

# THE WIPO JOURNAL:

## ANALYSIS OF INTELLECTUAL PROPERTY ISSUES

GENERAL EDITOR: PROFESSOR PETER K. YU

CONTENTS

2010 VOLUME 2 ISSUE 1

---

### Articles

Enforcement, Economics and Estimates

*Peter K. Yu*

A Half Century of Research on Patent Economics

*F.M. Scherer*

The Patent System in a Time of Turmoil

*Josh Lerner*

On Patenting Costs

*Walter G. Park*

Intellectual Property Enforcement in Smaller UK Firms: Findings from a Survey in 2009–2010

*Christine Greenhalgh, Robert Pitkethly, Mark Rogers*

Mitigating “Anticommons” Harms to Research in Science and Technology: New Moves in “Legal Jujitsu” against Unintended Adverse Consequences of the Exploitation of Intellectual Property Rights on Results of Publicly and Privately Funded Research

*Paul A. David*

Compulsory Licensing as an Antitrust Remedy

*Jay Pil Choi*

Open Source Software: Economics, Innovation, Law and Policy

*Rishab Aiyer Ghosh*

Has the Shift to Stronger Intellectual Property Rights Promoted Technology Transfer, FDI, and Industrial Development?

*Lee Branstetter, C. Fritz Foley and Kamal Saggi*

The Strengthening of IPR Protection: Policy Complements

*Ricardo H. Cavazos Cepeda and Douglas C. Lippoldt*

The Curious Economics of Parallel Imports

*Keith E. Maskus*

The Role of Intellectual Property Rights in Addressing Climate Change: The Case of Agriculture

*Russell Thomson and Elizabeth Webster*

# The WIPO Journal

Volume 2 Issue 1 2010

## Table of Contents

### Articles

Enforcement, Economics and Estimates <i>Peter K. Yu</i>	1
A Half Century of Research on Patent Economics <i>F.M. Scherer</i>	20
The Patent System in a Time of Turmoil <i>Josh Lerner</i>	28
On Patenting Costs <i>Walter G. Park</i>	38
Intellectual Property Enforcement in Smaller UK Firms: Findings from a Survey in 2009–2010 <i>Christine Greenhalgh, Robert Pitkethly and Mark Rogers</i>	49
Mitigating “Anticommons” Harms to Research in Science and Technology: New Moves in “Legal Jujitsu” against Unintended Adverse Consequences of the Exploitation of Intellectual Property Rights on Results of Publicly and Privately Funded Research <i>Paul A. David</i>	59
Compulsory Licensing as an Antitrust Remedy <i>Jay Pil Choi</i>	74
Open Source Software: Economics, Innovation, Law and Policy <i>Rishab Aiyer Ghosh</i>	82
Has the Shift to Stronger Intellectual Property Rights Promoted Technology Transfer, FDI, and Industrial Development? <i>Lee Branstetter, C. Fritz Foley and Kamal Saggi</i>	93
The Strengthening of IPR Protection: Policy Complements <i>Richardo H. Cavazos Cepeda and Douglas C. Lippoldt</i>	99
The Curious Economics of Parallel Imports <i>Keith E. Maskus</i>	123
The Role of Intellectual Property Rights in Addressing Climate Change: The Case of Agriculture <i>Russell Thomson and Elizabeth Webster</i>	133

ISSN: 2041-2029

This journal may be cited as (2010) 2 W.I.P.O.J. 00

The WIPO Journal is published by Thomson Reuters (Legal) Limited (Registered in England & Wales, Company No 1679046. Registered Office and address for service: 100 Avenue Road, London, NW3 3PF) trading as Sweet & Maxwell.

For further information on our products and services, visit [www.sweetandmaxwell.co.uk](http://www.sweetandmaxwell.co.uk)

CompuSet by Sweet & Maxwell. Printed and bound in Great Britain by MPG Books Ltd, Bodmin, Cornwall.

No natural forests were destroyed to make this product; only farmed timber was used and re-planted.

Each article and case commentary in this volume has been allocated keywords from the Legal Taxonomy utilised by Sweet & Maxwell to provide a standardised way of describing legal concepts. These keywords are identical to those used in Westlaw UK and have been used for many years in other publications such as Legal Journals Index. The keywords provide a means of identifying similar concepts in other Sweet & Maxwell publications and online services to which keywords from the Legal Taxonomy have been applied. Keywords follow the taxonomy logo at the beginning of each item. The index has also been prepared using Sweet & Maxwell's Legal Taxonomy. Main index entries conform to keywords provided by the Legal Taxonomy except where references to specific documents or non-standard terms (denoted by quotation marks) have been included. Readers may find some minor differences between terms used in the text and those which appear in the index. Please send any suggestions to [sweetandmaxwell.taxonomy@thomson.com](mailto:sweetandmaxwell.taxonomy@thomson.com).

Copies of articles from W.I.P.O.J. and other articles, cases and related materials can be obtained from DocDel at Sweet & Maxwell's Yorkshire office.

Current rates are: £6.95 + copyright charge + VAT per item for orders by post and DX.

Fax delivery is guaranteed within 15 minutes of request and is charged at an additional £1.15 per page (£2.15 per page outside the UK).

For full details and to order contact DocDel on:

- Tel 01422 888 019
- Fax 01422 888 001

• Email [sweetandmaxwell.docdel@thomson.com](mailto:sweetandmaxwell.docdel@thomson.com)

• Go to <http://www.sweetandmaxwell.co.uk/our-businesses>

Please note that all other enquires should be directed to Sweet & Maxwell, 100 Avenue Road, London, NW3 3PF; Tel 020 7449 1111; Fax 020 7449 1144.

Crown copyright material is reproduced with the permission of the Controller of HMSO and the Queen's Printer for Scotland.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, or stored in any retrieval system of any nature without prior written permission, except for permitted fair dealing under the Copyright, Designs and Patents Act 1988, or in accordance with the terms of a licence issued by the Copyright Licensing Agency in respect of photocopying and/or reprographic reproduction. Application for permission for other use of copyright material including permission to reproduce extracts in other published works shall be made to the publishers. Full acknowledgement of author, publisher and source must be given.

Thomson Reuters and the Thomson Reuters Logo are trademarks of Thomson Reuters. Sweet & Maxwell ® is a registered trademark of Thomson Reuters (Legal) Limited.

© 2010 The World Intellectual Property Organization and contributors. Published in association with Sweet & Maxwell.

# Enforcement, Economics and Estimates

**Peter K. Yu\***

*Kern Family Chair in Intellectual Property Law and Director, Intellectual Property Law Center, Drake University Law School; Wenlan Scholar Chair Professor, Zhongnan University of Economics and Law*

☞ China; Developing countries; Economics and law; Enforcement; Intellectual property

## Introduction

The debate on intellectual property enforcement has been highly contentious at both the international and domestic levels. At the international level, the increasing focus on enforcement standards has led to the negotiation of the highly unpopular Anti-Counterfeiting Trade Agreement (ACTA).<sup>1</sup> A spirited debate on these standards has also slowly emerged in such international fora as the WIPO Advisory Committee on Enforcement and the TRIPS Council of the World Trade Organization (WTO). Despite these ongoing developments, the positions of developed and less developed countries remain far apart.

At the domestic level, countries, especially those in the developed world, have explored the need to introduce greater criminal enforcement and border control to combat piracy and counterfeiting. For almost a decade, copyright holders have explored, with very limited success, legislative and technological solutions to challenges posed by the internet and new communications technologies.<sup>2</sup> The recent push for the establishment of a graduated response system in France, New Zealand, South Korea, Taiwan, the United Kingdom and other parts of the world provides a timely reminder of the serious online file-sharing problems in developed countries.<sup>3</sup>

Meanwhile, less developed countries—including both developing and least developed countries—are concerned about the increased bilateral, regional and multilateral demands for tougher intellectual property enforcement. Owing to institutional deficiencies and a lack of resources and expertise, many of these countries have yet to provide effective protection and enforcement. Significant resource constraints have also forced them to make very difficult allocation choices. Because intellectual property enforcement will take away scarce resources from other important public programmes, the enforcement debate to date has been as much about politics and morality as it is about economics.

Thus far, few policymakers, commentators or academics have denied the importance of intellectual property protection and enforcement. If the intellectual property system is to provide right holders with meaningful protection, the rights recognised in the system need to be effectively enforced. What experts continue to disagree about, however, is the type of enforcement standards a country needs to adopt and how much priority it should give to implementing those standards.

\* Copyright © 2010 Peter K. Yu. An earlier version of this article was presented at the 2010 International Law Weekend in New York. Part of the article draws on the author's testimony in the hearing before the US International Trade Commission on "China: Intellectual Property Infringement, Indigenous Innovation Policies, and Frameworks for Measuring the Effects on the U.S. Economy" on June 15, 2010. The author is grateful to Rebecca Goodrich, Cory McAnelly and Megan Snyder for excellent research and editorial assistance.

<sup>1</sup> Anti-Counterfeiting Trade Agreement (Text Subject to Legal Review, November 15, 2010), available at [http://www.ustr.gov/webfm\\_send/2379](http://www.ustr.gov/webfm_send/2379) [Accessed November 18, 2010]; Peter K. Yu, "Six Secret (and Now Open) Fears of ACTA" (2011) 64 SMU L. Rev. 81.

<sup>2</sup> Peter K. Yu, "The Escalating Copyright Wars" (2004) 32 Hofstra L. Rev. 907; Peter K. Yu, "P2P and the Future of Private Copying" (2005) 76 U. Colo. L. Rev. 653.

<sup>3</sup> Annemarie Bridy, "Graduated Response and the Turn to Private Ordering in Online Copyright Enforcement" (2010) 89 Or. L. Rev. 81; Alain Strowel, "Internet Piracy as a Wake-up Call for Copyright Law Makers—Is the 'Graduated Response' a Good Reply?" (2009) 1 W.I.P.O.J. 75; Peter K. Yu, "The Graduated Response" (2010) 62 Fla. L. Rev. 1373.

In the inaugural issue of *The WIPO Journal*, we brought together a group of leading intellectual property experts to examine issues on the cutting edge of the intellectual property debate. This special issue continues this tradition by assembling some of today's leading thinkers on the economics of intellectual property. It addresses a wide variety of topics, which range from patents to open source software and from parallel imports to climate change.

This introductory article focuses on intellectual property enforcement, a topic that is of great importance to both developed and less developed countries. It begins by refuting the simple, and often politically motivated, claim that many countries fail to provide effective intellectual property enforcement by virtue of their lack of political will. Drawing on the latest economic literature, this article shows that high enforcement standards come with a hefty price tag and difficult trade-offs. The article then outlines the challenges in measuring the cross-border economic impact of piracy and counterfeiting. As an illustration, the article discusses the ongoing effort by the US International Trade Commission (ITC) to measure the impact of intellectual property infringement in China on the US economy. The article concludes with an analysis of the various metrics that can be or have been used to develop cross-country comparative analyses. It highlights the continuous disagreement among nations over what metrics should be used. It also suggests new areas researchers can explore in their continuous search for a set of mutually satisfactory metrics that advance the international intellectual property enforcement debate.

### Enforcement

One of the central disagreements between developed and less developed countries over intellectual property enforcement concerns its hefty price tag. Strong enforcement requires a substantial investment of resources, the development of supporting institutional infrastructures and the introduction of complementary policy reforms. Although the challenge to obtaining resources to strengthen intellectual property enforcement exists in both developed and less developed countries, this challenge is particularly acute in less developed countries—especially those that are struggling just to meet basic needs, such as the provision of clean drinking water, food, shelter, electricity, schools and basic health care.

Sadly, despite the widely documented hardships of these countries, policymakers and trade groups continue to blindly and unrealistically attribute a country's failure to enforce intellectual property rights to a lack of political will on the part of local authorities.<sup>4</sup> While the causes of piracy and counterfeiting are multi-faceted and *some* self-interested government actors<sup>5</sup> indeed have resisted intellectual property reforms, it is rather ill advised and unfair for developed countries and their supportive industries to continue to ignore the high costs of enforcement.

Although commentators have explored ways to build a low-cost intellectual property system<sup>6</sup>—through user fees, outsourcing or streamlined operation—very few have discussed how a country can develop a low-cost but effective intellectual property enforcement regime.<sup>7</sup> In fact, developed country governments (such as those in the European Union and the United States) and international intergovernmental and

<sup>4</sup> Peter K. Yu, "Three Questions That Will Make You Rethink the US-China Intellectual Property Debate" (2008) 7 J. Marshall Rev. Intell. Prop. L. 412.

<sup>5</sup> These actors can come from different parts of the government. In China, for example, they can come from the national, provincial or local governments. Given the heavy decentralization and the ongoing turf wars among the various bureaucracies, it would be misleading to assume that the Chinese government is a monolithic actor.

<sup>6</sup> e.g. Commission on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy* (London: Commission on Intellectual Property Rights, 2002), pp.145–146; Robert M. Sherwood, *Intellectual Property and Economic Development* (Boulder, CO: Westview Press, 1990), pp.181–185; Sean A. Pager, "Patents on a Shoestring: Making Patent Protection Work for Developing Countries" (2007) 23 Ga. St. U. L. Rev. 755.

<sup>7</sup> Carsten Fink, "Enforcing Intellectual Property Rights: An Economic Perspective" in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries* (Geneva: ICTSD Programme on IPRs and Sustainable Development, 2009), p.19; Mark Liang, "A Three-Pronged Approach: How the United States Can Use WTO Disclosure Requirements to Curb Intellectual Property Infringement in China" (2010) 11 Chi. J. Int'l L. 285, 300–302. Carsten Fink, for example, called on developed countries or intellectual property right holders to bear the costs of intellectual property enforcement in less developed countries—for example, by introducing "a special levy upon registration and renewal of IP titles".

nongovernmental organisations (such as WIPO, UNCTAD, UNDP, the World Bank and ICTSD) have provided a considerable amount of resources to fund capacity building and technical assistance programmes.<sup>8</sup> Commentators have also underscored the importance for developed countries and right holders to provide support or subsidies to strengthen intellectual property enforcement in the less developed world.<sup>9</sup> In fact, article 67 of the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) specifically requires developed country members of the WTO to provide “technical and financial cooperation in favour of developing and least-developed country Members”.

Of primary concern to less developed countries are the administrative costs of a strong intellectual property enforcement regime: the costs incurred in building new institutional infrastructures; restructuring existing agencies; developing specialised expertise through training or other means; and staffing courts, police forces, customs offices and prisons.<sup>10</sup> While in the past private right holders funded enforcement costs through civil litigation, the growing demands for criminalisation and public enforcement have led to a gradual shift of responsibility from private right holders to national governments.<sup>11</sup>

More problematically, such a shift has brought with it significant risks that may ultimately backfire on a country’s goal to use intellectual property protection to attract foreign direct investment (FDI). For instance, strengthening border control requires the development of specialised expertise and sophistication on the part of customs authorities. If these authorities fail to develop the requisite expertise and sophistication, their inconsistent—and at times wrongful—application of new, and usually tougher, border measures may lead to uncertainty and other concerns that eventually frighten away foreign investors.<sup>12</sup> Even worse, the irregularities in applying these measures may become the subject of complaints firms file with their governments. These complaints, in turn, may lead to greater pressure from foreign governments—the United States’ notorious s.301 process easily comes to mind.<sup>13</sup> In the end, what started as a country’s means to attract FDI and promote economic development ends up being a heavy cost burden on this already resource-deficient country.

Of bigger concern among human rights groups, consumer advocates and other non-governmental organisations are the high opportunity costs incurred by strengthened intellectual property enforcement. Given the limited resources in many less developed countries, an increase in resources in the enforcement area inevitably will lead to the withdrawal of resources from other competing, and at times more important, public needs. These public needs include, among others, purification of water, generation of power, improvement of public health, reduction of child mortality, provision of education, promotion of public

<sup>8</sup> Commission on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy*, 2002, pp.149–151; Christopher May, *The World Intellectual Property Organization: Resurgence and the Development Agenda* (London: Routledge, 2007), pp.61–66; Carlos M. Correa, “The Push for Stronger Enforcement Rules: Implications for Developing Countries” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.35.

<sup>9</sup> Fink, “Enforcing Intellectual Property Rights” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.19; Timothy P. Trainer, “Intellectual Property Enforcement: A Reality Gap (Insufficient Assistance, Ineffective Implementation)?” (2008) 8 J. Marshall Rev. Intell. Prop. L. 47, 74.

<sup>10</sup> Timothy P. Trainer and Vicki E. Allums, *Protecting Intellectual Property Rights Across Borders* (St. Paul: Thomson West, 2008), pp.705–706; Fink, “Enforcing Intellectual Property Rights” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.15.

<sup>11</sup> Correa, “The Push for Stronger Enforcement Rules” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.42; Li Xuan, “Ten General Misconceptions about the Enforcement of Intellectual Property Rights” in Li Xuan and Carlos M. Correa (eds), *Intellectual Property Enforcement: International Perspectives* (Cheltenham, UK: Edward Elgar Publishing, 2009), pp.28–31; Henning Grosse Ruse-Khan, “Re-delineation of the Role of Stakeholders: IP Enforcement Beyond Exclusive Rights” in *Intellectual Property Enforcement*, 2009, pp.51–52; Susan K. Sell, *The Global IP Upward Ratchet, Anti-Counterfeiting and Piracy Enforcement Efforts: The State of Play* (Geneva: IQsensato, 2008), p.9.

<sup>12</sup> Ruse-Khan, “Re-delineation of the Role of Stakeholders” in *Intellectual Property Enforcement*, 2009, p.52.

<sup>13</sup> Yu, “Six Secret (and Now Open) Fears of ACTA” (2011) 64 SMU L. Rev. (forthcoming).

security, building of basic infrastructure, reduction of violent crimes, relief of poverty, elimination of hunger, promotion of gender equality, protection of the environment and response to terrorism, illegal arms sales, human and drug trafficking, illegal immigration and corruption.<sup>14</sup>

The competition between intellectual property enforcement and these public needs is particularly disturbing, as it comes at a time “when global investment in areas of poverty, hunger, health and education is less than half of what is needed to reach the Millennium Development Goals”.<sup>15</sup> The strengthening of intellectual property enforcement, therefore, not only may have an adverse impact on individual countries, but it may also undermine the ability of the global community to achieve these development goals.

The concerns of less developed countries, indeed, can be traced back to the negotiation of the TRIPS Agreement in the mid-1980s and the early 1990s, when these countries registered concerns about the resources needed to set up specialised intellectual property courts or strengthen intellectual property enforcement. At that time, less developed countries were so concerned that they specifically demanded the inclusion of art.41.5 in the TRIPS Agreement.<sup>16</sup> This provision states explicitly that a WTO Member State is not required to devote more resources to intellectual property enforcement than to other areas of law enforcement. Even today, less developed countries continue to insist that art.41.5 is a key concession they won through the TRIPS negotiation process.<sup>17</sup>

In addition to administrative and opportunity costs, economists and commentators have identified many other costs, such as adjustment costs due to labour displacement, social costs associated with monopoly pricing, higher imitation and innovation costs, potential costs resulting from the abuse of intellectual property rights, and costs of litigation and litigation error.<sup>18</sup> Although these costs are alarming, how high these costs will be ultimately depends on whether the intellectual property system is appropriately designed.

