research by asking how variables such as industry competition, patent laws, trade, and foreign direct investment influence the extent of cross-border litigation.

Nearly all empirical research on IPR enforcement focuses on domestic disputes and unilateral cross-border enforcement. Lanjouw and Schankerman (2001) find the propensity to pursue court litigation rises when the value of stakes involved is high. Using a set of litigated U.S. patents, they find patent litigation more likely when 1) the number of claims and/or the number of forward citations (patent references made by future applications) made by the patent is greater, 2) industries are "crowded" (those with many

competing firms), and 3) the patent is in a new technology area (one with fewer backward citations). Although their analysis is limited to the litigation of U.S. patents, the study does distinguish between domestic and foreign ownership. They find that foreign patents are much less likely to be enforced than domestic patents, presumably due to high costs of litigating abroad. This suggests that IPR infringements are more rampant when they involve firms from more than one country. In the present paper, we extend this work by investigating whether factors influencing domestic litigation apply to cross-border litigation.

This paper ties together the conceptual literature on cross-border litigation with the empirical literature on domestic litigation by introducing a novel approach to explain IPR litigation across national borders within a single legal framework. Four key regions are studied: United Kingdom, United States/Canada, Europe (except U.K.), and Asia/Pacific. This study examines a large selection of IPR cases conducted by the U.K. courts between 1981 and 2000. The motivation behind this framework is that firms from different countries have sufficient interests within the U.K.; as a result, they utilize its courts to resolve disputes. No previous research on IPR has studied the interaction of firms from multiple countries within a single market structure. In many cases, the issue at stake involves the loss of competitive market share resulting from alleged IPR violations. This study focuses on market competition and strategy in the U.K. by both U.K.-based firms and affiliates/subsidiaries of foreign-based firms. Our model seeks to identify the key factors that motivate IPR owners to pursue costly court action to protect their innovations from infringement. We then attempt to determine whether the threat of lost market share or the overall effect of foreign penetration (e.g. levels of trade and FDI) plays a role in the pursuit of cross-border litigation.

2. IPR PROTECTION AND ENFORCEMENT

Firms can seek protection of their innovations abroad by applying for IPR protection in the target country based on industry and country-level factors, such as perceived patent protection (Eaton and Kortum, 1996). Yet, applying for foreign patents does not guarantee protection; thus, a secondary decision must be made to enforce the IPR should it become infringed upon. Lanjouw and Lerner (1998) provide a simple theoretical model on the decision to litigate a patent based on the benefits and costs of litigation, along with the probability of success. A more recent study by Aoki and Hu (2003) investigates the effect of time lags (for example, in the litigation process) on the decision to seek settlements or full litigation. As the present study focuses exclusively on cross-border litigation, we attempt to identify the country-specific factors influencing the process, which ties into the development of the empirical model. We begin by conceptualizing the decision model facing each firm with respect to its litigation strategy.

Following a decision to initiate an enforcement action, conditions facing each party will influence a plaintiff's willingness to settle or to pursue full litigation. This paper attempts to explain cases that proceed through the full litigation process, which results in the estimation of the following joint probability:

$$[Pr(\text{IPR Violation}) \times Pr(\text{Full Litigation} \mid \text{IPR Violation})] + [Pr(\text{no IPR Violation}) \times Pr(\text{Full Litigation} \mid \text{no IPR Violation})] \quad (1)$$

where both guilty and innocent parties can be taken into trial. The decision to litigate is influenced by the expected payoff which is based on four key components: 1) probability of a successful case; 2) litigation costs incurred regardless of the result, 3) monetary value of the judgment to the plaintiff plus value of market share regained, and 4) consequences stemming from possible counteractions from a defendant or possible negative publicity arising from litigation (i.e., Bhagat et al., 1994).

In order to develop a feasible empirical model, several assumptions are introduced. First, the probability of success is assumed exogenous, though in truth it is influenced by the IPR being litigated along with characteristics of the firms, lawyers, and courts involved. Secondly, the costs and consequences of litigation are assumed to rise with the stakes involved at a constant rate and assumed independent of external factors. Finally, the decision to pursue settlement options (not studied in this paper) is assumed to be contingent on the level of uncertainty of the probability of success by the parties, due to information asymmetries. If both parties have symmetric information, then settlements are attractive when both parties realize a likely outcome of the trial; otherwise, a full trial may result. In cases where parties have

different information, settlements are attractive when one party has a low assessment of its likelihood of winning a trial. Cases that are carried out in court (and estimated in this model) are those where both parties have a neutral or confident assessment of their own success rate, making a trial worthwhile. As a result, the data show that the average success rate of cases taken to trial is approximately 50%, which implies that cases that are uncertain or not attractive to a settlement are more likely to be tried in court. This finding is consistent with Marco (2004), who studied selection effects and found that the success rate of patent cases that proceed to full trial as a result of infringement claims are close to 50%.

Given these assumptions, what remains of the decision to pursue litigation are the potential returns or stakes involved with each case; furthermore, it is possible to capture these factors based on available data. Specifically, we analyze factors that affect the expected gains from a successful case; these gains are influenced by market characteristics within an industry between the regions involved. Though some factors, such as market crowding, are introduced in previous studies, this paper introduces variables that specifically address cross-border enforcement. These include the extent of foreign penetration via trade, foreign direct investment (FDI), and the presence of affiliates or subsidiaries of foreign-based firms.