While an intellectual property system that is tailored to the needs of a rich country is unlikely to work well for a least developed country, there are still many possible ways to design an appropriate intellectual property system for an economically poor and technologically backward country. In fact, the less the system is based on a super-size-fits-all template—such as the one enshrined in the TRIPS Agreement or the recent bilateral and regional trade agreements—the more likely the system is to function well in a resource-deficient environment.

While discussions of capacity and resource constraints often focus on less developed countries, these constraints affect developed countries as well. In the United States, for example, Tim Trainer, the former president of the International Anticounterfeiting Coalition, lamented how “the staff dedicated solely to IPR enforcement [in the US Government] could be counted on two hands”.<sup>19</sup> Likewise, Chris Israel, the former US International IPR Enforcement Coordinator, testified before the US-China Economic and Security Review Commission that “[w]ith finite resources and seemingly infinite concerns, how [the

<sup>14</sup> e.g. Frederick M. Abbott and Carlos M. Correa, *World Trade Organization Accession Agreements: Intellectual Property Issues* (Geneva: Quaker United Nations Office, 2007), p.31; Ermias Tekeste Biadgleng and Viviana Muñoz Tellez, *The Changing Structure and Governance of Intellectual Property Enforcement* (Geneva: South Center, 2008), p.4; Correa, “The Push for Stronger Enforcement Rules” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.43; Fink, “Enforcing Intellectual Property Rights” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, pp.2, 16; Gregor Urbas, “Criminal Enforcement of Intellectual Property Rights: Interaction Between Public Authorities and Private Interests” in Christopher Heath and Anselm Kampermann Sanders (eds), *New Frontiers of Intellectual Property Law: IP and Cultural Heritage, Geographical Indications, Enforcement and Overprotection* (Oxford: Hart Publishing, 2005), p.321; Xue Hong, “Enforcement for Development: Why Not an Agenda for the Developing World” in *Intellectual Property Enforcement*, 2009, p.143; IP Justice, “ACTA’s Misguided Effort to Increase Govt Spying and Ratchet-Up IPR Enforcement at Public Expense: IP Justice Comments to U.S.T.R. on the Proposed Anti-Counterfeiting Trade Agreement (ACTA)”, available at <http://ipjustice.org/wp/2008/03/21/acta-ipj-comments-ustr-2008march/> [Accessed November 8, 2010].

<sup>15</sup> Li, “Ten General Misconceptions about the Enforcement of Intellectual Property Rights” in *Intellectual Property Enforcement*, 2009, p.29.

<sup>16</sup> Carlos M. Correa, *Trade Related Aspects of Intellectual Property Rights: A Commentary on the TRIPS Agreement* (Oxford: Oxford University Press, 2007), p.417; UNCTAD-ICTSD, *Resource Book on TRIPS and Development* (Cambridge: Cambridge University Press, 2005), p.585.

<sup>17</sup> e.g. *China—Measures Affecting the Protection and Enforcement of Intellectual Property Rights*, Report of the Panel, January 26, 2009, WT/DS362/R, annex B-4, para.33.

<sup>18</sup> Li, “Ten General Misconceptions about the Enforcement of Intellectual Property Rights” in *Intellectual Property Enforcement*, 2009, p.29; Keith E. Maskus, Sean M. Dougherty and Andrew Mertha, “Intellectual Property Rights and Economic Development in China” in Carsten Fink and Keith E. Maskus (eds), *Intellectual Property and Development: Lessons from Recent Economic Research* (Washington, D.C.: World Bank, 2005), pp.302–306.

<sup>19</sup> Trainer, “Intellectual Property Enforcement” (2008) 8 J. Marshall Rev. Intell. Prop. L. 47, 58.



United States] focus[es its] efforts is crucial”.<sup>20</sup> In the same public hearing, a former associate commissioner of the US Food and Drug Administration also noted the administration’s focus on getting “the best bang for the regulatory dollar ... [and going] after the big time criminals”.<sup>21</sup> Even Tim Phillips, a strong advocate of tough enforcement, acknowledged the impossibility for the New York Police Department “to raid all the warehouses all of the time without swallowing the entire NYPD anti-counterfeiting budget and taking officers off other duties”.<sup>22</sup>

To some extent, developed countries are confronted with the same type of resource-related challenges as those found in less developed countries. Given the similar challenges, one has to wonder whether it is intellectually dishonest to continue to insist on attributing intellectual property enforcement problems to a lack of political will on the part of local authorities. It is also worth exploring whether significant national divergences in enforcement costs, available resources and public policy priorities will warrant special and differential treatment for at least some less developed countries.<sup>23</sup>

Although commentators tend to focus on the costs and benefits of the intellectual property system, a successful intellectual property system does not depend on laws and policies alone. It also relies on the introduction of complementary policy reforms. As Keith Maskus observed:

“IPRs are an important component of the general regulatory system, including taxation, investment regulations, production incentives, trade policies, and competition rules. The joint implementation of an overall pro-competitive business environment matters most for FDI.”<sup>24</sup>

Likewise, Claudio Frischtak found that a country’s overall investment climate was often more influential on FDI decisions than the strength of its intellectual property protection.<sup>25</sup>

Moreover, as I and other commentators have pointed out, the successful effective enforcement of intellectual property rights depends on the existence of an “enabling environment” that provides the needed pre-conditions for successful intellectual property law reforms.<sup>26</sup> These pre-conditions include, among others, a consciousness of legal rights, a respect for the rule of law, an effective and independent judiciary, a well-functioning innovation and competition system, sufficiently developed basic infrastructure, established business practices and a critical mass of local stakeholders. It therefore may be unrealistic to expect strong intellectual property enforcement when these much-needed pre-conditions have yet to materialize.

If the intellectual property system is to be welfare-enhancing, countries may also need to put in place correction mechanisms or safeguard measures to ensure an appropriate balance between proprietary interests and public access needs. If such mechanisms do not exist, the intellectual property system could pose significant harm to the country when the system goes out of balance. While developed countries have the resources and regulatory mechanisms to reduce the impact of an unbalanced system—such as

<sup>20</sup> *Intellectual Property Rights Issues and Counterfeit Goods: Hearing before the U.S.-China Economic and Security Review Commission*, 109th Cong. 9 (2006) (written testimony of Chris Israel, International IPR Enforcement Coordinator, US Department of Commerce).

<sup>21</sup> *Intellectual Property Rights Issues and Counterfeit Goods: Hearing before the U.S.-China Economic and Security Review Commission*, 109th Cong. 183 (2006) (oral testimony of Peter Pitts, President, Center for Medicine in the Public Interest, New York).

<sup>22</sup> Tim Phillips, *Knockoff: The Deadly Trade in Counterfeit Goods* (London: Kogan Page, 2005), p.36.

<sup>23</sup> Fink, “Enforcing Intellectual Property Rights” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.16; Claudio R. Frischtak, “Harmonization Versus Differentiation in Intellectual Property Rights Regime” in Mitchel B. Wallerstein, Mary Ellen Mogege and Roberta A. Schoen (eds), *Global Dimensions of Intellectual Property Rights in Science and Technology* (Washington, D.C.: National Academy Press, 1993), p.98.

<sup>24</sup> Keith E. Maskus, “The Role of Intellectual Property Rights in Encouraging Foreign Direct Investment and Technology Transfer” (1998) 9 *Duke J. Comp. & Int’l L.* 109, 129.

<sup>25</sup> Frischtak, “Harmonization Versus Differentiation in Intellectual Property Rights Regime” in *Global Dimensions of Intellectual Property Rights in Science and Technology*, 1993, pp.99–100.

<sup>26</sup> “Creating an Enabling Environment to Build Respect for IP: A Concept Paper by Pakistan”, November 4, 2009, WIPO/ACE/5/11, available at [http://www.wipo.int/edocs/mdocs/enforcement/en/wipo\\_ace\\_5/wipo\\_ace\\_5\\_11-annex1.pdf](http://www.wipo.int/edocs/mdocs/enforcement/en/wipo_ace_5/wipo_ace_5_11-annex1.pdf) [Accessed November 8, 2010]; Ricardo Meléndez-Ortiz, “Foreword” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.xii; Peter K. Yu, “Intellectual Property, Economic Development, and the China Puzzle” in Daniel J. Gervais (ed.), *Intellectual Property, Trade and Development: Strategies to Optimize Economic Development in a TRIPS Plus Era* (Oxford: Oxford University Press, 2007), pp.213–216.



through the development of competition or antitrust laws or other public interest safeguards—less developed countries often do not.<sup>27</sup> It is, therefore, no surprise that the UK Commission on Intellectual Property Rights expressed concern that “the costs of getting the IP system ‘wrong’ in a developing country are likely to be far higher than in developed countries”.<sup>28</sup>

Finally, in a cost-benefit analysis of an intellectual property enforcement regime, there remain some difficult questions about the distributional effects of increased intellectual property enforcement.<sup>29</sup> While countries tend to focus on *net* economic gains when determining whether they should sign on to new or tougher standards, many of them ignore the fact that these gains will not be fairly distributed unless a well-functioning transfer mechanism already exists to allow the anticipated winners to share the new benefits with the potential losers. As Frederick Abbott reminded us about the adverse public health implications of the bilateral and plurilateral free trade agreements:

“The problem with ... using net economic gains or losses as the developing country benchmark is that gains for a developing country’s textile or agricultural producers do not directly translate into higher public or private health expenditures. Salaries for part of the workforce may increase and government tax revenues may rise, and this may indirectly help offset pharmaceutical price increases. However, in order for the health sector not to be adversely affected, there must be some form of transfer payment, whether in the form of increased public health expenditures on pharmaceuticals, by providing health insurance benefits, or other affirmative acts. In a world of economic scarcity, the prospect that governments will act to offset increases in medicines prices with increased public health expenditures is uncertain.”<sup>30</sup>

In sum, the debate about intellectual property enforcement cannot be reduced to a simple question about a government’s political will to enforce intellectual property rights. Rather, it involves complex questions about whether that government can discharge its heavy cost burdens, whether it can justify the trade-offs between intellectual property protection and other competing public needs and whether it has introduced the much-needed complementary policy reforms. The success of an intellectual property enforcement regime, therefore, depends on both its *internal* design and the *external* conditions. Because many of these external conditions work in tandem with the intellectual property system to promote creativity and innovation and to provide an appealing investment climate for foreign firms, they are both interdependent and mutually reinforcing.

## Economics

In June 2010, the ITC held a public hearing on the impact of intellectual property infringement and indigenous innovation policies in China on the US economy.<sup>31</sup> This hearing, along with two new studies, was initiated at the request of the US Senate Finance Committee. While the first study focuses on the development of a framework to measure the effects of intellectual property infringement and indigenous innovation policies in China on the US economy, the follow-up study will document these effects. Drawing on the ITC’s efforts to conduct these studies and my earlier testimony at the public hearing, this section outlines six different challenges in measuring the cross-border economic impact of piracy and counterfeiting.

<sup>27</sup> Peter K. Yu, “TRIPS and Its Discontents” (2006) 10 Marq. Intell. Prop. L. Rev. 369, 382–383.

<sup>28</sup> Commission on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy*, 2002, p.4.

<sup>29</sup> Anupam Chander and Madhavi Sunder, “The Romance of the Public Domain” (2004) 92 Cal. L. Rev. 1331; Margaret Chon, “Intellectual Property and the Development Divide” (2006) 27 Cardozo L. Rev. 2821; Peter M. Gerhart, “The Tragedy of TRIPS” [2007] Mich. St. L. Rev. 143; Keith E. Maskus, “Introduction” in Keith E. Maskus (ed.), *Intellectual Property, Growth and Trade* (Amsterdam: Elsevier Science, 2008), p.2.

<sup>30</sup> Frederick M. Abbott, “The Cycle of Action and Reaction: Developments and Trends in Intellectual Property and Health” in Pedro Roffe, Geoff Tansey and David Vivas-Eugui (eds), *Negotiating Health: Intellectual Property and Access to Medicines* (London: Earthscan, 2006), p.33.

<sup>31</sup> *China: Intellectual Property Infringement, Indigenous Innovation Policies, and Frameworks for Measuring the Effects on the U.S. Economy: Hearing before the U.S. International Trade Commission*, 111th Cong. (June 15, 2010).

The first three challenges are of a general nature and relate to virtually all surveys of intellectual property protection and enforcement. The first challenge concerns the difficulty in determining which US industries are relevant to the studies. With the ubiquity of intellectual property-related goods and services, intellectual property protection and enforcement affects virtually all industries. The only differences among these industries seem to be how much and how significant. The growing impact of intellectual property standards is indeed the reason why intellectual property has now moved from a legal backwater to the forefront of the domestic and international policy debates.

In the past decade, the publishing, recording, movie, software and game industries have greatly emphasised their important contributions to the US economy.<sup>32</sup> Their assessments include not only their direct contributions, but also the contributions of other supporting industries, including those whose positions may differ significantly from theirs.<sup>33</sup> In recent years, however, these other industries have become more active in documenting their own economic contributions. The Computer and Communications Industry Association, for example, pioneered a study to measure the contributions of the so-called fair use industries.<sup>34</sup> Even though this new set of studies is just as self-interested as the entertainment industries' studies, the proliferation of studies from disparate industries that take drastically different policy positions does make salient the importance of, and challenges to, determining the relevant industries for analytical purposes.

The second challenge concerns the difficulty in collecting data to illustrate the extent of piracy and counterfeiting. Admittedly, practical challenges to collecting data about illicit activities exist. As a result, self-interested trade groups often have to collect the data themselves.<sup>35</sup> Nevertheless, given how these data are collected, they remain highly suspect. In fact, unless the data are corroborated by independent researchers, studies that rely solely or primarily on them are likely to run into a serious "garbage in, garbage out" problem.

Consider, for example, the figures supplied by the Business Software Alliance (BSA) in its effort to document global piracy rates.<sup>36</sup> Policymakers, commentators and academics have widely questioned their accuracy. While a draft Australian government report described these statistics "as a 'self-serving hyperbole', 'unverified and epistemologically unreliable'",<sup>37</sup> Gary Shapiro, the president of the Consumer Electronics Association, called these figures "absurd on [their] face" and "patently obscene".<sup>38</sup> Ivan Png further demonstrated that the BSA's change of consultants had led to a change in methodology for measurement, which, in turn, resulted in systematic effects on published piracy rates.<sup>39</sup> Sadly, despite these many criticisms, the industry-supplied figures remain in wide use among policymakers, researchers and the mass media.

<sup>32</sup> Nam D. Pham, *The Impact of Innovation and the Role of Intellectual Property Rights on U.S. Productivity, Competitiveness, Jobs, Wages and Exports* (Washington, D.C.: NDP Consulting Group, 2010); Stephen E. Siwek, *Copyright Industries in the U.S. Economy: The 2003–2007 Report* (Washington, D.C.: Economists Incorporated, 2009).

<sup>33</sup> For example, the supporting industries include the "manufacturers, wholesalers and retailers of ... VCRs, personal computers and usage dependent products including blank recording material". However, these firms are likely to disagree with the positions taken by the core intellectual property industries.

<sup>34</sup> Computer and Communications Industry Association, *Fair Use in the U.S. Economy* (Washington, D.C.: Computer and Communications Industry Association, 2007); Computer and Communications Industry Association, *Fair Use in the U.S. Economy* (Washington, D.C.: Computer and Communications Industry Association, 2010). For the purposes of these studies, fair use industries include "manufacturers of consumer devices that allow individual copying of copyrighted programming; educational institutions; software developers; and Internet search and web hosting providers".

<sup>35</sup> Sherwood, *Intellectual Property and Economic Development*, 1990, p.68; United States Government Accountability Office, *Intellectual Property Observations on Efforts to Quantify the Economic Effects of Counterfeit and Pirated Goods* (Washington, D.C.: United States Government Accountability Office, 2010), pp.16–17.

<sup>36</sup> Business Software Alliance and International Data Corporation, *Seventh Annual BSA/IDC Global Software Piracy Study* (Washington, D.C.: Business Software Alliance and International Data Corporation, 2010).

<sup>37</sup> Li, "Ten General Misconceptions about the Enforcement of Intellectual Property Rights" in *Intellectual Property Enforcement*, 2009, p.25.

<sup>38</sup> "Software Piracy: BSA or Just BS?", *Economist*, May 21, 2005, p.93.

<sup>39</sup> I.P.L. Png, "On the Reliability of Software Piracy Statistics" (2010) 9 Elec. Com. Res. & Applications 365.

Among the flaws in the BSA study, the most widely criticized are the highly incredulous one-to-one substitution rate between legal and infringing goods and the overvaluation of pirated and counterfeit goods.<sup>40</sup> As Carsten Fink observed in an issue paper he wrote before joining WIPO as its first-ever chief economist:

“[BSA’s assumption] that, in the absence of piracy, all consumers of pirated software would switch to legitimate copies at their current prices ... is unrealistic—especially in developing countries where low incomes would likely imply that many consumers would not demand any legitimate software at all. Accordingly, estimated revenue losses by software producers are bound to be overestimated.”<sup>41</sup>

Indeed, it is virtually impossible to count as lost sales those products that firms cannot sell in less developed countries. At best, the figures reflect the retail value of pirated goods based on US prices, or whatever prices researchers have set.<sup>42</sup> Those figures, however, are drastically different from lost sales.

An additional problem concerns the failure by these studies to recognise the existence of a wide variety of offsetting welfare benefits. As the US Government Accountability Office (GAO) pointed out in its recent study, although piracy and counterfeiting may affect the core intellectual property industries, these industries, along with those in other sectors and individual consumers, may have obtained offsetting benefits. As stated in the study:

“[C]onsumers may use pirated goods to ‘sample’ music, movies, software, or electronic games before purchasing legitimate copies, which may lead to increased sales of legitimate goods. In addition, industries with products that are characterized by large ‘switching costs’, may also benefit from piracy due to lock-in effects ... [Moreover,] companies that experience revenue losses in one line of business—such as movies—may ... increase revenues in related or complementary businesses due to increased brand awareness. For instance, companies may experience increased revenues due to the sales of merchandise that are based on movie characters whose popularity is enhanced by sales of pirated movies. One expert also observed that some industries may experience an increase in demand for their products because of piracy in other industries. This expert identified Internet infrastructure manufacturers (e.g., companies that make routers) as possible beneficiaries of digital piracy, because of the bandwidth demands related to the transfer of pirated digital content. While competitive pressure to keep one step ahead of counterfeiters may spur innovation in some cases, some of this innovation may be oriented toward anticounterfeiting and antipiracy efforts, rather than enhancing the product for consumers.”<sup>43</sup>

Although the GAO study did not go further, one could easily question how much of the losses the intellectual property industries claimed to have suffered would be cancelled out by these benefits. If the benefits indeed outweigh the claimed losses, the country will have a *net* economic gain even though the core intellectual property industries may have suffered losses.

The third challenge concerns the complexity of intellectual property laws and the significant differences between “law on the books” and “law in action”—two areas that economists sometimes ignore.<sup>44</sup> Consider patent law, for example. It is pointless to assume that the length of patent protection to be a static 20 years

<sup>40</sup> United States Government Accountability Office, *Intellectual Property Observations on Efforts to Quantify the Economic Effects of Counterfeit and Pirated Goods*, 2010, pp.17–18.