3. EMPIRICAL OUTLINE

This paper uses data on court litigation involving parties from more than one country within a single legal framework and jurisdiction of the U.K. court system. The purpose of this model is to characterize the interaction of a plaintiff and a defendant belonging to one of four regions: U.K., U.S./Canada, Europe (except U.K.), and Asia/Pacific (see Table 1 for a list of selected countries within each region). Firms or individuals can serve as plaintiffs; however, due to *personal-matter* jurisdictional rules, a defendant must either have physical presence in the U.K. or have an affiliate or subsidiary within its boundaries. In all cases, the attributes tied to each case correspond to the region of the ultimate parent of the litigants.

TABLE 1: FOUR REGIONS AND THE CORRESPONDING COUNTRIES

Region	Countries
U.K.	United Kingdom
USA	United States, Canada
Europe	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland
Asia/Pacific	China, Hong Kong (China), India, Japan, Korea, Philippines, Singapore, Taiwan, Thailand

This paper analyzes sets of two-region interactions corresponding to the home location of the plaintiff and defendant. There are four regions, resulting in 12 possible two-region interactions (i.e., US vs. U.K., Europe vs. U.K., Asia vs. U.K., with each region serving both roles), with all data mapped accordingly to each interaction. We do not consider all 12 possible interactions because the inclusion of U.K.-based firms may bias the results as all cases are tried under its own courts. This is particularly true for U.K. defendant firms as they naturally fall under their own jurisdiction, whereas non-U.K. firms do not. Furthermore, variables measuring foreign presence do not apply in cases with U.K. defendants. As a result, this paper uses two sets of interactions: one with nine two-region interactions (omitting those with a U.K. defendant), and one with six two-region interactions (focusing strictly on non-U.K. regions).

Each two-region interaction is further classified into nine distinct industries (shown in Table 4) using a broad 2-digit SIC categorization. Due to limitations in data, further disaggregation of industry categories may cause potential problems. In addition, we restrict cases to no later than 2000 in order to ensure that, given time lags of cases and their reporting, all cases are reported for each year. The model has two 10-year periods (1981 to 1990 and 1991 to 2000). The total number of observations with nine two-region interactions is 162; with six two-region interactions, there are 108 observations.

This model focuses on the regional determinants of cross-border litigation. This is justified as long as countries within a region are relatively similar in their economy and firm structure. For example, if a U.S.

firm takes enforcement actions against a German firm, the impetus for such actions would likely be similar if it were a French firm. This is due to a regional effect: countries within a region have similar laws and market structure. However, this is not the case between regions; e.g. Europe and Asia. Focusing on regional variables minimizes the estimation of stochastic firm characteristics.

Various implications arise when analyzing cross-border cases within a single framework (U.K. courts). It facilitates legal interpretation, yet defines the relevant market as the U.K. market. The focus of the enforcement decision is influenced by competition for market share in the U.K. (but may also extend to the plaintiff's home market). This premise is important when defining the source of an IPR violation. A violation may occur outside of the U.K. by a foreign firm, while its subsidiary within the U.K. is subjected to litigation. Alternatively, a plaintiff could be a non-U.K. firm which has a legal basis for initiating a case (e.g. a U.K. patent owned by the plaintiff or its subsidiary). In all cases, the presence of non-U.K. firms in cross-border cases is likely influenced by conditions within the U.K. market facing the parties involved.

Data for the dependent variable derive from actual court litigation cases. Explanatory variables (see Table 6 for details) measure: 1) industry crowding within the U.K., 2) trade flows into the U.K., 3) industry-specific FDI in the U.K., 4) existence of affiliates of non-U.K. firms, 5) U.K. patent applications, 6) the existence of legal mechanisms and the effectiveness of IPR enforcement in the defendant region, 7) time variables that account for the existence of new legislation facilitating cross-border litigation, and 8) regional and industry dummies. The discussion of each variable follows.

The main hypothesis of this model is that cross-border IPR litigation is influenced by competition. Competition is influenced by the industry life cycle faced at any particular moment in time. As the number of firms increases, the intensity of competitive actions increases, forcing both entry and exit into the market (Agarwal and Audretsch, 2001). Patent litigation is a common strategy used to protect market share, and thus a larger number of firms would result in greater potential for accusations of IPR violations. The effect of the industry life cycle on competition can be empirically measured using common measures of market concentration as proxy variables. In our model, we measure market crowdedness within an industry in the U.K.; as the intensity of competitive actions rises, litigation is expected to increase.

In addition to the industry life cycle, competitive actions are influenced by the overall value of the U.K. market, which can be captured by the extent of foreign penetration into the U.K., occurring via three primary channels: import trade, FDI, and the existence of affiliates or subsidiaries of foreign-based firms. Each channel has been empirical analyzed in relation to IPR by Maskus and Penubarti (1995), Lee and Mansfield (1996), and Park (2003), respectively. Similar to market crowdedness, each channel of foreign penetration raises the potential value of engaging in court litigation, thereby increasing its occurrence.

It is important to note that foreign penetration into the U.K. not only affects U.K.-based firms but also existing foreign-based firms. As foreign penetration increases, existing firms (potential plaintiffs from all regions) within an industry face greater competition. We account for this by assuming that each foreign penetration variable affects the likelihood of court litigation based on how it affects a plaintiff's current market share in the U.K. For example, FDI by Asia into the U.K. is expected to increase the likelihood of cases taken against Asian firms; however, the region most likely to initiate a case is the one that has the largest existing market share in the industry. Conversely, a region having little presence in the U.K. is less likely to be affected, thus less likely to file a case. In our model, each foreign penetration variable is multiplied by the corresponding market share of each potential plaintiff region. Market share for each U.K. Industry n [$(n \in (1,9)$] in Time t [$t \in (1,2)$] is defined as the total number of firms by each Region p [$p \in (1,4)$] divided by the total number of firms from all regions (# potential plaintiff $firms_{pnt}$ / # total $firms_{nt}$).

An example of three regional interactions and their corresponding measure of FDI are as follows:

Plaintiff = U.K., Defendant = Asia $\Rightarrow$ (FDI – Asia into U.K.) x (U.K. market share),
Plaintiff = Europe, Defendant = Asia $\Rightarrow$ (FDI – Asia into U.K.) x (Europe market share),
Plaintiff = U.S., Defendant = Asia $\Rightarrow$ (FDI – Asia into U.K.) x (U.S. market share),

where market share is measured by Industry n in Time t within the U.K. The modification of each foreign penetration variable creates *effective* foreign penetration variables, defined as the effect of the foreign penetration variable on existing firms (potential plaintiffs) in the U.K. As each *effective* variable rises for a particular plaintiff region, litigation is expected to increase.

A measure of technology access is included in the model to capture the level of technology flows from the plaintiff region into the U.K., which is expected to have a positive correlation with litigation. From a legal standpoint, litigation can only be taken against a defendant firm within the U.K. when a U.K. law is violated (i.e. patent infringement). Therefore, having a U.K. patent becomes a condition for litigation. In this model, technology access is measured by the depreciated patent stock by industry (see Xu and Wang, 1999, for methodology on constructing patent stocks) from the plaintiff region into the U.K. This approach complements Llobet (2003) who showed greater litigation when firms with larger innovation holdings increase protection. In this paper, we measure patents exclusively, though this analysis concerns all types of intellectual property. However, the availability of data on patents is consistent and its ability to capture technology access is likely to parallel other IPR.

The extent by which defendant countries protect IPR domestically is another important factor. A potential defendant firm in a country with weak protection may engage in profit-seeking by penetrating the U.K. market with imitations. If domestic IPR enforcement in defendant countries is strong, thereby reducing cross-border violations, the extent of alleged violations within the U.K. is likely to fall. A measure of IPR protection across 110 countries is provided by Ginarte and Park (1997) and is based on memberships in international treaties as well as the coverage, restrictions, and duration of IPR in a country. Moreover, Ginarte and Park incorporate elements of domestic IPR enforcement in their index. It is expected that a higher Ginarte-Park rating results in fewer actions against a defendant country and hence its region.

Over the past two decades, various treaties were established to strengthen IPR law across countries, as well as to facilitate the litigation process between firms in different jurisdictions. The Trade-related Aspects of Intellectual Property Rights Agreement (TRIPS) and the Brussels and Lugano Conventions are recent examples that aim toward these goals. This model includes a time dummy to account for the existence of these conventions. It is expected that litigation will fall over time, all else equal, as IPR enforcement processes continue to be harmonized across nations.

4. DATA

The collection of multilateral data is a key component of this analysis, as data are not readily accessible. In this model, actual IPR court litigation case data are collected by manual analysis of each individual case as reported by two prominent law reporting sources: *Fleet Street Reports of Industrial Property Cases from the Commonwealth and Europe* (FSR) and *Reports of Patent, Design, and Trademark Cases* (RPC). Both sources have existed for over 50 years with minimal overlaps of cases. These reports focus on cases that are tried by U.K. courts, a majority by the Chancery Division of the High Court, under which there exists a specialized Patent Court. A majority of reported cases involve parties from multiple countries; this model investigates all cross-border cases reported from 1981 to 2000. The mapping of case data into regional and industrial categories is undertaken by comparing case data with firm data using *OneSource*. Industrial classifications are based on SIC (as most data came prior to NAICS).

Summary information on the selection of case data is shown in Tables 2 to 5. Table 2 reports the total and annual number of cases by each reporting source. Although there are apparent year-to-year differences in number of cases, there appears to be no long-term trend. Table 3 reports cases by type of IPR in dispute and the presiding court. FSR contains a more balanced selection of cases, while RPC picks up a larger share of patent cases. Table 4 shows the industrial classification of cases. Finally, Table 5 shows the number of cases represented by individual countries in both the roles of plaintiff and defendant. Note that countries represented may be parent firms of subsidiaries in trial within the U.K. court system; if the listed country is a defendant, this condition is a prerequisite to satisfy jurisdictional rules. All countries listed are the headquarter location of the ultimate parent of litigants in trial.