<sup>41</sup> Fink, “Enforcing Intellectual Property Rights” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.13.

<sup>42</sup> Li, “Ten General Misconceptions about the Enforcement of Intellectual Property Rights” in *Intellectual Property Enforcement*, 2009, p.25.

<sup>43</sup> United States Government Accountability Office, *Intellectual Property Observations on Efforts to Quantify the Economic Effects of Counterfeit and Pirated Goods*, 2010, p.15.

<sup>44</sup> Maskus, “Introduction” in *Intellectual Property, Growth and Trade*, 2008, p.3; Jonathan Putnam, “The Law and Economics of International Intellectual Property: A Primer” in *Intellectual Property, Growth and Trade*, 2008, p.84. On the challenges in mapping legal doctrines with economic ideas, see Suzanne Scotchmer, *Innovation and Incentives* (Cambridge, MA: MIT Press, 2004), pp.97–118.

without taking into consideration maintenance or renewal fees and potential regulatory delays.<sup>45</sup> Likewise, it will be ill advised to focus on the total patent count if many of the counted patents are likely to be invalidated upon legal challenge.<sup>46</sup> At the international level, it is also worth thinking more about the complications caused by the prosecution of identical patents by firms in different jurisdictions with varying patent quality.<sup>47</sup>

In addition, it is highly important to distinguish between infringement on the one hand and piracy and counterfeiting on the other—a distinction that policymakers and industry groups often overlook.<sup>48</sup> Microsoft,<sup>49</sup> MGM,<sup>50</sup> Twentieth Century Fox<sup>51</sup> and Universal Studios<sup>52</sup> have all been found to have repeatedly infringed others' intellectual property rights. Yet most would find it absurd to classify these firms as "repeat pirates". The important policy question, therefore, is not whether these firms have infringed—and in these examples, repeatedly infringed—but whether such infringement is a necessary part of doing legitimate business and how large the infringement-innovation ratio is. John Walsh, Ashish Arora and Wesley Cohen, for example, found that many university and industrial researchers use patented technology without a license when patent protection prevents them from gaining access to the needed research tools.<sup>53</sup>

It is important to remember that creativity and innovation often involve risks. Some industries, indeed, are more vulnerable to litigation than others—think newspapers and broadcasters in the copyright context<sup>54</sup> and software developers in the patent context.<sup>55</sup> Because an intellectual property system where firms are highly concerned about legal risks is likely to greatly stifle creativity and innovation, researchers need to think more about whether they should limit their studies to piracy and counterfeiting, as opposed to all forms of infringement.

Moreover, many intellectual property issues cannot be examined by focusing on economics alone. To be certain, many non-legally trained researchers have acknowledged their limited knowledge of intellectual property laws and the judicial process. Some laws also remain unsettled. Nevertheless, researchers will greatly benefit from a better understanding of the interplay between law and economics. These benefits are, indeed, why law schools in the United States and elsewhere have now championed the "law and economics" approach. Thanks in no small part to the pioneering efforts of William Landes and Richard Posner, an ever-growing number of scholars have conducted research using this approach—through cross-disciplinary collaborations or otherwise.<sup>56</sup>

While the first three challenges appear in virtually all surveys on piracy and counterfeiting, the next three challenges relate specifically to the ITC studies. The fourth challenge concerns the difficulty in quantifying such intangibles as the promotion of free speech, free press and democratic transition. As

<sup>45</sup> Christine Greenhalgh and Mark Rogers, *Innovation, Intellectual Property, and Economic Growth* (Princeton: Princeton University Press, 2010), pp.36–37, 167–169; Ashish Arora, "Intellectual Property Rights and the International Transfer of Technology: Setting out an Agenda for Empirical Research in Developing Countries" in World Intellectual Property Organization, *The Economics of Intellectual Property: Suggestions for Further Research in Developing Countries and Countries with Economies in Transition* (Geneva: World Intellectual Property Organization, 2009), p.46; Scotchmer, *Innovation and Incentives*, 2006, p.69; Peter K. Yu, "The International Enclosure Movement" (2007) 82 *Ind. L.J.* 827, 837 fn.40.

<sup>46</sup> Correa, "The Push for Stronger Enforcement Rules" in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, pp.42–43.

<sup>47</sup> Jonathan Eaton and Samuel Kortum, "Patents and Information Diffusion" in *Intellectual Property, Growth and Trade*, 2008, p.92.

<sup>48</sup> Mitchel B. Wallerstein, Mary Ellen Mogege and Roberta A. Schoen, "Introduction" in *Global Dimensions of Intellectual Property Rights in Science and Technology*, 1993, p.11.

<sup>49</sup> e.g. *i4i Ltd P Ship v Microsoft Corp* 598 F. 3d 831 (Fed. Cir. 2010); *Z4 Tech., Inc v Microsoft Corp* 507 F.3d 1340 (Fed. Cir. 2007).

<sup>50</sup> e.g. *Sheldon v Metro-Goldwyn Pictures Corp* 309 U.S. 390 (1940); *Barsha v Metro-Goldwyn-Mayer* 90 P. 2d 371 (Cal. Ct App. 1939).

<sup>51</sup> e.g. *L.C. Page & Co. v Fox Film Corp* 83 F. 2d 196 (2d Cir. 1936); *Fader v Twentieth Century-Fox Film Corp* 169 F. Supp. 880 (S.D.N.Y. 1959).

<sup>52</sup> *Stewart v Abend* 495 U.S. 207 (1990); *Twentieth Century-Fox Film Corp v MCA, Inc* 715 F. 2d 1327 (9th Cir. 1983); *Woods v Universal City Studios, Inc* 920 F. Supp. 62 (S.D.N.Y. 1996).

<sup>53</sup> John P. Walsh, Ashish Arora and Wesley M. Cohen, "Working through the Patent Problem" (2003) 299 *Science* 1021.

<sup>54</sup> The House Report on the 1976 US Copyright Act declared: "broadcasters and newspaper publishers ... are particularly vulnerable to [the] type of infringement suit" where the infringer was not aware and had no reason to believe that its acts constituted an infringement of copyright. H.R. Rep. No.94–1476, at 162.

<sup>55</sup> "[S]oftware patents accounted for 38 percent of the total cost of patent litigation to public firms during the late 1990s". James Bessen and Michael J. Meurer, *Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk* (Princeton: Princeton University Press: 2008), p.22.

<sup>56</sup> William M. Landes and Richard A. Posner, *The Economic Structure of Intellectual Property Law* (Cambridge, MA: Belknap Press of Harvard University Press, 2003).

economists have widely noted, depending on a country's market size and conditions as well as its imitative or innovative capacity, inadequate intellectual property protection can affect a country's ability to generate taxes, create jobs, transfer technology, diffuse knowledge, attract FDI, increase trade flows and develop human capital.<sup>57</sup> The lack of protection, nevertheless, can *enhance* welfare by encouraging the free flow of information.

For example, the reuse of copyrighted content helps provide information that otherwise may not be available. The provision of affordable communications technologies—whether licensed or not—also helps enlarge the much-needed public sphere. Although many assume that only certain types of information—such as news stories—will help promote democratic transition and civil society development, this is not entirely true. Entertainment products that are uncontroversial, highly commercial and seemingly frivolous could easily contain useful political information. While many of these commercial products may have been created to provide entertainment, in some countries they also supply an important window to the outside world. In addition, the creative reuse of pre-existing materials can promote the development of a vibrant democratic culture, which in turn affects a country's political future.<sup>58</sup>

It is not uncommon to find Hollywood movies or American television programmes portraying different forms of government, the need for checks and balances or separation of powers, and the protection of constitutional rights and civil liberties. The three prequels to *Star Wars*, for example, are filled with issues concerning corruption, slavery, federalism, democracy, racial tension and the American Government. Although I would not go so far to claim that the broadcast of the television series *Dallas* in East Germany led to the collapse of the Berlin Wall, as some suggested, I also hesitate to claim that Western entertainment products played no role at all. After all, it is more than simple trade protectionism when countries choose to ban Hollywood movies from their domestic markets!

As far as intellectual property enforcement in China is concerned, one area that researchers have largely overlooked is its relation to the way the masses communicate. Because of heavy information control, it is highly important that the public can reuse, without permission, materials previously approved by censors or that are only available abroad. To provide an alternative source of information, they may need to repost copyrighted stories, videos or photos that otherwise would not have been available. They may also need to repurpose pre-existing materials to address issues that they otherwise cannot discuss because of government censorship.

At times, parodies, satires, coded words, euphemisms and allusions to popular culture are the dominant vehicles of communication.<sup>59</sup> Materials that are seemingly unrelated to the intended original message may need to be used to create associations, build in tacit meanings, provide emotional effects and ultimately avoid censorship. Whether it is a remix of video clips from Western movies, the synchronisation of contents to rock 'n roll songs or the modification of news reports from foreign media, repurposed contents carry within them rich "hidden transcripts" that provide important social commentary.<sup>60</sup>

An additional concern relates to the potential for intellectual property rights to be used as a pretext to suppress or silence dissent.<sup>61</sup> After all, many of the reused contents are copyrighted. Only a few months ago, the *New York Times* provided a detailed report on the complaints by an outspoken Siberian environmental activist group about how Russian authorities had confiscated their computers (as well as

<sup>57</sup> e.g. Keith E. Maskus, *Intellectual Property Rights in the Global Economy* (Washington, D.C.: Institute for International Economics, 2000); Maskus, "The Role of Intellectual Property Rights in Encouraging Foreign Direct Investment and Technology Transfer" (1998) 9 *Duke J. Comp. & Int'l L.* 109; Carlos A. Primo Braga and Carsten Fink, "The Relationship Between Intellectual Property Rights and Foreign Direct Investment" (1998) 9 *Duke J. Comp. & Int'l L.* 163.

<sup>58</sup> Jack M. Balkin, "Digital Speech and Democratic Culture: A Theory of Freedom of Expression for the Information Society" (2004) 79 *NYU L. Rev.* 1.

<sup>59</sup> Ashley Esarey and Xiao Qiang, "Political Expression in the Chinese Blogosphere: Below the Radar" (2008) 48 *Asian Surv.* 752.

<sup>60</sup> James C. Scott, *Domination and the Arts of Resistance: Hidden Transcripts* (New Haven: Yale University Press, 1990).

<sup>61</sup> William P. Alford, "Making the World Safe for What? Intellectual Property Rights, Human Rights and Foreign Economic Policy in the Post-European Cold War World" (1997) 29 *NYU J. Int'l L. & Pol.* 135, 144–145; Yu, "Three Questions That Will Make You Rethink the U.S.-China Intellectual Property Debate" (2008) 7 *J. Marshall Rev. Intell. Prop. L.* 412, 424–432.

those of other advocacy groups and opposition newspapers) in the name of protecting Microsoft's copyrighted software.<sup>62</sup> That report eventually generated a raging public debate about the need to re-examine intellectual property protection and enforcement through the lens of corporate social responsibility.

In short, there are clearly costs to strengthened intellectual property protection and enforcement. Some of those costs, however, are hard to quantify. Although commentators have widely embraced democratic society and the promotion of human rights and civil liberties, the value of these benefits are often ignored in economic analyses—through convenient definitions, unrealistic assumptions or crafty interpretation of the researchers' mandates. As Amartya Sen reminded us, freedom and democracy are important because of:

- “1) their intrinsic importance;
- 2) their consequential role in providing political incentives for economic security;
- 3) their constructive role in the genesis of values and priorities.”<sup>63</sup>

The fact that freedom and democracy are not readily measurable does not mean that we should ignore their uneasy relationship with stronger intellectual property enforcement. In fact, given their paramount importance, freedom and democracy deserve greater recognition in empirical studies on intellectual property enforcement.

To be certain, it is fair to ask why intellectual property right holders need to subsidise free speech developments in foreign countries. However, if a country, like the United States, has already decided to provide funding to promote free speech developments in other countries, that question seems to be more about internal allocation of gains and losses through the legislative process than about whether subsidies should be made in the first place. For instance, should the entertainment industries be able to seek compensation from a pool of funds that have been earmarked for the promotion of democratic transition and civil society development? Should the government provide tax benefits to those whose works have been used to promote democracy and the protection of human rights—for example, by allowing entertainment firms to write off democracy-inducing losses? Should the government introduce an alternative means of compensation to support democracy-inducing activities—such as the purchase at reasonable cost of blanket licenses for civil society organisations? More challengingly, could the government introduce some of these measures without getting into a subjective and highly political debate about what democracy, freedom and human rights are?

The fifth challenge concerns how to determine what researchers should cover in a highly dynamic, complex and interdependent global environment. While it is not that difficult to determine the impact of pirated CDs, VCDs and DVDs on the entertainment industries—although researchers continue to disagree over the ultimate figures—it is much more difficult to determine the overall impact of piracy and counterfeiting in China on the US economy.

Consider the following broader questions. Should researchers consider as part of the US economy those Chinese firms that come to the United States and thereby produce US jobs? How should researchers handle those cheap, infringing materials American firms use as inputs in their outsourced productions in China? Should researchers consider as a benefit that piracy has developed in China a pool of cheap, but highly specialised labour that American firms can use for legitimate purposes? Should they consider as a benefit that piracy has led many American products—including Microsoft software—to become the industry standard and thereby produce network effects? What about those Chinese students who now want to study in the United States because they have watched pirated American television programmes? What about those Chinese tourists who now want to visit Disneyland, the Universal Studios, the Empire State Building,

<sup>62</sup> Clifford J. Levy, “Using Microsoft, Russia Suppresses Dissent”, *New York Times*, September 12, 2010, p.A1; Clifford J. Levy, “Microsoft Changes Policy Amid Criticism It Backed Suppression of Dissent in Russia”, *New York Times*, September 14, 2010, p.A4.

<sup>63</sup> Amartya Sen, *Development as Freedom* (New York: Anchor Books, 1999), p.246.

the bridges in Madison County, Iowa or other places in the United States after they have seen those places in pirated US movies? These are all difficult questions that could raise serious complications when researchers study the cross-border economic impact of piracy and counterfeiting.

Moreover, piracy and counterfeiting can provide benefits to US consumers. Policymakers and industry representatives have a high tendency to equate pirated or counterfeit products with sub-standard goods.<sup>64</sup> However, this tendency is somewhat misguided. Foreign businesses in China have repeatedly complained about how counterfeit products are made in what they call “ghost shifts”.<sup>65</sup> In these shifts, many of the infringing goods are made to the same specifications by the same factories using the same personnel and raw materials. Understandably, there may be limited quality control for infringing products. There may also be cost-cutting measures, especially when the manufacture of the products involves difficult processes or costly raw materials. The infringing factories may even want to introduce irregularities to distinguish the licensed goods from their unlicensed counterparts—or at least count those rejected irregular licensed goods as acceptable unlicensed products.

Nevertheless, it is incorrect to assume pirated products are *always* inferior. It is even more incorrect to assume infringing goods will *always* harm consumers. In many situations involving ghost shifts, factory overruns or contract disputes that have resulted in a *technical* loss of legal authorisation, the only difference between the legitimate goods and their infringing counterparts may be legal authorisation. Because the infringing goods in these situations are of the same standard, or close to that standard, the unauthorised production of those goods may actually result in a consumers’ surplus: consumers are now getting the same products for a much lower price. While ghost shifts, factory reruns and the continued production amid contract disputes may be bad for intellectual property right holders, they could be good for US consumers.

The final challenge concerns the interactions between intellectual property protection and a country’s competitive position. Although it is widely recognised that strong intellectual property protection is important to American firms, greater intellectual property protection in China can also weaken the US competitive position. This point sounds counterintuitive, but it actually makes sense. From a long-term competition standpoint, greater intellectual property protection will make China more innovative and therefore more competitive. Such increased competitiveness will slowly erode away the competitive edge that the United States has enjoyed as a result of its much higher intellectual property standards.

In fact, if all countries offer the same level of intellectual property protection and enforcement, other location factors—such as market size and growth or costs of labour, transportation or raw materials—will be determinative.<sup>66</sup> As China offers stronger intellectual property protection, more American and multinational firms may consider relocating to China to take advantage of its lower production costs and considerable market potential.<sup>67</sup> More technology will be transferred as a result, and more US jobs—a key focus of the ITC studies—will be outsourced.

It is no coincidence that many research and development (R & D) intensive industries remain located in the United States—and for that matter, other countries with a strong intellectual property system. It is also worth noting that many researchers and highly educated people choose to stay in the country.<sup>68</sup> To some extent, weaker intellectual property protection abroad may have helped keep US jobs in the R & D

<sup>64</sup> Li, “Ten General Misconceptions about the Enforcement of Intellectual Property Rights” in *Intellectual Property Enforcement*, 2009, pp.20–21.

<sup>65</sup> Phillips, *Knockoff: The Deadly Trade in Counterfeit Goods*, 2005, pp.25–28.

<sup>66</sup> Examples of other location factors include local demand patterns, distance from markets, access to natural resources, trade protection, education and training of the local workforce, the condition of the financial sector, the health of the legal system and the transparency of governmental procedures. Paul J. Heald, “Mowing the Playing Field: Addressing Information Distortion and Asymmetry in the TRIPS Game” (2003) 88 *Minn. L. Rev.* 249, 258–259; Maskus, “The Role of Intellectual Property Rights in Encouraging Foreign Direct Investment and Technology Transfer” (1998) 9 *Duke J. Comp. & Int’l L.* 109, 123.

<sup>67</sup> Peter K. Yu, “Trade Barriers Won’t Contain China’s Cars”, *Detroit News*, October 25, 2007, p.15A.

<sup>68</sup> Sherwood, *Intellectual Property and Economic Development*, 1990, p.156; Edmund W. Kitch, “The Patent Policy of Developing Countries” (1994) 13 *UCLA Pac. Basin L.J.* 166, 173–176.



intensive industries, especially amid the current global economic crisis. Stronger intellectual property protection and enforcement in China, therefore, is a double-edged sword: it can help and hurt the US economy at the same time.

In sum, although it is easy to point out the harmful effects of piracy and counterfeiting in China on the US economy, it is rather hard to determine their overall impact. The assessment of such impact depends on a wide variety of factors, including some of those that are hard to quantify and not readily measurable as well as those that have yet to receive significant research attention. The challenges the ITC now encounters in undertaking its two studies, therefore, provide a good illustration of the immense challenges researchers continue to face in their efforts to measure the cross-border economic impact of piracy and counterfeiting.

## Estimates

While it has been challenging to undertake research on the cross-border economic impact of piracy and counterfeiting, it is equally challenging to figure out how to compare a multitude of countries with different sizes, economies, market conditions, technological proficiencies, institutional infrastructures and cultural backgrounds. One of the critical challenges in comparative analysis is to locate the *tertium comparationis* (what to compare).