TABLE 2: TOTAL NUMBER OF CASES REPORTED AND CORRESPONDING YEAR OF LITIGATION

Total Cases Reported: 768

By *Fleet Street Reports of Industrial Property Cases from The Commonwealth and Europe* (1981-2000): 523

By *Reports of Patent, Design, and Trademark Cases*: (1981-2000): 245

Year	FSR	RPC		Year	FSR	RPC		Year	FSR	RPC
2000	27	9		1993	24	12		1986	22	15
1999	24	9		1992	26	12		1985	27	7
1998	35	9		1991	29	14		1984	30	11
1997	34	9		1990	19	16		1983	27	11
1996	26	8		1989	19	17		1982	24	16
1995	25	17		1988	26	15		1981	35	9
1994	25	15		1987	19	14		**Total**	**523**	**245**

TABLE 3: TYPES OF CASES AND COURT OF LITIGATION

Type of Case	FSR	RPC	Total	% Total
Patent Infringement	148	125	273	36%
Trademark Infringement	55	29	84	11%
Passing Off	121	34	155	20%
Copyright Infringement	179	45	224	29%
Other	20	12	32	4%
Total	**523**	**245**	**768**	**100%**

Court	FSR	RPC	Total	% Total
U.K. High Court Chancery Division	248	60	308	40%
U.K. Court of Appeals	80	63	143	19%
U.K. Patent Court	93	74	167	22%
Other U.K. Courts*	24	20	44	6%
Other Courts**	78	28	106	14%
Total	**523**	**245**	**768**	**100%**

*Includes the Outer House, Inner House, Patent County Court, and the High Court Queens Branch

**Includes courts in the British Commonwealth along with regional courts (i.e. European Court of Justice).

TABLE 4: INDUSTRIAL CLASSIFICATION OF PRODUCT INVOLVED

SIC Codes	Description	FSR		RPC
2800 to 2899	Pharmaceuticals and Chemicals	75		50
3000 to 3399	Primary Materials	50		15
3400 to 3599*	Machines and Tools	57		43
3600 to 3699*	Electronic Goods	32		16
Computers*	Computers and Software	34		16
3800 to 3899	Medical Supplies & Equipment	33		15
Manufactures**	Remaining Manufactures	107		58
>5000*	Services	134		31
<2000, 4000 to 4999	Other Industries	1		1
Total	**All Industries**	**523**		**245**

*SIC Codes 3571 to 3573, 3661, 3674, and 7372 are classified into computers, and thus are not part of the Machines, Electronics, or Services categories.

**This category includes all manufactures not classified elsewhere, including 2000 to 2799, 2900 to 2999, 3700 to 3799, and 3900 to 3999.

TABLE 5: NATIONALITY OF PLAINTIFFS AND DEFENDANTS (BY ULTIMATE PARENT FIRM)

Plaintiff	FSR	RPC		Defendant	FSR	RPC
U.K.	276	110		U.K.	341	152
USA	123	69		USA	58	26
Germany	20	10		Germany	13	9
France	19	14		France	5	3
Netherlands	10	8		Netherlands	11	7
Japan	10	1		Japan	7	2
Hong Kong	3	2		Hong Kong	15	3
Sweden	9	7		Sweden	3	2
Other	53	24		Other	70	41
Total	**523**	**245**		**Total**	**523**	**245**

Note: Hong Kong is treated separately from China, as much of the data is taken prior to 1997.

Trade data are taken from recent editions of *Eurostat* (European Commission). These volumes contain detailed import and export values at the industry level between the U.K. and US, Europe, and Asia. For the few cases of incomplete data, data from the *International Trade Statistics Yearbook* (United Nations) are used. All data are corrected to reflect real (1990) U.S. dollars.

Detailed industry and country data on foreign direct investment (FDI) as well as U.K. affiliates and subsidiaries of transnational corporations are available from the *World Investment Directory* (United Nations). Data for FDI are available for 1980, 1990, and 2000 for each country and industry group, and in terms of flows and stocks. This model measures the average aggregate value of FDI stock by each region into the corresponding U.K. industry group over each time period. The FDI stock (in constant 1990 U.S. dollars) is measured by the net book value (depreciation taken into account) of all fixed assets plus working capital over each time period (the methodology for the construction of this variable is provided in the *World Investment Directory)*. Foreign affiliates are measured by the average number of total affiliates or subsidiaries of foreign parent firms within an industry in the U.K. over each time period.

Annual U.K. patent application flows are available by the World Intellectual Property Organization's *Industrial Property Statistics* and by broad industry categories from the *U.K. Patent Office Annual Reports*. Using flow data, patent stocks are constructed using a 15% depreciation rate similarly used by previous authors (e.g. Xu and Wang, 1999). Measuring depreciated patent stocks allows the model to capture a level of current innovation within the U.K.

5. EMPIRICAL MODEL

This model estimates the propensity and the extent of cross-border IPR litigation. The dependent variable CASE-N (N=1,2) is defined as the existence of a case and the total number of complete cases, respectively, between a plaintiff in Region p [p=1,2,3,4] and a defendant in Region d (d=1,2,3,4), where $p \neq d$ (ruling out litigation between firms within the same region, even if they represent different countries; i.e. France vs. Germany). In addition, all subsequent appeals and counteractions are classified within the same case to avoid a selection bias. CASE-N is further categorized into Industry Classification n ($n \in 1,9$) and Time t (t=1,2). Using Probit and Negative Binomial Models (to estimate the likelihood and extent of cases, respectively), and taking the natural log of each variable, the equation to be estimated is:

$$(\text{CASE-N}_{pdnt}) = \alpha_0 + \alpha_{pd} + \alpha_n + \alpha_t + \alpha_1 \ln(\text{MARKET}_{nt}) + \alpha_2 \ln(\text{IMPORTS}_{dnt}) + \alpha_3 \ln(\text{FDI}_{dnt}) + \alpha_4 \ln(\text{FOR-SUB}_{dnt}) + \alpha_5 \ln(\text{PATENTS}_{pt}) + \alpha_6 \ln(\text{G-PARK}_{dt}) + \varepsilon_{pdnt} \quad (2)$$

where N=1,2. CASE-1_{pdt} is a binary variable (1=yes) for the Probit model and CASE-2_{pdt} is a count variable indicating the total number of cases and is used in the Negative Binomial model. MARKET_{nt} is the total number of firms in the U.K. within Industry n during Time t. Variables representing foreign penetration into the U.K. are IMPORTS_{dnt}, FDI_{dnt}, and FOR-SUB_{dnt}, which are the real value of imports, the real value of foreign direct investment stock, and the number of U.K. affiliates of foreign corporations,

respectively, from defendant Region d into the U.K. in Industry n in Time t. Each variable is multiplied by the existing U.K. market share of each potential plaintiff Region p. $PATENTS_{pt}$ is the depreciated U.K. patent stock owned by plaintiff Region p in Time t. $G\text{-}PARK_{dt}$ is the Ginarte and Park (1997) index of patent protection and enforcement within defendant Region d. A time dummy, α_t, distinguishes between the two 10-year periods, and ε_{pdnt} is a random error term that accounts for uncontrolled variables. Finally, regional-interaction and industry fixed effects, represented by α_{pd} and α_n, respectively, are included in latter regressions to account for remaining time-invariant characteristics not captured by the independent variables. For example, inherent industry features or unique jurisdictional rules may allow for more effective litigation across national borders. These possibilities are not captured by the control variables and hence may be controlled via fixed effects.

6. RESULTS

Probit estimation results are shown in Table 7 (Reg. 7.1 to 7.4) and Table 8 (Reg. 8.1 to 8.4). Negative Binomial results are shown in Table 7 (Reg. 7.5 to 7.8) and Table 8 (Reg. 8.5 to 8.8). Table 6 provides summary statistics. The specifications in Tables 7 and 8 are identical; Table 7 includes nine two-region interactions (omitting cases with a U.K. defendant) and Table 8 includes six two-region interactions (omitting all cases with a U.K. litigant). With nine industry categories and two time periods, the number of observations is 162 and 108, respectively.

TABLE 6: VARIABLE DEFINITIONS AND SUMMARY STATISTICS

Interaction Panel (9,6 regional interactions, 9 industries, 2 time periods)
Upper numbers correspond to Table 7 with 162 observations
Lower numbers correspond to Table 8 with 108 observations
Single numbers correspond to both Tables

Variable	Description	Mean	StDev	Min	Max
CASE-1	Binomial variable representing the existence of a case (1 = yes) within Interaction pd, Industry n in Time t	0.51 0.40	0.50 0.49	0.00 0.00	1.00 1.00
CASE-2	Actual number of cases within Interaction pd, Industry n in Time t	2.43 1.94	1.86 1.47	0.00 0.00	7.00 6.00
MARKET	Market crowdedness (number of firms in thousands by all countries) within Industry n in the U.K. in Time t	15.07	12.64	2.47	54.03
IMPORTS	Value of imports from defendant region d into the U.K. in Industry n in Time t (in constant 1990 $US billions)	34.06	51.65	0.60	295.68
FDI	Foreign direct investment stock from defendant Region d into U.K. in Industry n in Time t (in 1990 $US billions)	2.32	4.40	0.00	23.48
FOR-SUB	Number of foreign affiliates of defendant Region d trans-nationals (TNEs) into the U.K. (in thousands)	1.22	0.76	0.19	2.14
PATENTS	Depreciated patent stock by plaintiff Region p into the U.K. in Time t based on flows (in tens of thousands)	4.57 5.68	2.49 2.30	1.50 2.34	9.58 9.58
G-PARK	Ginarte/Park Index of Patent Protection in defendant country (0 = least protection to 5 = most protection)	4.03	0.26	3.71	4.52
TIME	Time constant (1 = 1991 to 2000)	0.50	0.50	0.00	1.00

Regressions 7.1, 7.5, 8.1, and 8.5 are baseline regressions that include all variables presented in Equation 2. Reg. 7.2, 7.6, 8.2, and 8.6 separate the foreign penetration variables of FDI from the number of foreign subsidiaries to test for possible correlation between the variables. Reg. 7.3, 7.7, 8.3, and 8.7 are identical to Reg. 7.2, 7.6, 8.2, and 8.6 with the exception that the former includes region-interaction fixed effects. Reg. 7.4, 7.8, 8.4, and 8.8 include both region-interaction and industry fixed effects. Overall, the key variables reveal the expected signs though with varying levels of significance. Results from Table 8, which do not include cases involving U.K. firms, reveal a better fit according to

expectations. Results show that both domestic and foreign competition factors influence the use of cross-border court litigation; however, different avenues of foreign competition have varying effects.