Consider, for example, a cross-country comparison of piracy and counterfeiting—a topic on which many policymakers, industry groups and academic commentators have focused. Should researchers compare the countries based on the total amount of piratical and counterfeiting activities (or the amount of pirated or counterfeit goods they produce)? Should researchers measure the countries against an idealised yardstick of effective intellectual property protection and enforcement? Should the comparisons take into account the various stages of development—and if so, should the stages be determined based on self-selection,<sup>69</sup> GDP, per capita income or the Human Development Index? Does it matter how established the intellectual property system in these countries is? Should researchers rely on subjective perceptions of firm managers—an approach used in Edwin Mansfield’s seminal study and the World Economic Forum’s *Global Competitiveness Report*?<sup>70</sup> Should researchers consider both the quality and quantity of enforcement—for example, does it matter whether enforcement is “consistent, transparent, and procedurally fair”?<sup>71</sup>

Let’s continue to use China for our illustrations. If researchers focus on the total amount of piratical and counterfeiting activities, China is likely to be found one of the world’s biggest pirates by virtue of its huge economy and high export volume. The outcome is likely to be the same in the short term, regardless of whether China has worked very hard to strengthen intellectual property protection and enforcement. It is, indeed, no surprise that China has more piratical and counterfeiting activities than, say, Georgia, Zimbabwe, Bangladesh and Moldova. According to the latest BSA survey—my earlier criticisms notwithstanding—all of these countries have piracy rates of more than 90 per cent and are considered the world’s biggest pirate nations.<sup>72</sup> By contrast, China’s piracy rate was merely 79 per cent, and the country was not even included in the list of the world’s top 25 pirate nations.<sup>73</sup>

Moreover, many of the piratical and counterfeiting activities occur in China because of its low costs of production, labour and distribution. At present, China is the low cost provider of many different categories of goods and services. As Oded Shenkar wrote in 2005:

<sup>69</sup> Self-selection is the method the WTO uses to determine a country’s developing country status.

<sup>70</sup> Edwin Mansfield, *Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer* (Washington, D.C.: International Finance Corp, 1994); World Economic Forum, *The Global Competitiveness Report 2010–2011* (Geneva: World Economic Forum, 2010), p.367.

<sup>71</sup> Martin K. Dimitrov, *Piracy and the State: The Politics of Intellectual Property Rights in China* (Cambridge: Cambridge University Press, 2009), p.6.

<sup>72</sup> Business Software Alliance and International Data Corporation, *Seventh Annual BSA/IDC Global Software Piracy Study*, 2010, p.7.

<sup>73</sup> China was 26th in the survey, in a tie with Botswana, Ivory Coast, Kenya and Nicaragua.

“China-based factories make 70 percent of the world’s toys, 60 percent of its bicycles, half its shoes, and one-third of its luggage ... [China also] builds half of the world’s microwave ovens, one-third of its television sets and air conditioners, a quarter of its washers, and one-fifth of its refrigerators.”<sup>74</sup>

Given the large amount and variety of products China manufactures, it is understandable why pirates and counterfeiters consider China an ideal location for manufacturing their products. Indeed, if an organised crime syndicate in Europe or the United States, as opposed to China, needs to produce infringing products, they are likely to select China as a place of production for no other reason than it makes simple business sense. It is important to remember that pirates and counterfeiters are rational businesspeople who seek profits and opportunities!<sup>75</sup>

By contrast, if researchers focus on piracy and counterfeiting on a per capita basis, China is likely to be saved by its 1.3-billion population. Other less developed countries may also fare better. As Aaron Schwabach observed with respect to the study conducted for the Motion Picture Association of America:

“In only four of the countries listed in the [study] as the top ten markets for losses to U.S. producers does the average person steal more from U.S. studios than do the Americans themselves. Three of these four countries are developed members of the European Union: France, Spain, and the United Kingdom. Mexico aside, the developing countries on this list have far lower per capita piracy rates ... Russia, often portrayed in the media as a lawless Wild West dotted with organized-crime fiefdoms, has a per-capita rate only slightly higher than that of notoriously law-abiding Japan, and lower than that of equally staid Germany.

With China, the difference is exceptionally stark: The per capita cost of piracy is negligible, an order of magnitude lower than Germany’s.”<sup>76</sup>

Likewise, China is not much of an outlier if researchers compare China with other countries at comparable levels of economic development. This finding is actually not surprising. From Germany to the United States to Japan, all of today’s industrial powers have passed through what I have described as the “crossover point”.<sup>77</sup> Even though both the United States and Japan have now become major *demandeurs* for strong global intellectual property enforcement norms, both of them had a chequered past as one of the world’s biggest pirate nations.<sup>78</sup> As William Kingston reminded us:

“From the start of the industrial revolution, every country that became economically great began by copying: the Germans copied the British; the Americans copied the British and the Germans, and the Japanese copied everybody.”<sup>79</sup>

If researchers are willing to make comparison based on the age of the country’s intellectual property system, China may also fare quite well vis-à-vis other countries in both the developed and less developed worlds. The present Chinese intellectual property system was instituted shortly after the country’s re-opening to foreign trade in the late 1970s. The trade mark, patent and copyright systems in China were established in 1982, 1984 and 1990, respectively. Even if one is willing to trace the Chinese intellectual property

<sup>74</sup> Oded Shenkar, *The Chinese Century: The Rising Chinese Economy and Its Impact on the Global Economy, the Balance of Power, and Your Job* (Upper Saddle River, N.J.: Wharton School Publishing, 2005), pp.2–3.

<sup>75</sup> Fink, “Enforcing Intellectual Property Rights” in *The Global Debate on the Enforcement of Intellectual Property Rights and Developing Countries*, 2009, p.15; Thomas Lagerqvist and Mary L. Riley, “How to Protect Intellectual Property Rights in China” in Mary L. Riley (ed.), *Protecting Intellectual Property Rights in China* (Hong Kong: Sweet & Maxwell Asia, 1997), p.17; Peter K. Yu, “From Pirates to Partners (Episode II): Protecting Intellectual Property in Post-WTO China” (2006) 55 Am. U. L. Rev. 901, 949.

<sup>76</sup> Aaron Schwabach, “Intellectual Property Piracy: Perception and Reality in China, the United States, and Elsewhere” (2008) 2 J. Int’l Media & Ent. L. 65, 74.

<sup>77</sup> Peter K. Yu, “The Global Intellectual Property Order and Its Undetermined Future” (2009) 1 W.I.P.O.J. 1, 10–15.

<sup>78</sup> William Kingston, “An Agenda for Radical Intellectual Property Reform” in Keith E. Maskus and Jerome H. Reichman (eds), *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime* (Cambridge: Cambridge University Press, 2005), p.658; Yu, “The Global Intellectual Property Order and Its Undetermined Future” (2009) 1 W.I.P.O.J. 1, 12–13.

<sup>79</sup> Kingston, “An Agenda for Radical Intellectual Property Reform” in *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime*, 2005, p.658.

system back to the one the imperialist powers imposed on China through gun-boat diplomacy at the turn of the 20th century, the age of this adolescent intellectual property system is still far younger than that of the fully grown adults in the United States and Western Europe.<sup>80</sup> The system is also much younger than many of the colonial intellectual property systems that the imperialist powers put in place in Africa, Asia and Latin America.<sup>81</sup>

In the United States, for example, the copyright and patent systems were established as early as the 18th century. The US Constitution of 1789 stated explicitly that:

“Congress shall have Power ... to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.”

In Europe, one could trace the origin of the patent system to as early as the Renaissance. On March 19, 1474, the Venetian Republic adopted its first patent law to encourage inventors and reward them for ingenuity.<sup>82</sup> The Venetian patent statute has since inspired the development of patent systems in France, the Holy Roman Empire and other parts of Europe.

Notwithstanding this substantial headstart, Italy and many other European countries—such as France, Portugal and Spain—continue to have a piracy rate of between 40 to 50 per cent, according to BSA at least.<sup>83</sup> If these countries have a tough time reducing piracy despite many centuries of headstart, one cannot help but appreciate the tremendous progress China has made in fewer than 30 years of intellectual property law developments (or even 100 years if one counts the imperialist years and ignores all the interruptions from revolutions, warlordism, wars, the UN trade embargo, class struggles and political turmoil<sup>84</sup>). A piracy rate of 79 per cent does not seem to be too high when other more economically developed and technologically advanced countries can only reduce their rates to half of China’s current level despite having a well-functioning intellectual property system for many more centuries.

If the challenges in selecting these metrics are not daunting enough, researchers also need to consider whether they should focus on only certain types of intellectual property rights or piratical and counterfeiting activities. For example, intellectual property covers a large and ever-expanding variety of rights, such as copyrights, patents, trade marks, trade names, geographical indications, industrial designs, layout designs of integrated circuits, plant varieties, trade secrets and other undisclosed information, sui generis database rights and the protection of traditional knowledge and cultural expressions.

It would be misleading to use patent as a proxy for intellectual property rights, even though many researchers have done just that. Most commentators have also treated trade marks separately owing to their very different justifications and goals. In fact, what intellectual property rights a country needs may depend on the type of FDI it wants to attract.<sup>85</sup> If one counts the protection of traditional knowledge and

<sup>80</sup> William P. Alford, *To Steal a Book Is an Elegant Offense: Intellectual Property Law in Chinese Civilization* (Stanford: Stanford University Press, 1995), pp.37–38; Peter K. Yu, “Piracy, Prejudice, and Perspectives: Using Shakespeare to Reconfigure the U.S.-China Intellectual Property Debate” (2001) 19 BU Int’l. L.J. 1, 6.

<sup>81</sup> India, for example, enacted a patent law in 1856, based on the British Patent Law of 1852.

<sup>82</sup> Stephen P. Ladas, *Patents, Trademarks, and Related Rights: National and International Protection* (Cambridge, MA: Harvard University Press, 1975), p.6; Peter K. Yu, “Currents and Crosscurrents in the International Intellectual Property Regime” (2004) 38 Loy. L.A. L. Rev. 323, 330.

<sup>83</sup> Business Software Alliance and International Data Corporation, *Seventh Annual BSA/IDC Global Software Piracy Study*, 2010, p.13.

<sup>84</sup> Despite commercial treaties with the US, Britain and Japan at the turn of the 20th century, China did not introduce substantive copyright, patent, and trademark laws until 1910, 1912 and 1923, respectively.

<sup>85</sup> Firms that seek to market finished products, for example, may need a different mix of intellectual property protections from those that seek to merely relocate their manufacturing or R & D facilities. Heald, “Mowing the Playing Field: Addressing Information Distortion and Asymmetry in the TRIPS Game” (2003) 88 Minn. L. Rev. 249, 258–260; Maskus, “The Role of Intellectual Property Rights in Encouraging Foreign Direct Investment and Technology Transfer” (1998) 9 Duke J. Comp. & Int’l L. 109, 119–128.

cultural expressions, some less developed countries may even argue that developed countries remain some of the world's biggest pirates because of their engagement in "biopiracy",<sup>86</sup> not to mention their strong and continuous resistance to the protection of traditional knowledge and cultural expressions.<sup>87</sup>

It is also important not to focus solely or primarily on physical piracy while ignoring similar problems on the internet. Although less developed countries, especially those in Asia, have been heavily criticised for their lack of protection and enforcement of intellectual property rights with respect to optical discs, it is important to remember that online piracy has been rather serious in virtually all developed countries. In the past decade, for instance, the US entertainment industries have labelled a large number of American teenagers and college students as "pirates", notwithstanding the fact that they look and behave quite differently from the Asian pirates thousands of miles away. Since 2003, the recording industry alone has filed lawsuits against more than 35,000 individuals in the United States for illegal distribution of copyrighted works via peer-to-peer networks.<sup>88</sup> Courts in the developed world, such as Australia, Canada and the United States, have also been inundated with cases addressing secondary copyright liability.<sup>89</sup> Given the massive online "piracy" in the United States and other developed countries, it is not surprising to find policymakers, commentators and the general populace in less developed countries complaining about the double standards used by developed country governments and industry trade groups.

Although the discussion in this section thus far focuses on intellectual property enforcement alone, it is worth exploring further whether researchers should go beyond the intellectual property field to look at other areas of law enforcement—for example, tax collection, human and drug trafficking and illegal arms sales. To be certain, some would find this approach rather curious given the incommensurability of the different areas. After all, why should researchers compare apples with oranges? Patrick Glenn, however, provided a convincing response to this question in his leading comparative law text, *Legal Traditions of the World*:

"[H]ow do we know there is such difference if comparison has not somehow, already, taken place? Think of apples and oranges and how you can actually compare them. There are obvious criteria of roundness, acidity, colour, sweetness, price, and so on."<sup>90</sup>

Indeed, both apples and oranges are fruits; people do compare their taste and nutritional value when deciding what fruit to eat. They are also easier to compare than, say, apples and beef (although vegetarians and vegans would do so as well).

With respect to intellectual property enforcement, researchers should therefore think about whether they should compare intellectual property enforcement challenges with other unrelated challenges that are equally widespread and systemic. For example, in the United States, serious enforcement problems exist with drug possession and trafficking and illegal arms sales. While the existence of enforcement problems in these areas does not excuse other countries from a lack of intellectual property enforcement, the discussion of these seemingly unrelated problems does allow us to better appreciate the inherent challenges in confronting problems that are widespread and systemic.

<sup>86</sup> "Biopiracy is seen as a new form of Western imperialism in which global seed and pharmaceutical corporations plunder the biodiversity and traditional knowledge of the developing world. Biopiracy is the unauthorized and uncompensated expropriation of genetic resources and traditional knowledge." Susan K. Sell, *Private Power, Public Law: The Globalization of Intellectual Property Rights* (Cambridge: Cambridge University Press, 2003), p.140.

<sup>87</sup> Ikechi Mgbеoji, *Global Biopiracy: Patents, Plants and Indigenous Knowledge* (Vancouver: UBC Press, 2006); Vandana Shiva, *Biopiracy: The Plunder of Nature and Knowledge* (Cambridge, MA: South End Press, 1997).

<sup>88</sup> Fred von Lohmann, "RIAA v. The People Turns from Lawsuits to 3 Strikes", available at <http://www.eff.org/deeplinks/2008/12/riaa-v-people-turns-lawsuits-3-strikes> [Accessed November 8, 2010].

<sup>89</sup> e.g. *Metro-Goldwyn-Mayer Studios Inc v Grokster, Ltd* 545 U.S. 913 (2005); *BMG Canada Inc v John Doe* [2005] F.C. 193 (Can.); *Universal Music Austl. Pty Ltd v Sharman License Holdings Ltd* (2005) 65 I.P.R. 289 (Austl.).

<sup>90</sup> H. Patrick Glenn, *Legal Traditions of the World: Sustainable Diversity in Law*, 3rd edn (Oxford: Oxford University Press, 2007), p.43.

Such comparisons are beneficial for at least three reasons. First, they will raise important questions about how countries can work together to share lessons and best practices, identify common or comparable challenges and ultimately formulate the much-needed solutions to target the crux of the enforcement problems. Secondly, such comparisons will help change the tone of the intellectual property enforcement debate. If countries continue to focus only on areas where some countries have limited enforcement problems while others have very serious ones, the debate will remain an adversarial one with a tone that is closer to accusation—or worse, confrontation—than co-operation. Thirdly, such comparisons take into account the fact that intellectual property enforcement goes hand in hand with other forms of law enforcement. Because there is a significant overlap in infrastructure, personnel, training, techniques and procedures, solutions in one area of law enforcement can easily illuminate another.

It is also worth exploring whether researchers should focus narrowly on the existing intellectual property system. Should researchers go behind the present standards to think more about the ultimate goals of having a well-functioning intellectual property system—for example, economic development, promotion of creativity and innovation, diffusion of knowledge, transfer of technology or facilitation of environmental sustainability? Should researchers rethink enforcement considering the fact that many innovative ways now exist to spur creativity and innovation (including those that are not based on intellectual property protection and enforcement)? Should researchers re-evaluate the suitability of traditional intellectual property standards for stimulating creativity and innovation in countries with limited resources and a small market?<sup>91</sup> Should researchers take into account enforcement measures that are not available in the Western world or currently enshrined in international treaties—for example, a parallel system of administrative and criminal enforcement that was challenged in the recent United States-China WTO dispute?<sup>92</sup> Should enforcement be reconceptualised by taking account of *both* rights and responsibilities—for example, by focusing on abuse of rights or restraint on trade in addition to protection of right holders? If the answer to any of these questions is yes, what should researchers take into account in their comparative analyses?

Finally, commentators continue to question whether we can actually compare countries that are unique, such as Brazil, China and India. With highly uneven economic and technological developments, these countries can be as technologically proficient as developed countries, yet as economically poor on a per capita basis as many other less developed countries. Many commentators, indeed, have considered these so-called “BRIC countries” sui generis. Some commentators also noted the need to replace the focus on economic development with one on technological proficiency.<sup>93</sup> In short, the arrival of these middle-income countries has raised important questions about how researchers should undertake cross-country comparative analyses.

Intellectual property enforcement is of paramount importance to both developed and less developed countries. While the former have expressed grave concerns over the growth and spread of piracy and counterfeiting, the latter are equally concerned about the lack of protection for traditional knowledge and cultural expressions.<sup>94</sup> Notwithstanding these shared interests, the positions of these two groups of countries have yet to converge. If we need to get these groups to finally understand their shared interests, a greater appreciation of the challenges in developing mutually satisfactory metrics for measuring piracy and counterfeiting is badly needed.

<sup>91</sup> Fink and Maskus, “Why We Study Intellectual Property Rights and What We Have Learned” in *Intellectual Property and Development*, 2005, p.5.

<sup>92</sup> “China—Measures Affecting the Protection and Enforcement of Intellectual Property Rights”, Report of the Panel, January 26, 2009, WT/DS362/R; Peter K. Yu, “The TRIPS Enforcement Dispute” (2011) 89 Neb. L. Rev. (forthcoming).

<sup>93</sup> Shamnad Basheer and Annalisa Primi, “The WIPO Development Agenda: Factoring in the ‘Technologically Proficient’ Developing Countries” in Jeremy de Beer (ed.), *Implementing the World Intellectual Property Organization’s Development Agenda* (Waterloo, ON: Wilfred Laurier University Press, 2009).

<sup>94</sup> Peter K. Yu, “Cultural Relics, Intellectual Property, and Intangible Heritage” (2008) 81 Temp. L. Rev. 433, 452–453.

## Conclusion

The development of the intellectual property system has presented many challenging questions for policymakers, industry executives, commentators and academics. As the economist Fritz Machlup noted half a century ago in his critical evaluation of the US patent system:

“If we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it.”<sup>95</sup>

While his timeless “inconclusive conclusion” has been widely cited and successfully captures the immense challenge to evaluating the patent system “as a whole”, commentators who quoted his words tend to omit the next, and arguably equally important, sentence:

“This last statement refers to a country such as the U.S.—not to a small country and not a predominantly nonindustrial country, where a different weight of argument might well suggest another conclusion.”<sup>96</sup>

This omitted sentence is of critical importance to the less developed world. It speaks to the important need to tailor the intellectual property system to local needs, conditions, interests and priorities.

In addition, it is worth recalling Professor Machlup’s emphasis on “the basis of our present knowledge”. Since the negotiation and entering into effect of the TRIPS Agreement, an abundance of studies have been undertaken to examine the economic implications of higher intellectual property standards for less developed countries. There is, therefore, no denial that the state of our *present* knowledge has advanced further than what it was half a century ago.<sup>97</sup> If Professor Machlup was unsure about whether the patent system as a whole would benefit less developed countries when he wrote the study, his doubts have now become even clearer today, when many less developed countries are struggling to obtain access to textbooks and essential medicines and technologies.