In all Probit and Negative Binomial specification in Tables 7 and 8, the three avenues of foreign competition—imports, FDI, and the number of U.K. affiliates of transnational corporations— each reveal a positive correlation to court litigation. Furthermore, the effect of foreign penetration via FDI and U.K. affiliates of transnational corporations is significant under most specifications. This finding is intuitively reasonable since direct foreign penetration implies physical presence within the home jurisdiction, which facilitates the initiation of court actions. The results are not as strong when foreign competition exists strictly via imports. The coefficients for the import variable, though positive and mostly marginally significant, are generally less significant than FDI. Thus, the ability to use court litigation effectively is an important determinant in the likelihood and extent of cases; the physical presence of potential defendant firms within the U.K. increases the ability to take such actions.

The results provide evidence that competition factors play an influential role in the decision process of innovating firms faced with alleged IPR violations. Based on coefficients of the individual penetration variables from Reg. 7.1 and 7.5, an independent one standard deviation increase of each variable (imports, FDI, and foreign affiliates) from its mean ($51.65 Billion, $4.40 Billion, and 760) increases the probability of a case by 22%, 27%, and 48%, and the number of cases rises by 0.26, 0.61, and 0.13 (increase of 11%, 26%, and 7% from the mean), respectively. Thus, the effect of the FDI variable dominates the import variable.

TABLE 7: PROBIT AND NEGATIVE BINOMIAL ESTIMATION OF A CASE IN A REGIONAL PANEL (Two 10-Year Time Intervals in 9 Industries for 9 Regional Interactions)

Dependent Variable:	**CASE-1: Existence of a case filed in Time t, Ind. n, Region pd**				**CASE-2: Number of cases filed in Time t, Ind. n, Region pd**			
Regression #	**7.1**	**7.2**	**7.3**	**7.4**	**7.5**	**7.6**	**7.7**	**7.8**
Estimation Method	Probit				Negative Binomial			
Industry Dummies	No	No	No	Yes	No	No	No	Yes
Region-Int Dummies	No	No	Yes	Yes	No	No	Yes	Yes
Log(MARKET)	0.217	0.248	0.226	0.028	0.113	0.192	0.242	0.080
	(1.46)^	(1.89)*	(1.77)*	(0.54)	(0.92)	(1.45)^	(1.69)*	(0.44)
Log(IMPORTS)	0.251	0.187	0.224	0.162	0.272	0.383	0.164	0.095
	(0.83)	(1.52)*	(1.13)	(0.97)	(1.48)^	(1.70)*	(1.38)	(0.74)
Log(FDI)	0.249	0.302	0.924	0.293	0.750	0.992	0.501	0.111
	(1.50)^	(1.84)*	(1.48)^	(1.25)	(1.79)*	(1.95)**	(1.66)*	(0.76)
Log(FOR-SUB)	0.997	____	____	____	0.440	____	____	____
	(1.72)*				(1.56)^			
Log(PATENTS)	0.146	0.151	0.067	0.060	0.077	0.094	0.030	0.032
	(0.90)	(0.94)	(0.33)	(0.30)	(0.39)	(0.48)	(0.15)	(0.18)
Log(G-PARK)	1.017	1.529	1.246	2.235	2.163	1.745	0.439	0.491
	(0.60)	(0.77)	(0.51)	(1.01)	(1.00)	(0.88)	(0.10)	(0.12)
Time Constant	-0.483	-0.531	-0.217	-0.065	-0.453	-0.428	-0.291	-0.206
	(-1.99)**	(-2.13)**	(-0.59)	(-0.13)*	(-1.60)^	(-1.55)^	(-0.78)	(-0.63)
# of Observations	162	162	162	162	162	162	162	162
Pseudo R^2	0.2284	0.2271	0.5245	0.5778	0.1522	0.1508	0.2513	0.3356
Log-likelihood	-100.81	-102.25	-76.30	-53.70	-122.19	-123.20	-111.23	-101.09

Notes: Z-Statistics in parentheses. ^, *, **, *** represent significance levels at the 15%, 10%, 5%, and 1% levels, respectively.

TABLE 8: PROBIT AND NEGATIVE BINOMIAL ESTIMATION OF A CASE IN A REGIONAL PANEL (Two 10-Year Time Intervals in 9 Industries for 6 Regional Interactions)

Dependent Variable:	**CASE-1: Existence of a case filed in Time t, Ind. n, Region pd**				**CASE-2: Number of cases filed in Time t, Ind. n, Region pd**			
Regression #	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**	**8.8**
Estimation Method	Probit				Negative Binomial			
Industry Dummies	No	No	No	Yes	No	No	No	Yes
Region-Int Dummies	No	No	Yes	Yes	No	No	Yes	Yes
Log(MARKET)	0.304	0.361	0.495	0.198	0.231	0.286	0.338	0.104
	(1.67)*	(2.08)**	(2.54)**	(0.68)	(1.37)	(1.48)^	(1.69)*	(0.64)
Log(IMPORTS)	0.271	0.242	0.249	0.266	0.221	0.280	0.251	0.089
	(1.48)^	(1.46)^	(1.43)^	(1.51)^	(1.00)	(1.41)^	(1.30)	(0.36)
Log(FDI)	0.302	0.307	0.256	0.323	0.372	0.269	0.205	0.174
	(1.80)*	(1.95)**	(1.32)	(1.50)^	(2.06)**	(1.70)*	(1.44)^	(1.07)
Log(FOR-SUB)	0.281	____	____	____	0.257	____	____	____
	(1.70)*				(1.81)*			
Log(PATENTS)	1.561	1.505	0.578	0.467	1.287	1.260	0.610	0.517
	(2.52)**	(2.47)**	(0.98)	(0.76)	(2.41)**	(2.38)**	(1.28)	(1.06)
Log(G-PARK)	1.840	1.279	8.138	6.530	2.476	1.813	5.524	4.095
	(0.71)	(0.52)	(1.23)	(0.97)	(0.75)	(0.57)	(1.18)	(0.93)
Time Constant	-1.580	-1.556	-1.197	-1.003	-1.291	-1.278	-1.002	-0.817
	(-1.68)*	(-1.65)*	(-0.87)	(-0.80)	(-1.83)*	(-1.78)*	(-1.19)	(-1.01)
# of Observations	108	108	108	108	108	108	108	108
Pseudo R^2	0.2844	0.2796	0.5235	0.5712	0.2008	0.1993	0.2831	0.3696
Log-likelihood	-58.87	-59.59	-49.18	-35.45	-71.58	-72.09	-66.57	-57.45

Notes: Z-Statistics in parentheses. ^, *, **, *** represent significance levels at the 15%, 10%, 5%, and 1% levels, respectively.

In addition to foreign competition, the existence and extent of court litigation in both Probit and Negative Binomial models is positively influenced by market crowdedness within the industry in the U.K. Reg. 7.3, 7.7, 8.3, and 8.7 include regional-interaction fixed effects but not industry fixed effects; the coefficients clearly fall when industry fixed effects are added in Reg. 7.4, 7.8, 8.4, and 8.8, suggesting inherent differences between industries in terms of the number of total firms. As the number of firms increases within an industrial sector, the level of competition increases along with the number of potential plaintiffs. And by assuming a constant case-per-potential-plaintiff ratio, this increases overall court actions, all else equal. In Reg. 7.3 and 7.7, an increase in market crowdedness by one standard deviation from the mean (12,640 firms) increases the probability of a case by 15% and results in 0.16 more cases (6% increase). This finding complements the Lanjouw and Schankerman (2001) finding that market crowdedness increases the likelihood for domestic court actions; in this paper we find that market crowdedness also increases the likelihood and extent of cross-border actions.

The level of technology access is presumed to have an important effect on potential violations and resulting litigation. Regressions in Table 8 (U.K. firms excluded) reveal a significantly positive correlation between a plaintiff's technology-base in the U.K. and the likelihood and extent of litigation when fixed effects are excluded (the inclusion of fixed effects appears to capture some technological differences between industries and regions). An increase of patent applications by one standard deviation from the mean (approximately 23,000 patents) increases the probability of a case by 53% and results in 0.42 additional cases (22% increase) based on coefficients from Reg. 8.1 and 8.5, respectively. As firms from different regions file for U.K. patents, these firms gain a legal basis to file for litigation within the U.K. court

system. However, the magnitudes are largely reduced when cases with U.K. plaintiffs are included (Table 7). The inclusion of U.K. plaintiffs appears to dilute the technology effect since they naturally have a basis for initiating litigation in their own country.

This model controls for the level of domestic IPR protection using the Ginarte-Park (1997) index with the hypothesis that a higher rating would correspond to a lower likelihood of patent infringement. This variable, however, is never significant. A likely explanation is that each region is relatively homogeneous in terms of IPR protection. To clarify, the average U.K. rating for the two periods is 3.57 out of 5, and the average for the U.S., Europe, and Asia is 4.36, 3.79, and 3.94, respectively. Thus, the slight variation in ratings does not indicate major differences in IPR protection. This result may change if regions are disaggregated into country-level observations; however, due to data limitations, we do not test this.

Results show consistent significant negative estimates for the time dummy, which takes into account differences in the legal environment affecting the propensity to violate IPR across borders. Holding all other factors constant, the time effect (t = 1) results in an average 45% decrease in probability of a case and an average 16% decrease in number of cases per observation. Though numerous explanations could be given for this decline, a strong contributing factor is the implementation of recent legislation to strengthen IPR law, such as the TRIPS agreement and the Brussels and Lugano Conventions.

Finally, we introduce a new dummy variable in Reg. 7.1 to 7.8 to indicate the 54 observations with a UK-firm as plaintiff (this variable is not shown in Eq. 2 nor in Table 7). Because the inclusion of these 54 observations is the only difference between Tables 7 and 8, adding a dummy variable allows one to estimate the effect of including observations with UK firms. Results show that in Reg. 7.1, 7.2, 7.5, and 7.6 (those without regional-interaction fixed effects), the UK dummy is positive and significant, suggesting that the inclusion of UK firms (more willing to litigate using its own courts) does affect the results, all else equal. With regional-interaction fixed effects, the UK dummy becomes insignificant, suggesting that the fixed effect is already picking up the inclusion of UK firms.