Today, many less developed countries have failed to develop a balanced intellectual property system that is sensitive to their local needs, national interests, technological capabilities, institutional capacities and public health conditions. While the TRIPS Agreement, WIPO-administered treaties and other multilateral and regional agreements have laid down the minimum standards for intellectual property protection and enforcement, they say very little about whether those standards, in fact, have struck an optimal balance for participating countries.

Worse still for less developed countries, the older international treaties, such as the Paris and Berne Conventions, were all legacy agreements that were established during the colonial era with very limited participation from these countries.<sup>98</sup> While the later agreements were more inclusive, they were at best uneasy political compromises between developed and less developed countries.<sup>99</sup> The TRIPS Agreement, for example, involved a complex cost-benefit calculus involving a large number of trade items. Some less

<sup>95</sup> Fritz Machlup, *An Economic Review of the Patent System* (Washington, D.C.: Subcommittee on Patents, Trademarks, and Copyrights, Senate Committee on the Judiciary, 1958), p.80.

<sup>96</sup> Some of the rare exceptions are the UK Commission on Intellectual Property Rights, Hazel Moir and David Vaver. Commission on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy*, 2002, p.16; Hazel V.J. Moir, “Are Gene Patents Good for Us?”, Submission to the Senate Community Affairs Committee, available at [http://www.aph.gov.au/senate/committee/clac\\_ctte/gene\\_patents/submissions/sub20.pdf](http://www.aph.gov.au/senate/committee/clac_ctte/gene_patents/submissions/sub20.pdf) [Accessed November 8, 2010]; David Vaver, “General Introduction” in *Intellectual Property Rights: Critical Concepts in Law* (London: Routledge, 2006), Vol.1, p.15.

<sup>97</sup> Michele Boldrin and David K. Levine, *Against Intellectual Monopoly* (Cambridge: Cambridge University Press, 2008), pp.243–244.

<sup>98</sup> Ruth L. Okediji, “The International Relations of Intellectual Property” (2003) 7 *Sing. J. Int’l & Comp. L.* 315, 323–325; Peter K. Yu, “International Enclosure, the Regime Complex, and Intellectual Property Schizophrenia” [2007] *Mich. St. L. Rev.* 1, 3–5.

<sup>99</sup> On the origins of the TRIPS Agreement, see Daniel Gervais, *The TRIPS Agreement: Drafting History and Analysis*, 3rd edn (London: Sweet & Maxwell, 2008), pp.3–27; Jayashree Watal, *Intellectual Property Rights in the WTO and Developing Countries* (The Hague: Kluwer Law International, 2001), pp.11–47; Yu, “TRIPS and Its Discontents” (2006) 10 *Marq. Intell. Prop. L. Rev.* 369, 371–379.

developed countries have also complained about the coercive pressures from developed country governments, industry trade groups and multinational corporations as well as their rather limited knowledge at that time of the full implications of high intellectual property standards, especially in relation to other issue areas. A greater empirical evaluation of the existing international intellectual property system, therefore, deserves our urgent empirical attention.

To open up this second volume, we are very fortunate to have a number of distinguished scholars to guide us through the analysis of some highly complex economic questions. Although lately the economics of intellectual property have received considerable policy and scholarly attention in developed countries and at the international intergovernmental level,<sup>100</sup> rigorous economic analysis and empirical assessment remain wanting in many less developed countries, not to mention the continuously limited pool of home-grown economists that have intellectual property-related expertise. I hope you will find this special issue timely, informative and stimulating, and I strongly encourage you to explore the economic underpinnings and empirical basis of both the domestic and international intellectual property systems.

<sup>100</sup> e.g. *Intellectual Property and Development*, 2005; Greenhalgh and Rogers, *Innovation, Intellectual Property, and Economic Growth*, 2010; Maskus, *Intellectual Property Rights in the Global Economy*, 2000; Scotchmer, *Innovation and Incentives*, 2006; World Intellectual Property Organization, *The Economics of Intellectual Property*, 2009.



# A Half Century of Research on Patent Economics

**F.M. Scherer**

*Harvard University*

☞ Economics and law; Patents; Research; United States

The invitation to submit an article for the *WIPO Journal* came as a challenging surprise. It was a surprise because defunct academic scribblers, to use John Maynard Keynes's felicitous phrase, are seldom asked to contribute their thoughts to a contemporary debate. It was challenging because, as I near the completion of eight decades on our planet, it is hard to say really new things, which is what scholars ought to do in writing a paper. The alternative—reflecting upon one's past encounters with an issue—is equally challenging because it is at odds with scholarly traditions. Despite the stigma, I have opted for reflection. The article will recount my principal encounters as a scholar and activist at the interface between economics and patent policy. They are, I believe, sufficiently consequential that the exercise should be useful to readers.

## The incentive effects

My first published contribution on patents came in 1958. As students in the Manufacturing course taught at Harvard Business School by General Georges Doriot, president of the first modern American high-technology venture capital firm, we were required to form groups and write a so-called "topic paper". Many of the papers were on promising new technological opportunities; I believe they informed Doriot's investments at the American Research and Development Corporation. Our group chose instead to write about a policy issue: the widespread imposition of compulsory patent licensing as a remedy in settlement of antitrust cases. Up to that time, there had been roughly 100 such settlements,<sup>1</sup> highlighted by the decrees in early 1956 requiring compulsory licensing, often at zero royalties, of thousands of patents owned by AT&T and IBM—two of the most admired innovators in the panoply of American industry. The main theme of Doriot's course was that technological innovation was the mainspring of American economic growth and business prosperity. The antitrust actions appeared to conflict with the maintenance of that nexus. As the *Wall Street Journal* editorialised following the two decrees<sup>2</sup>:

"So it may turn out that these are dangerous victories the Government boasts about. The settlements in these cases indicate a belief that everybody's patents should be everybody else's. But this is a philosophy that strikes at incentive; new ideas and new inventions may be lost. Such Government victories may turn out to be far more costly for the nation than for the companies."

Pursuing research on the incentive effects of compulsory licensing was suggested by me. I was alert to the issues because I had written my honours thesis in economics at the University of Michigan in 1954 on "The Atomic Energy Patent Laws and Economic Progress", addressing inter alia the compulsory licensing provisions in both the original Atomic Energy Act (the 1954 revision was still being debated by Congress) and in other nations' laws. How I knew about the IBM and AT&T cases is now a mystery. At the time they were settled, I was stationed at a remote army outpost near the German iron curtain and had little access to major newspapers. But somehow we found out and launched a major research effort. Over

<sup>1</sup> US Senate, Committee on the Judiciary, Subcommittee on *Patents, Trademarks, and Copyrights*, Report, Patents, Trademarks, and Copyrights (Washington: 1957), p.14.

<sup>2</sup> "Dangerous Victory", *Wall Street Journal*, January 22, 1956, p.6.

Christmas vacation of 1957–58, we fanned out to interview 22 companies, most of which had experienced compulsory licensing decrees.<sup>3</sup> We also received detailed mail questionnaires from 69 additional companies holding 45,500 patents, conducted a statistical analysis of patenting by companies that had entered into compulsory licensing decrees versus those that had not, and read extensively in the patent economics literature, aided inter alia by numerous publications from the Senate Subcommittee on Patents (the so-called O’Mahoney Committee).

We were astonished by the results.<sup>4</sup> Fully expecting to find important negative effects, we encountered few in our interviews. Combining interview and questionnaire responses to a hypothetical question on the effects of reasonable-royalty compulsory licensing, 52 companies said there would be no effect, 18 that there would be a decrease in research and development (R & D) effort, three that R & D would be discontinued, four that R & D would be increased; and 21 (including 10 with decreased R & D) that they would patent only inventions which would necessarily become known to competitors. That there was some reduction in patenting following decrees, mostly by companies emphasising internal process R & D, was verified by our larger statistical analysis.

We also asked companies about the importance of patents in their R & D decisions. Among five factors ranked by 91 respondents, patent protection was first or second in importance for seven companies. A large majority of the respondents evaluated patent protection as the least important of five factors. Much more important to R & D investments, the majority reported, were the necessity of maintaining competitive leadership, the necessity of remaining competitive, the desire for efficient production and the desire to expand sales or diversify product lines.<sup>5</sup> Evaluating this and other evidence compiled in our survey, we concluded that “competitive exigencies were far more important among established corporations as reasons for research and development than considerations of potential patent protection”.<sup>6</sup> We cautioned, however, that most of the companies in our sample were indeed well established, and that patents might play a more important role for start-up companies and established companies branching out into completely new lines where they lacked experience and well-developed marketing channels. Among our interviewees, the Polaroid Corp placed the highest weight on patent protection. Its executives believed that without patent protection, much larger and better-established Eastman Kodak would imitate its picture-in-a-minute technology and overwhelm it. Indeed, during the 1980s Kodak did launch a challenge, but was repelled by Polaroid’s patent portfolio and was required in 1990 to pay damages of \$909 million.<sup>7</sup>

Apprehensive over the validity of our findings, I returned to the subject in 1977, when the first comprehensive data on R & D spending by American corporations became available. In an analysis of 679 companies, 42 of which had experienced significant compulsory licensing settlements under antitrust, I found that 1975 R & D/sales ratios were on average 36 per cent *higher* than unaffected companies in the same industries for the compulsory licensing subjects, taking into account also company sales.<sup>8</sup> This result persisted when controls were included also of the severity and extent of the compulsory licensing and the lag from the time of the decree to 1975, the year for which sales were measured.

<sup>3</sup> A surviving list reveals that interviews were held with AT&T, Babcock & Wilcox, Bendix, Dewey & Almy, Esso, General Electric, General Motors, Goodrich, Goodyear, Hazeltine, IBM, International Harvester, IT&T, Minneapolis Honeywell, MMM, Norton, Pitney Bowes, Polaroid, RCA, Sunbeam, Union Carbide and United Shoe Machinery.

<sup>4</sup> F.M. Scherer, S.E. Herzstein, Alex Dreyfoos, W.G. Whitney, O.J. Bachmann, C.P. Pesek, C.J. Scott, T.G. Kelley and J.J. Galvin, *Patents and the Corporation* (Boston: privately published; 1st edn 1958, rev. edn 1959), Ch.12.

<sup>5</sup> Scherer et al., *Patents and the Corporation*, 1958, p.118.

<sup>6</sup> Scherer et al., *Patents and the Corporation*, 1958, p.149.

<sup>7</sup> It is remarkable that despite this victory, Polaroid failed to cope with the shift to digital photography and declared Chapter 11 bankruptcy in December 2008.

<sup>8</sup> F.M. Scherer, *The Economic Effects of Compulsory Patent Licensing* (New York: New York University Graduate School of Business Administration monograph 1977-2, 1977), p.73.

When we published *Patents and the Corporation*, our knowledge of economic theory was the smattering one would expect from MBA students. After building my knowledge through PhD studies and (more importantly) teaching in economics, I later systematised our findings.<sup>9</sup> The basic rationale of patents is to delay imitation of one's invention until there is an expectation of sufficient profits to cover the costs and risks of innovation. But our interviews revealed, and later research confirmed, that there are alternative non-patent barriers to imitation, which later came to be known as "first-mover" advantages.<sup>10</sup> These include the head-start that innovators usually have over imitators and the opportunity to earn supra-normal profits during this period; the extension of that head-start through resort at first to product and then production process secrecy; the opportunity to advance down learning curves and hence reduce costs during the head-start period; the reputation advantage that accrues to those who are perceived by consumers to have pioneered a product innovation, permitting the retention of sizeable market shares and premium prices despite imitation<sup>11</sup>; and the fact that imitators often have to spend nearly as much on research and development as innovators but typically capture much smaller market shares over which to amortise their R & D costs.

A striking illustration of this last relationship is found by comparing the characteristics of innovation in commercial aircraft, where studies have found patents to be unimportant, and pharmaceuticals, which place unusually heavy emphasis on patent protection. In aircraft, an imitator must complete its own detailed designs, however imitative they are; build static and then dynamic test models; create tooling; and test full-size prototypes to ensure that actual performance matches theoretical predictions. The costs of all this are close to those the first mover incurs. In the meantime, an innovator has advanced far down its learning curve, under which unit costs fall by roughly 20 per cent with each cumulative doubling and redoubling of output. In pharmaceuticals, the first mover under modern conditions is likely to spend upwards of \$400 million for early screening tests (mostly unsuccessful), animal tests, and then for the surviving molecules, full-scale, carefully controlled tests in human beings.<sup>12</sup> Most of these expenditures are made to identify interesting molecular targets and then prove that they are efficacious and safe in human beings. Once this is known, the evidence on efficacy is there for all to see. Thus what is produced is mainly pure public good knowledge. Absent patents or other regulatory barriers, a generic imitator can then spend only a few million dollars to devise its own production methods and go into competition. Patents prevent such easy "cheap-riding" imitation.

One might dismiss our *Patents and the Corporation* findings, which among other things involved no pharmaceutical company interviewees, as the blundering of rank amateurs. But as time passed, our findings were confirmed through research by several other more mature investigators. First chronologically was the study in England by Silberston and Taylor, who were unaware of our research.<sup>13</sup> They asked company officials what impact a worldwide regime of compulsory licensing at "reasonable" royalties would have on company R & D expenditures. The weighted average impact across all industries was 8 per cent, although in pharmaceuticals, a decrease of 64 per cent was predicted. Aware of our results, Edwin Mansfield asked 100 US corporate R & D executives what proportion of the inventions they introduced between 1981 through 1983 would not have been developed without patent protection. The weighted average adverse

<sup>9</sup> My first synthesis, modified marginally in later editions, was in F.M. Scherer, *Industrial Market Structure and Economic Performance* (Chicago: Rand McNally, 1970), pp.382–388. Remarkably prescient, but unknown to me at the time, was Arnold Plant, "The Economic Theory Concerning Patents for Inventions" (1934) 1 *Economica* 30, 44.

<sup>10</sup> I am unsure who first coined the term "first-mover advantage". It may have been Oliver Williamson, probably during the 1960s.

<sup>11</sup> Important new insights into this phenomenon came from Ronald Bond and David Lean, *Sales, Promotion, and Product Differentiation in Two Prescription Drug Markets*, Federal Trade Commission staff report (Washington: 1977); and Robert D. Buzzell and Paul Farris, "Marketing Costs in Consumer Goods Industries" in Hans Thorelli (ed.), *Strategy + Structure = Performance* (Bloomington: Indiana University Press, 1977), pp.128–129. For a later survey, see W.T. Robinson and Claes Fornell, "Sources of Market Pioneer Advantages in Consumer Goods Industries" (1985) 22 *Journal of Marketing Research* 305.

<sup>12</sup> In the 1950s, when our study was conducted, the average cost of a marketable new pharmaceutical product was less than \$10 million in year 2000 dollars.

<sup>13</sup> C.T. Taylor and Z.A. Silberston, *The Economic Impact of the Patent System* (Cambridge, UK: Cambridge University Press, 1973).

impact was 14 per cent, with pharmaceuticals an outlier again at 60 per cent.<sup>14</sup> Richard Levin (later president of Yale University) and colleagues surveyed an even larger sample of 650 US R & D executives, asking *inter alia* how effective various first-mover advantages were in allowing them to capture the benefits from new products.<sup>15</sup> Averaging across 130 industries, patents were found to be less effective than superior sales or service efforts, being first with an innovation, and moving quickly down the learning curve. Again, however, pharmaceuticals was an outlier, viewing patent protection as the most important appropriation mechanism.

It would not be surprising to find further research revealing that patents have become more important to US corporations during the past two decades. In part because of appellate court interpretations concerning patent validity and the damages that can be awarded to infringers more favourable to patent holders, and in part because patent “trolls” and some operating corporations have found suing possible infringers to be a profitable business, innovators risk dangerous litigation when they enter into or work in a patent-rich area. Companies have sought to defend themselves by accumulating their own substantial patent portfolios, protecting existing developments more fully and amassing ammunition for counter-suits against non-troll litigants in their home markets. These developments are not unlike an arms race, in which each party spends more to bolster its defences against possible aggressors. As the theory of arms races demonstrates, it is far from clear that collectively the economy gains from such a proliferation of defensive activity.<sup>16</sup>

Thus a scholarly consensus appears to be emerging. There are cases when patents provide important protection and hence stimulate socially beneficial innovative efforts. But on average, other first-mover advantages tend to be much more important than patent protection, and the supply of innovations would by no means dry up if no patent protection were available.

## Government-supported inventions

My own next systematic return to the question of patent effects was as a consultant during the late 1960s to the US Committee on Government Patent Policy (COGPP), whose quantitative and case study research was a precursor to passage of the Bayh-Dole and Stevenson-Wydler Acts of 1980. We found that the most important factor determining whether an invention made under government contracts was utilised in commercial markets was whether the contractor had experience selling in relevant civilian markets. With experience, the utilisation rate was 22.8 per cent; without it, 6.0 per cent.<sup>17</sup> There was evidence that utilisation was higher when contractors received exclusive rights on the patents they sought for contract inventions, although the direction of causality was unclear, since contractors bargained harder for exclusivity when they anticipated commercial applications. Pharmaceuticals was found again to be an outlier. When the US health care authorities changed their policies to threaten companies’ ability to gain exclusive rights on the new molecules they tested on behalf of academic grant recipients, the pharmaceutical companies abruptly ceased such testing, resuming only when the Department of Health, Education and Welfare restored a presumption of exclusivity.

Patent protection is most important when the R & D outlays needed to bring an invention into commercial use are high relative to the size of the market being tapped. In more than half of the 120 cases on which COGPP estimates were available, the R & D costs needed to move from government-supported invention to commercial utilisation were less than \$10,000.<sup>18</sup> In only five cases were the R & D costs more than \$1

<sup>14</sup> Edwin Mansfield, “Patents and Innovation: An Empirical Study” (1986) 32 *Management Science* 173.

<sup>15</sup> R.C. Levin, Alvin Klevorick, R.R. Nelson and S.G. Winter, “Appropriating the Returns from Industrial Research and Development” (1987) 3 *Brookings Papers on Economic Activity* 783.

<sup>16</sup> See Kenneth Boulding, *Conflict and Defense* (New York: Harper: 1962), Chs 1–3.

<sup>17</sup> Scherer, *The Economic Effects of Compulsory Patent Licensing*, 1977, p.80.

<sup>18</sup> Scherer, *The Economic Effects of Compulsory Patent Licensing*, 1977, p.81. The observed skew distribution of R & D costs, with many low-cost projects and only a few high-cost, appears to be quite typical. See F.M. Scherer, *New Perspectives on Economic Growth and Technological Innovation* (Washington: Brookings, 1999), p.69.

million, and in seven more, they were reported to range between \$500,000 and \$1 million. For the cases in which R & D costs were modest, it seems likely that commercial utilisation could follow even without patent protection.

## The economic value of patents

On many occasions I have used patent data in tracing how technology affects the economy and vice versa. Those studies cannot detain us here.<sup>19</sup> Let us instead focus on research attempting to measure the economic value of patents.

For a 1965 article exploring large corporations' patenting,<sup>20</sup> I questioned whether patent counts could be used as a proxy for the underlying value of the inventions. My main lever on the problem was a survey by researchers at George Washington University on the profits from 281 US patented inventions.<sup>21</sup> Having just heard a lecture by Benoit Mandelbrot on the strange statistical properties of highly skew Pareto distributions, I plotted the Sanders et al. data and found that they conformed tolerably well to Mandelbrot's Pareto distribution.<sup>22</sup> Skew distributions are those in which most of the observations entail relatively low values, e.g. profits, but there is a long right-hand "tail" of the distribution involving observations with exceptionally large values. Indeed, for the distribution parameters I measured using the Sanders et al. data, I found that the law of large numbers might not work at all. That is, as one increased the size of one's sample, there was a small chance that some new observation would be so large that it swamped the previous values and caused the distribution's mean to explode. My conclusion at the time was a modest one: that the occasional strategic inventions opening up new markets and new technologies had to remain the domain of economic historians, not statisticians.

Several investigators followed up this suggestion by taking advantage of the fact that some patenting jurisdictions—most notably, Germany—charge annual renewal fees escalating over time.<sup>23</sup> Presumably, renewal is waived first on the least valuable patents, with values escalating over time as patents are renewed despite rising fees. From these data they estimated a statistical distribution and then extrapolated that distribution to predict the value of patents in "the tail"—that is, those that were renewed to full term.

I was apprehensive about this methodology, largely because the right-hand "tail" values—those that are by far the largest and hence wag the combined value dog—were derived only through extrapolation. To make further progress, I teamed with Dietmar Harhoff to study the German "Class of 1977"—i.e. the last cohort of patent applications prior to the advent of complicating Europatents.<sup>24</sup> Through telephone interviews, we obtained economic value estimates for 772 German-origin patents that had survived to full term. Interviews obtaining further value data were then held with companies holding 69 of the most valuable patents, i.e. those valued at DM 5 million or more. An intensive analysis yielded inter alia the insight that the distribution, although highly skew, was more likely to be log normal than Pareto, so that

<sup>19</sup> But see F.M. Scherer, *Patents: Economics, Policy and Measurement* (Cheltenham: Elgar, 2005), Part II.

<sup>20</sup> F.M. Scherer, "Firm Size, Market Structure, Opportunity, and the Output of Patented Inventions" (1965) 55 *American Economic Review* 1097, 1098.

<sup>21</sup> Barkev Sanders, J. Rossman, and L.J. Harris, "The Economic Impact of Patents" (1958) 2 *Patent, Trademark, and Copyright Journal of Research and Education* 340.

<sup>22</sup> Benoit Mandelbrot, "New Methods in Statistical Economics" (1963) 71 *Journal of Political Economy* 421. Mandelbrot's analysis has among other things revolutionised thinking about financial investment portfolios. For a layperson's introduction to skew distributions and their implications, see F.M. Scherer, "The Innovation Lottery" in Rochelle Dreyfuss et al. (eds), *Expanding the Boundaries of Intellectual Property* (Oxford: Oxford University Press, 2001), pp.3–22.

<sup>23</sup> Ariel Pakes, "Patents as Options: Some Estimates of the Value of Holding European Patent Stocks" (1986) 54 *Econometrica* 755; Mark Schankerman and Ariel Pakes, "Some Estimates of the Value of Patent Rights in European Countries during the Post-1950 Period" (1986) 96 *Economic Journal* 1052; Jean O. Lanjouw, "Patent Protection in the Shadow of Infringement" (1998) 65 *Review of Economic Studies* 671.

<sup>24</sup> Our most complete publication is Dietmar Harhoff, F.M. Scherer and Katrin Vopel, "Exploring the Tail of Patented Invention Value Distributions" in Ove Granstrand (ed.), *Economics, Law and Intellectual Property* (Boston: Kluwer, 2003), pp.279–309.

the law of large numbers held crudely (with mean values converging to the true population mean) as ever larger samples were drawn. The convergence, however, was quite attenuated relative to what is assumed with so-called “normal” or Gaussian distributions.

Here appeared, however, an important paradox. Our “tail” value estimates were from 10 to 100 times larger than those reported by economists who had extrapolated their values using only patent renewal data without detailed research on the tail values. For example, the average estimated value for patents in the top 0.1 per cent of our parent sample was DM 193 million if all relevant observations were counted or DM 48 million if one extreme value was deleted from the calculation. Lanjouw, on the other hand, estimated values of the right-hand 0.1 per cent tail of her German patent sample between DM 191,000 and 433,000.

Why this huge discrepancy? In part, it might be attributed to more thorough exploration of the tail by our team. But that is not the most probable explanation. Our methodologies elicited quite different value estimates. With the renewal method, the counter-factual assumption was that without payment of a fee, the patent lapsed into the public domain, but that the patent recipient still could exploit its invention commercially, benefiting from all the first-mover advantages it had accumulated. Our methodology asked respondents to answer a quite different counter-factual question:

“If in 1980 you had known how its contribution to the future profitability of your enterprise would unfold, what is the minimum price for which you would have sold the patent, assuming that you had a good-faith offer to purchase?”

Members of the interviewing team were told to stress that in selling the full patent rights, the inventing company could be excluded from continuing to commercialise its own invention. In field interviews, the validity of this interpretation was tested *inter alia* by obtaining data on total profits over time from the invention.<sup>25</sup>

Thus what was at stake in our counter-factual was the full economic profit value (appropriately discounted) of the invention, whereas with the renewal extrapolation method, one measured only the value of *excluding* others from imitation of the invention, while the patent recipient’s rights to exploit the invention itself were retained. Whatever qualms one might have about the specific numerical comparisons, it is quite clear that the exclusionary value of patents is much less than the full economic value of the underlying inventions. The main difference between the two is the possession and exploitation of non-patent first-mover advantages.

## Activism

Not all of what I have learned about how the patent system functions came through disinterested scholarship. On occasion I have been involved as an *ex parte* participant in patent litigations. I recount here the most interesting example.

In January 1973, the US Federal Trade Commission charged the Xerox Corp with monopolising the plain paper copying machine industry.<sup>26</sup> Xerox rose to dominate the industry following the launch in 1959 of its revolutionary 914 copier. Before that innovation it accumulated a sizeable portfolio of patents, some quite fundamental, and it continued to accumulate improvement patents until, in the early 1970s, it had approximately 1,000 patents claiming to protect successor machines to the 914. It also pursued diverse bundling and price discrimination strategies that arguably overstepped permissible bounds under the US antitrust laws—hence the FTC complaint. I inherited the case when I became director of the FTC’s Bureau

<sup>25</sup> This was facilitated by the fact that under German law, companies are required to maintain files on the economic value of their inventions for purposes of compensating employee inventors.

<sup>26</sup> Prior to launching a case, the FTC staff prepares a complaint memorandum and forwards it to the Commission for decision. While the staff was copying its memorandum for circulation, the copying machine jammed. The Xerox repairman was called. On viewing the work in progress, he observed that it would certainly interest his superiors.

of Economics in the summer of 1974. My main contribution to the prosecution of the case was providing to the FTC staff a PhD dissertation written under my supervision at the University of Michigan.<sup>27</sup> That dissertation was a brilliantly original analysis of the business strategies Xerox used to enhance its profits while maintaining its dominance in supplying xerographic copying machines.

For reasons that in hindsight probably proved erroneous, Xerox executives chose to negotiate a settlement to the case rather than undergoing protracted litigation.<sup>28</sup> The principal provision required compulsory licensing of Xerox's copying machine patents—the first three (at the licensee's choice) royalty-free, then three at 0.5 per cent ad valorem each, with a maximum royalty for the entire Xerox portfolio of 1.5 per cent. Included under the terms were patents applied for in the three years following the decree.

Under FTC rules, the full five-member Commission sits as the ultimate arbiter of antitrust case findings and remedies, although its decisions in turn can be appealed to the US federal appellate courts. The Commission also issues the complaints that initiate a litigation. However, from the time when a complaint issues to the time when a preliminary decision is either negotiated or litigated before an administrative law judge, members of the FTC staff are forbidden to communicate in any way about the case with the Commissioners. Thus, when a settlement is negotiated, a request for approval of the settlement has to be forwarded to the Commission by heads of the enforcement bureaus—in antitrust cases, by the directors of the lawyer-based Bureau of Competition and the economist-based Bureau of Economics. At the time the Xerox settlement was ripe for recommendation to the Commission, the Bureau of Competition, which normally has precedence in such matters, had a new chief who ceded to me a principal role in the decision.

It was one of the most difficult decisions in my life. Xerography was a marvellous invention—one of the most important in the 20th century. The technology was developed by a relatively small company that took considerable risks with R & D expenditures of approximately \$20 million. Xerox had, to be sure, engaged in some questionable business strategies, but the legal issues were relatively evenly balanced. Should one penalise under the antitrust laws a company that had made such a large contribution to economic welfare? And what would be the effect of compulsory licensing on subsequent incentives to continue inventing? Did I trust my own research, and that of Taylor and Silberston, as to the effects of compulsory licensing on post-decree R & D investments? Paramount in my mind was the fact that in 1975, when the decision had to be made, we were 16 years removed from the original 914 copier's introduction—i.e. the first major completion of R & D—and even farther removed from the date of the fundamental (often expired) xerography patents. Under US law at the time, the life of patents was to be 17 years from issue. Those 17 years had nearly or fully tolled during the commercial life of Xerox's machines. To be sure, Xerox had continued to accumulate later improvement patents, but how long should the patent-based monopoly continue? My judgment, attempting to respect the original intent of the Founding Fathers who enacted the first US patent laws, was that Xerox had enjoyed all or most of its 17-year monopoly, and it was time for the forces of competition to take over. My co-director and I recommended to the Commission that the settlement be accepted, and it was.<sup>29</sup>

Events soon proved that both we and the Xerox management had erred in an important respect. IBM and Eastman Kodak had developed their own plain paper copying machines, and both Xerox officials and we expected the two to be the principal new competitors. We were wrong. Several Japanese firms developed their own Xerox-based technology and captured substantial shares of the US copier market.

The key question remained, did this new evolution improve or worsen the welfare of US copying machine users? And relatedly, how did it affect Xerox's incentives to continue innovating?

<sup>27</sup> Erwin A. Blackstone, "The Copying Machine Industry: A Case Study" (unpublished PhD dissertation, University of Michigan, 1968).

<sup>28</sup> See David Kearns and David Nadler, *Prophets in the Dark: How Xerox Reinvented Itself and Beat Back the Japanese* (New York: Harper, 1992), pp.62–68 and 75–76.

<sup>29</sup> *In the Matter of Xerox Corp* 86 F.T.C. 364 (1975). The printed decision includes the initial complaint. As was not uncommon at the time, the complaint provided no indication of anticipated remedies, including compulsory licensing.



My qualms were eased preliminarily when Timothy Bresnahan, an able Stanford University economist, prepared at the FTC's request a careful analysis of the compulsory licensing decree's effects.<sup>30</sup> Much more surprising support materialised seven years later, when the former chief executive officer of Xerox, David Kearns, published a book-length memoir on his experiences.<sup>31</sup> Recounting a 1977 speech by Xerox's previous chief executive officer, the author said that CEO Peter McColough delivered<sup>32</sup>:

“... a blunt appraisal of the marketplace and Xerox's position in it. In no uncertain terms, he made it clear that Xerox was being ‘out-marketed, out-engineered, outwitted in major segments of our market’. He underscored the fact that Xerox would never have it the way it did when it was protected by its patents, when it could take its sweet time developing and marketing products and when it made no difference how much it cost to make something because the company could charge almost whatever it wanted ... ‘We are now faced with the urgent need for change within this company.’”

Kearns continues in his own words<sup>33</sup>:

“The real problems that afflicted us ... were that we had lost touch with our customers, had the wrong cost base, and had inadequate products ... The monopoly environment that Xerox thrived in encouraged internal competition, but not external. We would measure the quality of a new Xerox machine according to the specifications of older Xerox copiers. Those specifications didn't mean very much if other companies were producing something altogether better.”

Thus the emergence of new competition, aided in part by compulsory patent licensing, caused Xerox to “reinvent” itself, intensifying R & D and innovation. It did not retard them.

## Conclusion

A half-century of occasional research on the economics of the patent system has convinced me that, although patents are important, other first-mover advantages are even more powerful as spurs to investment in technological innovation. Unfortunately, this knowledge does not appear to be widely diffused. Many policy initiatives proceed as if patents were the only effective stimulus to invention and innovation. The full story needs to be recognised more widely.

<sup>30</sup> His findings are summarised from a longer paper in “Post-Entry Competition in the Plain Paper Copier Market” (May 1985) 75 *American Economic Review* 15.

<sup>31</sup> Kearns and Nadler, *Prophets in the Dark*, 1992.

<sup>32</sup> Kearns and Nadler, *Prophets in the Dark*, 1992, p.100.

<sup>33</sup> Kearns and Nadler, *Prophets in the Dark*, 1992, pp.68, 123.

# The Patent System in a Time of Turmoil

**Josh Lerner\***

*Harvard University and National Bureau of Economic Research*

☞ Patents; United States

In this article, I take a broad view of the issues facing the patent system worldwide. I will begin with the “good news”, discussing why intellectual property is vitally important. Then, I will turn to the key challenges facing the patent system worldwide. I finally end with a discussion of the implications for policymakers and patent offices worldwide.

Before I start, though, I should mention an important caveat: that this is a huge topic. Economists have been studying the intellectual property system for almost 200 years, and many of these years have seen vigorous debates about features of intellectual property. Finding consensus about many questions is elusive. Thus these are complex issues, and of necessity this article will have to simplify some of these debates to fit within my allotted space.

## The importance of intellectual property

We must begin with the recognition of the vital importance of technology. Economists agree on few things, but one where there has been remarkable consensus is that technology plays a vital role in improving our lives. We see this on an intuitive level whether we look at our health (new medical approaches), ability to relate each other (the vast increase in the ability to communicate cheaply) and overall quality of life (for instance, freedom from dreary chores).

Since the work of Abramowitz in the 1950s,<sup>1</sup> economists have realised there are only two ways to boost our quality of life:

1. Having more inputs, for instance, having workers work longer and retire later, or
2. Getting more from those inputs through various forms of innovations.

Abramowitz’s pioneering work concluded that 85 per cent of the growth in the United States was coming from the second factor. Later on, Robert Solow<sup>2</sup> and many others refined the techniques used to look at this question, but the answer was always the same: technological innovation plays a critical role in making our lives better.

Over time, technology allows us collectively to live longer, healthier lives; to have growing monetary incomes; and to consume a broader array of goods and services. It is the primary reason why our lives look so different from those of our grandparents. It is in our collective interests to create social, cultural and legal institutions that foster technological innovation.

\* I thank Harvard Business School’s Division of Research for financial support. This is based in part on Adam Jaffe and Josh Lerner, *Innovation and Its Discontents: How Our Broken Patent System Is Endangering Innovation and Progress, and What to Do about It* (Princeton: Princeton University Press, 2004). All errors and omissions are our own.

<sup>1</sup> Morris Abramowitz, “Resource and Output Trends in the United States since 1870” (1956) 46 *American Economic Review* 5.

<sup>2</sup> Robert M. Solow, “Technical Change and the Aggregate Production Function” (1957) 39 *Review of Economics and Statistics* 312.

But this observation does not answer the question of whether intellectual property is necessary. For instance, why do we grant patents? After all, even when granted for truly new inventions, and not abused, patents are still a government-sanctioned monopoly. Monopolies are bad. Why not abolish the patent system altogether?

This was the conclusion that the Dutch Parliament reached in 1859.<sup>3</sup> They abolished the patent system there, using the logic above. These arguments have been repeated since in many different contexts.

As it turned out the Dutch were forced to revisit their decision several decades later and restore their intellectual property system. Because it turns out that intellectual property does play a vital role. In particular, there are three critical aspects of the role that intellectual property plays in modern societies: incentives, commercialisation and disclosure.

The first step in the incentive argument for having intellectual property as part of that legal environment is the recognition that the process of technological innovation is expensive. New products and services do not just spring full-grown from the creative mind of an inventor. Though an instantaneous spark of creative genius may start an innovative flame, it typically takes years of research and development to nurture that fire into a commercially viable blaze, with a lot of false alarms along the way. And that nurturing process costs money—often a lot of money.

If technological innovation is socially desirable, but is expensive, then society needs to have institutions that direct time and money into the processes of research and development. One approach to this, at least hypothetically, might be to have the government use money raised through taxes to research and develop new technologies. In fact, the US Government does do a lot of R & D, particularly in areas like defence, space and the environment that are themselves important areas of government responsibility. But in our free-enterprise system, we do not think it is a good idea to give the government the job of developing new products and processes for industry. Government is good at many things, but taking entrepreneurial initiative is not one of them.

If society wants technological innovation, but the government can't do it, then what we need are institutions that create *incentives* so that private individuals and firms will invest their own money in the process. With the occasional exception of the visionary inventor who wants to see an invention to market at all cost, the incentive to invest in R & D must come, ultimately, from an expectation of making a bunch of money if the thing pans out.

To make innovation rewarding, the government must give or grant something valuable to people or firms that produce important innovations. Under a patent system, this grant takes the form of using the government's legal system to create a zone of economic exclusivity for the innovator.

Suppose you, or someone who works for you, gets the creative spark that is the route to a really new and better mousetrap. You spend millions of dollars putting the idea into practice, getting the kinks out of it and testing it. Now you put it on the market; the world beats a path to your door. Those profits are the very prize you hoped for when you spent the millions developing the new idea.

So far, so good, except that all of the other mousetrap manufacturers are likely to notice that crowd on your doorstep. So what they are likely to do is to buy a couple of your new traps, and figure out how they work. If they can, they will copy your design, and sell their own version. This may be easy to do—you have already spent the money to refine the design and test it—they can simply jump in at the end and *imitate* your invention and its implementation.

And because most innovations have relatively little value, the competitors will focus their energies on copying your winning design, and thereby severely erode your profits. Put another way, the nature of the innovation game is such that the profits or returns to innovation are extremely skewed. Most investments in new products and processes fail, meaning that their investors lose money. A very small fraction of investments in new products or processes succeed. For the overall “game” of investing in new technology

<sup>3</sup> Fritz Machlup and Edith T. Penrose, “The Patent Controversy in the Nineteenth Century” (1950) 10 *Journal of Economic History* 1.

to be worthwhile, the successes must earn enough profit to cover not only their own costs and reasonable return, but also the costs and a reasonable return on those costs for all of the failures. Otherwise, the overall investment strategy will be a loser. Indeed, many R & D investments produce large *negative* returns. That is, you may simply lose all your investment. It is easy to see that this likelihood increases even further the profit that must be earned on the “successes,” if the overall return on a portfolio of investments is to be adequate.

Consider the pharmaceutical industry. Studies of pharmaceutical R & D estimate that if you screen five to ten thousand compounds for possible clinical use, on average 250 of these will show enough promise to be put into pre-clinical testing. Of these 250, five will show sufficient promise to enter clinical testing; the rest are simply abandoned. Clinical testing is where the really big bucks get spent, typically in excess of half a *billion* dollars per drug.<sup>4</sup> Of these five drugs subjected to expensive clinical testing, on average only one will be approved by regulators. And of course, regulatory approval does not ensure large profits. Many approved products have small markets. If we combine the risks of failure at the clinical trial and market stages, 80 per cent of these expensive testing efforts are complete losers, never leading to an approved product. About 14 per cent lead to an approved product, but do not earn sufficient profits to recoup their own development costs. Only 6 per cent earn sufficient profits to recoup their own investment costs, and of course this 6 per cent must also earn sufficient profits to pay for all of the losses on the other 94 per cent of compounds tested!<sup>5</sup>

And yet, once the drug is on the market, however, anyone with a decent chemistry lab can figure out what it is made of, and in most cases could then manufacture and sell it.