7. CONCLUSION

The use of court litigation is a costly yet popular means of enforcing intellectual property rights (IPR), particularly against foreign-based firms. This paper analyzes litigation data within the U.K. by both U.K.-based and foreign-based firms. A model is introduced to identify factors influencing IPR litigation between four regions competing within the U.K. market in knowledge-intensive goods. We test whether firms within similar industries utilize court litigation as an avenue to protect innovations and market share from competitors suspected of IPR violation.

The decision to utilize cross-border litigation is influenced by the value of its potential benefits based on factors such as industry concentration, imports, foreign firm penetration, as well as the existence of domestic enforcement mechanisms in the defendant firm's region. The results suggest that litigation, when controlled for asymmetries in IPR protection and technological access, increased as industry competition and various avenues of foreign competition rose in the U.K. Specifically, the extent of FDI and affiliates and subsidiaries of foreign corporations into the U.K. increases the likelihood and extent of court actions by all existing firms (both U.K.-based and non-U.K.-based) against the source of the penetration. This finding holds at the industry level and remains robust after controlling for overall market crowdedness, the level of patent stocks within the U.K., and IPR protection in the defendant region. The underlying reasoning for these findings is that competition spurs court actions; furthermore, court actions increase when jurisdictional conditions are satisfied.

In the past two decades, the rapid globalization of knowledge-based industries dramatically increased the importance of IPR protection across national borders. The enforcement of IPR via cross-border court litigation is a leading avenue for dispute resolution between firms, despite the high costs of court litigation. As a result, the decision by plaintiff firms to initiate and pursue court litigation in multi-country cases is contingent on the potential of reaping sufficient returns from such actions. These potential returns are highly influenced by market competition factors facing the firms within their respective industries.

REFERENCES

Agarwal, R., and D. Audretsch, "Does Entry Size Matter? The Impact of the Life Cycle and Technology on Firm Survival," Journal of Industrial Economics, 49, 2001, 21-43.

Aoki, R., and J. Hu, "Time Factors of Patent Litigation and Licensing," Journal of Institutional and Theoretical Economics, 159, 2003, 280-301.

Arnold, R., "Cross-border Enforcement: The Latest Chapter," Intellectual Property Quarterly, 4, 1999, 389-426.

Bhagat, S., J. Brickley, and J. Coles, "The Costs of Inefficient Bargaining and Financial Distress: Evidence from Corporate Lawsuits," Journal of Financial Economics, 35, 1994, 221-47.

Dutson, S., "The Internet, Intellectual Property and International Litigation: The Implications of the International Scope of the Internet on Intellectual Property Infringements," Centre for Commercial Law Studies, QMW, 1998.

Eaton, J., and S. Kortum, "Trade in Ideas: Patenting and Productivity in the OECD," Journal of International Economics, 40, 1996, 251-78.

Eurostat, External and Intra-European Union Trade, Statistical Yearbook, 1958 to 1996.

Ginarte, J., and W. Park, "Determinants of Patent Rights: A Cross-National Study," Research Policy, 26, 1997, 283-301.

Lanjouw, J., and J. Lerner, "The Enforcement of Intellectual Property Rights: A Survey of the Empirical Literature," The Annals d'Economie et de Statistique, 49/50, 1998, 223-46.

Lanjouw, J., and M. Schankerman, "Characteristics of Patent Litigation: A Window on Competition," Rand Journal of Economics, 32, 2001, 129-51.

Lee, J.Y., and E. Mansfield, "Intellectual Property Protection and U.S. Foreign Direct Investment," Review of Economics and Statistics, 78, 1996, 181-6.

Llobet, G. "Patent Litigation When Innovation is Cumulative," International Journal of Industrial Organization, 21, 2003, 1135-57.

Marco, A., "The Selection Effects (and Lack Thereof) in Patent Litigation: Evidence from Trials," Topics in Economic Analysis and Policy, 4, 2004, 1-45.

Maskus, K., Intellectual Property Rights in the Global Economy, Institute for International Economics, Washington, D.C., 2000.

Maskus, K., and M. Penubarti, "How Trade-Related are Intellectual Property Rights?," Journal of International Economics, 39, 1995, 227-48.

Park, W., "Do Intellectual Property Rights Stimulate R&D and Productivity Growth? Evidence from Cross-National and Manufacturing Industry Data," in Jon Putnam (ed.), Intellectual Property Rights and Innovation in the Knowledge-Based Economy, 2003, Calgary: University of Calgary Press.

Pooley, J., "Putting Together a Global Enforcement Solution", Managing Intellectual Property,1999,16-19.

Sweet & Maxwell, Fleet Street Reports of Industrial Property Cases from the Commonwealth and Europe, 1981 to 2003, The European Law Centre at Sweet & Maxwell.

United Kingdom Patent Office, Reports of Patent, Design, and Trademark Cases, 1981 to 2003, London, Patent Office.

United Nations Centre on Transnational Corporations, World Investment Directory, 1992, U.N.: New York.

United Nations Statistics Division, International Trade Statistics Yearbook, 1981 to 2000, U.N: New York.

Xu, B., and J. Wang, "Capital Goods Trade and R&D Spillovers in the OECD," Canadian Journal of Economics, 32, 1999, 1258-74.

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