If there was no intellectual property protection, competition from such imitators would then drive down the price of the drug. (Indeed, this is exactly what happens when the patent expires and the drug is subject to “generic” competition.) Lower prices for drugs might seem like a good thing for society, but if competition quickly reduces the price of a new drug, the company that invented the drug would not earn significant profits from selling it. And, in a world with no patents, this scenario is exactly what drug firms would expect to unfold if they developed a truly successful new drug.

Now, put yourself in the lab coat of a pharmaceutical R & D director. Every time you try to bring a drug to market, you have to ask for permission to spend a couple hundred million dollars for clinical testing. If the drug turns out to be a dud—the overwhelming majority of promising new compounds never even get approved, and many of those approved have only modest sales—you lose a couple hundred million. If it turns out to be successful, you can sell a bunch of it—but in this hypothetical patent-free world, all your competitors would then jump in and sell it too, so you wouldn’t really make much money selling it. Maybe you would make back part of what you spent developing it, but probably not all of it. So the game you are playing is “heads you lose big, tails you lose only a little”. This is not a game that your board of directors is going to let you play for very long. And if no one plays this game, no new drugs get developed.

Thus patents make new drugs expensive, which is bad. But if they weren’t expensive, then the revenue from selling them wouldn’t justify the large cost of developing them. So nobody would. And expensive new drugs are better than no new drugs. This is the trade-off at the heart of the patent system. We grant monopolies, *knowing* that this will make the patented products more expensive, and allow some holders of patent monopolies to earn large profits. We do this because the prospect of those obscene profits is what drives firms to develop new products and processes in the first place, and the flow of revenues from one generation of successful products provides a reliable means of financing the research necessary to develop the next generation.

<sup>4</sup> Joseph A. DiMasi, Ronald W. Hansen, and Henry G. Grabowski, “The Price of Innovation: New Estimates of Drug Development Costs” (2003) 22 *Journal of Health Economics* 151.

<sup>5</sup> “PhRMA Industry Profile”, Pharmaceutical Research and Manufacturers of America, at <http://www.phrma.org/files/attachments/PhRMA%202009%20Profile%20FINAL.pdf> [Accessed December 7, 2010].

Generally speaking, neither the managers of firms nor investors like risk. Investments that are risky are less likely to be undertaken, all else being equal. So the high risk associated with R & D tends to discourage firms from undertaking it, even if the rewards are reasonably high. Investment in new technology is therefore handicapped by its riskiness, when compared with other forms of spending (for instance, expenditures on heavier marketing of an existing brand). Furthermore, when a business builds a new factory or buys some new equipment, it doesn't normally worry that its competitors will simply come and steal the equipment. When a business invests in R & D, it is "building" an asset that it hopes to profit from, just as it does when it builds a factory. But the asset that you build with research is intangible. Being intangible, it is much easier for other firms to steal.

This is where the patent system comes in. Your ability to patent your better mousetrap allows you to build a security fence around your idea, analogous to the security fence that you might build around your factory. Like any fence, it won't necessarily prevent all theft, but it will make theft harder and hence make the property more secure. And the knowledge that this fence will be available if you "build" your intangible property through R & D makes you more willing to take the risk of building it to begin with.

In summary: we want investments to be made in technological innovation. We don't think it will work well to have all or most such investments made using public funds, so we need to provide incentives for private individuals and firms to make the investments. The likelihood of imitation if new products are successful makes such investments very risky, and hence in the absence of a way to protect against imitation, we worry that not enough would be spent on R & D in the private sector. Patents provide such a mechanism, although we will soon see that even the best-functioning patent system is not costless.

A more direct approach might be to simply reward the innovator with money. In the 17th and 18th centuries the early patent system in Great Britain coexisted with the use of "prizes" to reward people who produced successful innovative solutions to particular technological problems. Some scholars of the innovation process continue to advocate the use of prizes; Michael Kremer, for example, has argued that governments or private foundations should offer a major prize as an inducement for drug companies to develop vaccines for tropical diseases (because the people and governments that need these vaccines are too poor to make this research profitable even with patent protection).<sup>6</sup>

While prizes may be an effective mechanism for drawing forth a specific, desired technology, they are not as effective a mechanism for bringing forth innovation in general. First, it would be expensive to hand out enough prizes to reward the gamut of industrial innovation; raising the tax money to do this would be both unpopular and economically burdensome. Further, it would be hard to figure out how big a prize to give to each innovation. In most cases, the importance of a discovery is initially uncertain. If the government tried to reward innovation in a general way with prizes, it would probably set too large a reward in some cases and not enough of a prize in others. For instance, a full £50,000 (several millions of today's dollars) was paid by the British government to John Palmer, the inventor of a new way of organising the mail. This was far more than that paid to Edward Jenner for his smallpox vaccine, which would be responsible for saving literally millions of lives in the years to come.<sup>7</sup> Patents, on the other hand, are by their nature proportional to the size of the discovery: the exclusive right to a modest discovery is unlikely to be worth very much, while the exclusive right to an important new technology is usually very valuable. Thus, at least in principle, patents provide an appropriately calibrated reward for different innovations.

<sup>6</sup> Michael Kremer, "Creating Markets for New Vaccines: Part I: Rationale" and "Creating Markets for New Vaccines: Part II: Design Issues" (2000) *Innovation Policy and the Economy* 35.

<sup>7</sup> The history of British prizes for invention is reviewed in depth in "Report and Minutes of Evidence Taken Before the Select Committee of the House of Lords Appointed to Consider of the Bills for the Amendment of the Law Touching Letters Patent for Inventions with Appendix and Index", *Parliamentary Papers* 1851 (486) XVIII, 1851.

Intellectual property has other advantages as well. The first is disclosure. The leading alternative to patents is trade secrecy. Yet if the firms rely on keeping ideas secret, there will be much less of a flow of ideas. Numerous studies suggest that knowledge spillovers are vitally important in encouraging economic growth, as people suggest improvements to others' ideas. With secrecy instead of patents, this exchange of ideas is lost.

Another important advantage is facilitating technology transfer. In many cases, the creation of an innovation is the beginning of the story rather than the end. There may be the need for considerable follow-on invention, for instance, of a discovery made by a professor at a university. Without intellectual property, firms would not have the incentives to make these follow-on investments, and the owners of the intellectual property—for instance, a university—would not have the incentives to find an appropriate party to license the discovery to.

### **The patent system's challenges**

As mentioned in the introduction, however, these issues have a lot of complexity. And in many ways, the simple case I discuss here is too simple. One of the most important areas where my account is too simple is the idea that stronger protection of intellectual property will lead to more innovation. Almost all economists would agree that some intellectual property protection is better than no intellectual property protection at all. But this does not mean that very strong protection is better than a more moderate level of protection.

In particular, there has been a substantial body of research on what is called “sequential innovation”.<sup>8</sup> This suggests that most innovation is not done by one firm, but rather by a series of inventors, each building on each others' ideas. If intellectual property protection is too strong, this process of one building on each other will break down: there won't be enough incentives for the follow-on innovators. As a result, a society with very strong intellectual property protection may have less innovation than one with a more moderate level of protection.

An example of too strong protection may be found in the United States today. Almost all formal disputes involving patents are tried in the federal judicial system. The initial litigation must be undertaken in a district court. Prior to 1982, appeals of patent cases were heard in the appellate courts of the various circuits. These differed considerably in their interpretation of patent law, to the extent that it is unlikely that variations in the mixture of cases could explain the large disparities. For instance, why should the patents litigated in the 8th Circuit (covering the Great Plains states) have been almost seven times less likely to be valid than those adjudicated in the 10th Circuit (Rocky Mountains) and four times less likely to be valid than in the 7th Circuit (Illinois, Indiana and Wisconsin)?<sup>9</sup> These differences persisted because the Supreme Court, which normally steps in to insure national legal uniformity, rarely heard patent-related cases.<sup>10</sup> The justices were apparently reluctant to devote their time to these “banal” commercial disputes.

The result was widespread “forum shopping” in patent cases. Patent applicants would crowd the hallway in the patent office where the list of patent awards was distributed at noon on each Tuesday. Upon discovering that their patent was issued, they would rush to the pay phones to instruct their lawyers to file suit against some alleged infringer of the newly minted patent, filing the lawsuit in a patent-friendly district court, such as Kansas City. Meanwhile, representatives of firms who might be accused of infringing the issued patent would be racing to the phone bank as well, ordering their lawyers to file a lawsuit seeking

<sup>8</sup> These issues have been explored in a series of papers by Suzanne Scotchmer and her co-authors. For an overview, see Suzanne Scotchmer, “Standing on the Shoulders of Giants: Cumulative Research and the Patent Law” (1991) 5 *Journal of Economic Perspectives* 29.

<sup>9</sup> The source of this information is Gloria K. Koenig, *Patent Invalidity: A Statistical and Substantive Analysis* (New York: Clark Boardman, 1980). These comparisons are based on 1,447 cases, and the statistical margins of error are small relative to the observed differences. The differences across circuits also remained consistently wide over the different years examined.

<sup>10</sup> For instance, in her careful compilation of patent cases at all levels of the Federal judicial system between 1953 and 1978, Gloria Koenig is only able to identify four Supreme Court decisions on the question of patentability. See Koenig, *Patent Invalidity*, 1980, pp.4–17.

to have the new patent declared invalid, but filing in a district known to be sceptical of patents—e.g., San Francisco. Such duelling lawsuits would usually be combined into a single action, heard in the district court in which the earliest filing was made. Often the fate of the case—and many millions of dollars in damages—would depend on which lawyer got an earlier date-time stamp on his filing documents.

In 1982, the US Congress decided to address this problem, which was perceived to be undermining the effectiveness of patent protection, and thereby threatening US technological and economic strength. It established a centralised appellate court for patent cases, the Court of Appeals for the Federal Circuit (CAFC). The change was presented in the congressional hearings as a benign one, bringing consistency to the chaotic world of patent litigation, and predictability to the enforcement of valid patent rights.<sup>11</sup> But it was clear from the beginning that advocates of stronger patent protection hoped that the new court would come down squarely on the side of patent holders.

And this is precisely what happened. Over the next decade, in case after case, the court significantly broadened and strengthened the rights of patent holders. One illustration is a comparison of the CAFC's rulings with those of the previous courts. The share of cases where a district court finding of patent infringement was upheld increased, as did the share of cases reversing an earlier finding that a patent was not entitled to damages. Whereas the circuit courts had affirmed 62 per cent of district court findings of patent infringement in the three decades before the creation of the CAFC, the CAFC in its first eight years affirmed 90 per cent of such decisions. On the other hand, when the district court had found that a patent was invalid or not infringed—thereby denying the patentee enforcement of the patent—the circuits had reversed only 12 per cent of the cases. In the first eight years of the Federal Circuit, 28 per cent of these cases were reversed.<sup>12</sup> Likewise, the CAFC greatly expanded patent holders' rights along a number of other dimensions, including making it easier to shut down a rival's business even before a patent is proven valid (through a preliminary injunction) and to extract significantly greater damages from infringers.

The consequences of the CAFC's strengthening of the system for enforcing patents have been exacerbated by changes in the behaviour of inventors and of the US patent office, which have led to a dramatic increase in the number of patent applications filed, and in the fraction of these applications that are successful in producing granted patents. Decisions of the CAFC encouraged more patent applications, for three distinct reasons. First, the CAFC made it clear that the realm of patentable subject-matter included technologies like software, business methods and certain kinds of biotechnology that hitherto were believed by many to be unpatentable. Secondly, the new court issued rulings on the standards of "novelty"<sup>13</sup> and "non-obviousness"<sup>14</sup> that made it easier for applicants to qualify for a patent. Finally, the improved enforceability of granted patents encouraged patent applications by making the patent right more economically valuable.<sup>15</sup> As a result, the rate of patent application in the United States began to increase shortly after the creation of the CAFC.

<sup>11</sup> Advisory Committee on Industrial Innovation, US Department of Commerce, *Final Report* (Washington: US Government Printing Office, 1979), p.152.

<sup>12</sup> These statistics are gleaned from Koenig, *Patent Invalidity*, 1980, and Robert P. Merges, *Patent Law and Policy: Cases and Materials* (Charlottesville, Virginia: Michie Co, 1992).

<sup>13</sup> *In re Lee* 277 F. 3d 1338 (Fed. Cir. 2002).

<sup>14</sup> *Stratoflex Inc v Aeroquip Corp* 713 F. 2d 1530, 1538 (Fed. Cir. 1983). The problems with the court's treatment of the CAFC's treatment of non-obviousness are discussed at length in Robert P. Merges, "Commercial Success and Patent Standards: Economic Perspectives on Innovation" (1988) 76 *California Law Review* 802.

<sup>15</sup> For instance, in decisions such as *Latria Corp v Cambridge Wire Cloth Co* 785 F. 2d 292 (Fed. Cir. 1986), the CAFC has made clear that infringers are expected as a matter of course to pay interest on damages from the date of the infringement to the date the judgment is entered against the firm and the increased ability to obtain injunctive relief: as Robert L. Harmon notes, "injunctive relief against an infringer is the norm [in decisions by the CAFC]": *Patents and the Federal Circuit*, 5th edn (Washington: Bureau of National Affairs, 2001), p.767.

Just as the tide of patent applications began to rise, Congress intervened once again to modify the patent system. Beginning in the early 1990s, it converted the US patent office (PTO) from an agency funded by tax revenues, which collected nominal fees for patent applications, into one funded by the fees it collects. Indeed, the patent office has become a “profit center” for the Government, collecting more in application fees than it costs to run the agency!

Again, this apparently merely administrative change has had important consequences. These changes introduced many strains on the US patent office. Chronically strained for resources, patent office officials have struggled to find qualified examiners, particularly in the “new” areas of software, financial methods and biotechnology where it had not previously had much expertise. As the CAFC opened the door to new kinds of patents, the few examiners in these new areas were overwhelmed with applications. Examiners of financial patents, for example, often had as little as a dozen hours to assess whether a patent application was truly novel.<sup>16</sup>

Moreover, retaining the few examiners skilled in the new technologies has been difficult for the office. Companies have been eager to hire these examiners, who are valuable not only for their knowledge of the PTO examination procedure in the new technology, but also for their understanding of what other patent applications are in process but not yet awarded. (US patent applications are often held confidential until time of award.) Moreover, corporations and law firms can offer many times over the approximately starting salaries that the Government offers examiners. Needless to say, this federal compensation is far less than market rates, especially for the examiners of specialised patent applications.<sup>17</sup>

Increasingly, the PTO views itself as an organisation whose mission is to serve patent applicants. And, of course, what applicants want is for their applications to be granted! Furthermore, the new orientation creates strong incentives for the PTO to process applications as quickly as possible, and at the lowest possible cost. As a result, there has been a widely perceived decline in the rigour with which the standards of novelty and non-obviousness are applied in reviewing patent applications. This, in turn, encourages more people to apply for dubious patents.

The weakening of examination standards and the increase in patent applications have led to a dramatic increase in the number of patents granted in the United States. The number of patents granted in the United States, which increased at less than 1 per cent per year from 1930 until 1982 (the year the CAFC was created), roughly tripled in the next two decades. Applications, too, have ballooned.

If this increase in patenting reflected an explosion in US inventiveness, it would be cause for celebration. But unfortunately it is clear that the rapid increase in the rate of patenting has been accompanied by a proliferation of patent awards of dubious merit. This disturbing trend is confirmed by international comparisons, which show that the number of US-origin inventions with confirmed worldwide significance grew in the 1990s at a rate less than half that of domestic US patent office grants.

The proliferation of patents on previously existing technologies would sow confusion and legal uncertainty under the best of circumstances, but it has occurred just as the CAFC has been making it easier to *enforce* the rights they convey. The predictable result has been a parallel increase in the number of lawsuits fought over patents. Burgeoning patent litigation is increasingly making lawyers rather than entrepreneurs and researchers the key players in competitive struggles. As the patent system becomes a distraction from innovation rather than a source of incentive, the engine of technological progress and economic growth begins to labour.

<sup>16</sup> Statement by David E. Martin, *Patents: Improving Quality and Curing Defects*, Subcommittee on Courts, the Internet, and Intellectual Property, Committee on the Judiciary, US House of Representatives, 107th Congress, 1st Session (Washington: US Government Printing Office, 2001), p.65.

<sup>17</sup> This is based on <http://www.uspto.gov/about/offices/> and <http://www3.uspto.gov/go/jars/sgs.html>, as well as interviews with current and past employees of the PTO.



The pernicious consequences of the evolving patent situation can be seen in two broad kinds of competitive and legal interactions. In one scenario, an established firm, frequently one whose competitive position and innovative activity are declining, realises it has a valuable stockpile of issued patents. This firm then approaches rivals, demanding that they take out licences to its patents. In many cases, they will target smaller firms, who do not have extensive financial resources to engage in protracted patent litigation.

Even if the target firm believes that it does not infringe, it may choose to settle rather than fight. The small firm may simply be unable to raise the capital needed to finance a protracted court battle or be unwilling to sacrifice investments in R & D and new facilities to finance the fight. Furthermore, there are substantial indirect costs associated with patent litigation. The pre-trial proceedings and trial are likely to require the alleged infringer to produce extensive documentation and its employees to make time-consuming depositions, and may generate unfavourable publicity. Its officers and directors may also be held individually liable, or be targeted in shareholder lawsuits if the stock price drops.

For numerous large companies—most notoriously, Digital Equipment, IBM, Texas Instruments and Wang Laboratories—these types of patent enforcement activities have become a line of business in their own right. These firms have established patent licensing units, which have frequently been successful in extracting licence agreements and/or past royalties from smaller rivals. For instance, Texas Instruments has in recent years netted close to one billion dollars annually from patent licences and settlements resulting from its general counsel's aggressive enforcement policy. In some years, revenue from these sources has exceeded its net income from actually selling products.<sup>18</sup>

In addition to being forced to pay royalties, small firms may reduce or alter their investment in R & D. Evidence from surveys and practitioner accounts suggest that the time and expense of intellectual property litigation is a major consideration when deciding whether to pursue an innovation, especially among smaller firms. Smaller firms tend to shy away from pursuing innovations in areas where large firms have established patent portfolios. Thus these types of enforcement activities by large firms may have the effect of suppressing innovation by younger, more vibrant concerns.

A second worrisome development has been the emergence of individual inventors who seek to “hold up” established firms in their industries. In many cases, these individuals have received a patent of dubious validity, often with overly broad claims. Yet established players have often chosen to settle such disputes, not wishing to risk the uncertainty associated with submitting a complex piece of intellectual property to trial.

Individual inventors will employ various strategies to make the battle more one-sided and drive the large firm to settle the suit. In many cases, the individual inventor will demand a jury trial, and then present himself as engaged in a “David v Goliath” dispute. He may choose a legal jurisdiction where the residents will be highly unsympathetic to the defendant. For instance, Jerome Lemelson, an individual inventor who claimed to have invented bar-coding technology, filed suits against Japanese and Korean firms in the Southern District of Texas. Similarly, individual inventors frequently threaten corporations with the promise that they will obtain a preliminary injunction, which will stop the defendant from using the patented technology even before the trial begins. While an established business might be reluctant to ask for such a drastic measure, lest the other party seek a similar ban against itself, individual inventors often feel no such compunction. Given the uncertainty of the trial process, the defendant firm frequently decides to settle with an individual inventor rather than fight.

In short, the “reforms” of the patent system have created a substantial “innovation tax” that afflicts some of America's most important and creative firms. And this is not just an American problem. Intellectual property protection is getting increasingly strong around the globe, in Europe, Asia and elsewhere. As it does, the danger of “overshooting,” or getting too strong a level of innovation, increases.

<sup>18</sup>The estimated royalties are from Kevin G. Rivette and David Kline, “Discovering New Value in Intellectual Property” (2000) 78 *Harvard Business Review* 54, and on Texas Instruments' securities filings.

## Implications

Finally, what are the implications of these changes for patent offices and policymakers worldwide? I will highlight three important aspects: the need for communication, the need for vigilance and the need to avoid unnecessary reform.

The first implication is the importance of communication. Just as when the Dutch banned patents in the 19th century, there is a lot of scepticism today about the role of intellectual property. We see this in many places: among open source programmers, among file sharing teenagers, among activists trying to make pharmaceuticals available for no cost to everyone, regardless of the patents protecting them.

There is a crucial need to convey to the public the case for intellectual property. We need to do a better job of communicating why innovation is so vitally important, why innovators need incentives, and that the experience of many nations over the centuries have shown that intellectual property protection can play a vital role in encouraging innovation.

Secondly, there is a need for vigilance, to make sure the intellectual property system continues to work well. The innovation process is, as discussed above, complex and uncertain. Patent examiners have to deal with a large and growing workload. Almost by definition, there will be bad patents. This is really inevitable!

But if, as has happened in the United States, there are too many bad patents, we can get into a vicious cycle. As the quality of patent examination has deteriorated, the incentive for submitting marginal patent applications has increased. A vicious cycle has emerged in which bad examination increases the application rate, which in turn overwhelms the examiners, reducing examination quality further and feeding on itself. Monitoring the quality of the patent system, and insuring that such problems are avoided, is a vital challenge for the patent community.

A third implication is to avoid undertaking reforms are not needed. A number of observers, grappling with the current dysfunction of the patent system with regard to particular technologies or industries, have concluded that the problems of encouraging invention in that particular setting require a patent policy that distinguishes among technologies. Software, business methods and certain aspects of biotechnology such as genetic sequences are all technologies for which the courts has expanded the range of patentable subject-matter beyond what was perceived to be patentable at the end of the 1970s. Each of these areas has subsequently been characterised by major controversies over patents that appear to be either invalid, overly broad or both, leading to concern that the patent system is inhibiting rather than encouraging invention in these areas. As a result, there have been numerous suggestions that inventions in these areas should not be patentable, or, if patent protection is to remain available, that different rules and procedures are necessary to adapt the institution of patents to these technologies.

I believe that trying to tailor the patent system to different technologies would be a mistake. The major problems that are perceived in these areas are, in essence, manifestations of the broader problems of the system as a whole. Hence the best solution is to fix the system as a whole. Opening the door to such tuning is likely to quickly lead to special pleading that will not serve the public interest.

The argument that new software and business methods are not really inventions is, at best, an irrelevant semantic one, and, at worst, a kind of techno-snobbery that is inconsistent with how technology evolves in general. What is the substantive difference between a “tinkerer” who comes up with some new kind of machine, and a business visionary who comes up with a new method of inventory management? In either case, the invention may be made with or without the benefit of “science” in any meaningful sense. To say that one is technological and one is not is pointless. The real question, from a policy perspective, is whether the incentive provided by patent protection is necessary to bring forth the invention, and/or to protect it sufficiently to justify the investment necessary to work the kinks out and develop the raw idea into a viable commercial product or process. As a general proposition, important new business methods are not dissimilar from other forms of innovation: they often require major investments of time and money in development;

there are methods other than patents (e.g. secrecy) that can sometimes be used to protect these investments, but there are also cases where, in the absence of patent protection, the risk of imitation would seriously undermine development incentives.

There is also a strong practical argument against differential treatment. Simply put, differential treatment is hard to implement, because as soon as patentees in a particular category get treatment that is different from everyone else, there will be an inevitable tendency for people to position themselves to get the most favourable treatment. An example can be seen in the PTO's efforts to deal with the outrage over business method patents by instituting a special internal review of all business method patents, on the grounds that the prior art is difficult to identify. In effect, patents that fall in a particular patent class are examined twice, to try to make sure that non-traditional prior art is not missed. The result has been a decline in applications in the targeted class, but a continued rise in applications related to business methods more broadly defined.

By and large, the presumption today is that everyone gets the same patent treatment. Without this presumption, there would be tremendous pressure by particular industries to get features in "their" patents that they found desirable.

# On Patenting Costs

**Walter G. Park**

*Department of Economics, American University, Washington, D.C.*

## Introduction

Previous research has focused on the importance of patent rights to innovative activity, but little attention has been given to whether patent protection is *affordable*. Several unanswered questions exist: How costly is it to acquire and enforce patent rights? Is it necessary to contain the costs of patenting? Do they disadvantage small firms or inventors from developing economies? Or are the costs of patenting too low from society's perspective? How should policymakers structure fees or influence patenting costs? What impacts do the costs of acquiring and enforcing patent rights have on innovative activity?

This article provides a short introduction to some of the issues pertaining to patenting costs. The next section discusses some trends in the costs of patenting and litigation. The third section reviews some economics research on patenting costs. The fourth section discusses policy options for influencing patenting and litigation costs. The final section suggests some areas where further research is desired.

## Trend in patenting costs

The costs of patenting vary with the way in which a patent is sought. An inventor can apply for a patent at a national patent office and/or a regional patent office, like the European Patent Office (EPO) or World Intellectual Property Organization (WIPO). If the inventor files an application with the EPO or WIPO, the filing would designate the countries or contracting states of the EPO or WIPO in which the inventor seeks a patent right.

WIPO itself does not grant patents, but rather provides a procedure for an international patent application—namely a Patent Cooperation Treaty (PCT) patent. A PCT application process includes an optional preliminary patent examination (to check whether the invention meets patentability criteria). After a PCT patent is issued, the applicant can then proceed to the *national phase* in which the national patent offices of the various countries designated in the PCT application review the application and determine whether to grant a patent. The national offices will build upon the preliminary examination and search reports of the PCT. The applicant pays the necessary fees associated with each country.<sup>1</sup>

Similarly, a patent application at the EPO also involves a two-step process—an entry phase and a national phase—except that the EPO does grant a patent. The EPO conducts a search and substantive examination of the patent, and if granted, the application moves on to the national phase, where the patent must be *validated* in each of the contracting states designated in the patent application within a specified timeframe. Validation takes place through the payment of national fees and the translation of the patent into an official language of the state, where required. Note that the EPO can itself be one of the designations in a PCT patent application.

<sup>1</sup> While there are added fees associated with a PCT patent—that is, the national phase fees in addition to the international (entry) phase fees—the PCT offers a number of advantages. For example, the international phase can last up to 18 months, providing applicants more time to assess the patentability of their invention or the desirability of a patent. The preliminary search and examination reports of the PCT also provide quality opinions on patentability and can therefore help reduce the work of the national patent offices.

Thus an inventor who seeks patent protection has various options. Suppose the inventor wishes to obtain patent protection in 10 countries, all of which are contracting states of the PCT and half of which are contracting states of the EPO. The inventor can file: (1) a separate application in each of the 10 countries; (2) one PCT application, which designates six states: the EPO (as a unit) and the five non-EPO countries; (3) an EPO application that designates five contracting states and a PCT application that designates five non-EPO states; or (4) an EPO application that designates some of the five EPO contracting states, a PCT application that designates some of the five non-EPO states, and the rest as separate national patent applications. Hence there are several possible permutations, each of which yields a different stream of patenting costs, depending on the mixture of national and regional fees.<sup>2</sup>

Table 1, below, provides a sample of the patent procurement and maintenance fees for a selection of countries, some developed and some developing, and for the EPO and WIPO. The unit of analysis here is a patent, 25 pages in length, including five pages of drawings and containing 15 claims.<sup>3</sup> The table shows the fees for the year 2010 and the growth rate of fees since 2000 in parentheses.<sup>4</sup> The fees are in real 2005 US dollars. The translation costs are from the perspective of English-speaking applicants or applicants whose country of residence has English as an official language. The maintenance fees (based on renewal fees) are for 20 years of protection, except in the case of the EPO and WIPO (to be explained below), and are not in present discounted value terms. Of course, many patent holders do not renew their patents for the full term of 20 years, but for purposes of comparison across countries, the full term is used. Agent fees refer to attorney fees and the like, and official fees incorporate application and examination fees (but not search fees).

Among patent procurement costs, the cost of agent representation is relatively the highest. Translation costs are next, except if the destination country shares an official language with the applicant country. Across countries, it is generally the case that larger economies (or offices that receive relatively the most patent applications) tend to have the higher official fees, such as the United States, Japan, EPO, and WIPO. Patent offices in developing economies, like Brazil, China, India and Russia, charge fairly low official fees. However, the variation in attorney fees across countries (or between developed and developing countries) is not as large as that in official fees. The cost of hiring a patent agent is quite high in developing countries as well; for example, it is more expensive to hire an agent in India than in Canada. As for translation costs, these costs correlate well with an index of linguistic similarity<sup>5</sup>—that is, translating an English document into another Indo-European language is cheaper than translating it into an Asian language—but of course translation costs also depend on the market for translation services.

Maintenance fees over the full term of a patent do not seem to vary by level of economic development. Maintenance fees are just as high in Brazil as they are in the Netherlands. Furthermore, the United States has the lowest maintenance fees among the countries listed in Table 1. Note the absence of maintenance fees with a PCT patent since WIPO does not grant patents. The EPO collects maintenance fees up to three years, after which an EPO patent holder pays renewal fees to the national offices designated in the EPO patent.<sup>6</sup> Berger surveys 254 companies that file EPO patents and estimates that 32 per cent of the cost of an EPO patent is due to national renewal fees.<sup>7</sup> Furthermore, validation costs account for about 23 to 27

<sup>2</sup> A survey by Roland Berger, “A Study on the Cost of Patenting”, prepared on behalf of the European Patent Office, (Munich: Roland Berger Market Research 2005) finds that most companies (74%) file first at their respective national patent offices, 18% file first at the EPO, and 8% first file a PCT patent. Also, most companies use the PCT-EPO route—that is, they designate the EPO as one of the states in their PCT application. Only 39% of their EPO applications were *directly* filed with the European Patent Office.

<sup>3</sup> Different assumptions can be made about the number of claims, but the ranking of costs across countries will not be affected too greatly. The source of the fee data is *Global IP Estimator*, at <http://www.globalipestimator.com> [Accessed October 11, 2010].

<sup>4</sup> For estimates of patenting costs in the early 1990s, see Samson Helfgott, “Patent Filing Costs around the World” (1993) 75 *Journal of the Patent and Trademark Office Society* 567; and Edwin F. Berrier Jr, “Global Patent Costs Must Be Reduced” (1996) 36(4) *IDEA: The Journal of Law and Technology* 473.

<sup>5</sup> See Walter G. Park, “Impact of the International Patent System on Productivity and Technology Diffusion” in Owen Lippert (ed.), *Competitive Strategies for the Protection of Intellectual Property* (Vancouver, B.C.: Fraser Institute, 1999), pp.47–72.

<sup>6</sup> The income from these national renewal fees are shared between the EPO and the national patent offices.

<sup>7</sup> Berger, “A Study on the Cost of Patenting”, 2005.

per cent of the cost of patenting in the EPO, and perhaps owing to these costs, the study finds that the average EPO patent is validated in seven contracting states, even if many more were actually designated in the patent.<sup>8</sup>

Table 1: Sample patenting costs by destination, year 2010<sup>9</sup>

Destination	Official fees	Agent fees	Translation fees*	Maintenance fees
Australia	\$707 (88.7%)	\$7,267 (209.0%)	\$0 (0.0%)	\$13,109 (68.7%)
Brazil	\$666 (85.7%)	\$6,576 (124.7%)	\$1,742 (134.0%)	\$19,366 (12.7%)
Canada	\$1,285 (69.0%)	\$5,281 (177.8%)	\$0 (0.0%)	\$11,113 (48.8%)
China	\$591 (112.1%)	\$5,059 (143.2%)	\$2,232 (83.2%)	\$10,957 -(21.2%)
France	\$945 (70.3%)	\$4,750 (102.0%)	\$2,623 (98.4%)	\$12,490 (24.8%)
Germany	\$644 (60.0%)	\$5,486 (151.6%)	\$3,623 (182.5%)	\$22,288 (22.8%)
India	\$463 (85.0%)	\$6,108 (191.3%)	\$0 (0.0%)	\$8,783 (74.8%)
Italy	\$715 (106.5%)	\$5,961 (169.7%)	\$3,220 (90.3%)	\$14,690 (5.9%)
Japan	\$2,776 (20.3%)	\$6,626 (73.9%)	\$5,487 (68.4%)	\$15,745 -(49.4%)
Mexico	\$1,003 (43.8%)	\$5,898 (168.6%)	\$2,040 (105.5%)	\$7,440 -(6.2%)
Netherlands	\$529 (17.4%)	\$2,984 (96.7%)	\$2,444 (61.1%)	\$19,206 (40.6%)
Republic of Korea	\$1,033 -(37.0%)	\$4,945 (77.3%)	\$2,389 (20.4%)	\$13,804 -(56.1%)
Russia	\$476 -(29.7%)	\$5,483 (153.9%)	\$2,617 (78.4%)	\$12,585 -(13.6%)
Spain	\$1,397 (42.7%)	\$7,848 (172.9%)	\$2,617 (72.8%)	\$11,825 -(15.0%)

<sup>8</sup> In the EPO, from 1999 to 2009, there had been designation fees up to seven countries and none beyond that. After April 2009, a new flat designation fee system at the EPO went into effect.

<sup>9</sup> All fees are in real 2005 US dollars and are for August 2010. Figures in parentheses are the percentage change in fees since August 2000. Official fees include filing, examination, granting, and prosecution fees. Agent fees include attorney fees and in-house and miscellaneous charges (e.g. for fax, courier services, drawings and certification).

Maintenance fees refer to patent renewal fees or annuities and are the non-discounted sum across 20 years of protection.

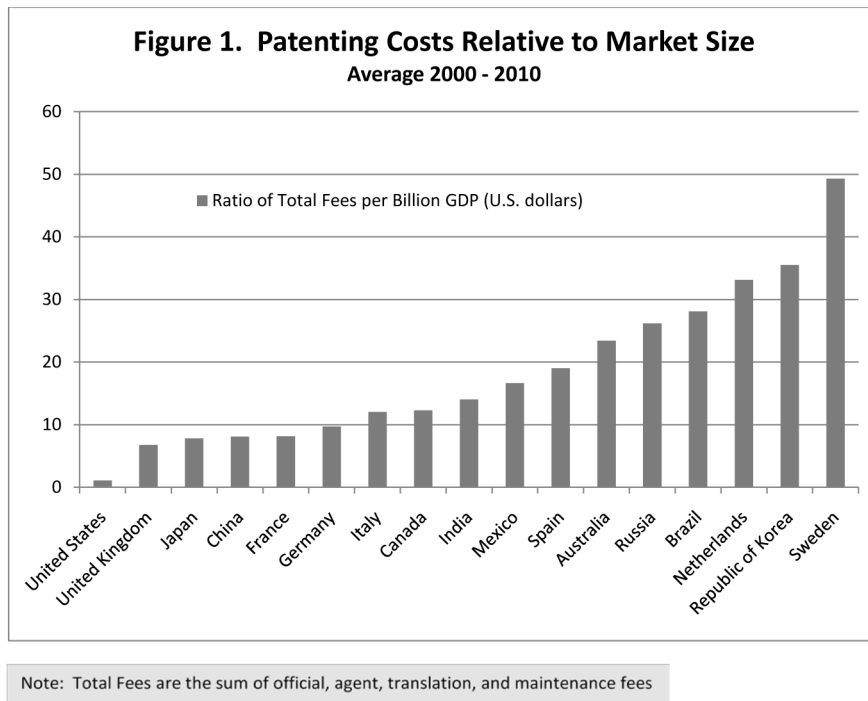
PCT Patent refers to the Patent Cooperation Treaty Patent administered by the World Intellectual Property Organization.

\* Translation costs are from the perspective of English-speaking applicants.

Source: <http://www.globalpestimator.com> [Accessed October 12, 2010]

Destination	Official fees	Agent fees	Translation fees*	Maintenance fees
Sweden	\$992 (2.7%)	\$4,954 (118.4%)	\$3,296 (88.3%)	\$12,269 (27.9%)
United Kingdom	\$394 (16.3%)	\$5,302 (124.2%)	\$0 (0.0%)	\$12,771 (30.7%)
United States	\$2,625 (22.5%)	\$7,059 (576.6%)	\$0 (0.0%)	\$7,394 (7.4%)
European Patent Office	\$4,750 (43.8%)	\$10,812 (153.8%)	\$1,368 (50.3%)	\$1,874 (39.2%)
WIPO PCT Patent	\$3,996 (101.3%)	\$2,806 (131.4%)	\$0 (0.0%)	\$0 (0.0%)

As Table 1 indicates, most of these fees have increased in real terms since 2000. Official fees fell only in Korea and Russia. Maintenance fees are lower in China, Korea, Japan, Russia and Spain. Agent and translation fees, where applicable, have all increased, especially attorney costs in the United States. Of course, it is important to gain some perspective over these fees, which have thus far been presented in absolute terms. Figure 1 shows patenting costs relative to gross domestic product (GDP) by country. GDP is used here as a proxy for market size and patenting costs are the sum of all the fees discussed so far. Seen from this perspective, patenting in the United States is relatively the cheapest; that is, the costs of patenting in the United States seem to be a bargain considering the market that a patent in the United States covers. Among the countries shown, patenting is relatively most expensive in Sweden and Korea. A better perspective of whether patenting is expensive or inexpensive could be provided if the cost of patenting were compared to the *value* of a patent. However, aside from the issues associated with obtaining measures of patent value, it is important to note that an inventor or patent applicant incurs the costs of patenting (other than renewal fees) up front *before* marketing the invention, commercialising it and earning sales or licensing income. At the time of application, inventors may largely have uncertain expectations of the value of the invention or the value of obtaining a patent right (as opposed to relying on trade secrecy). Furthermore, some inventors may be liquidity constrained and unable to borrow against future income from patents to pay for the upfront costs.



Yet another perspective on costs is that an inventor may file a patent application in not just one country but many, given that patent rights are territorial and must be registered in the countries in which protection and enforcement are sought. For example, if the same invention were patented in all of the countries and regions indicated in Table 1, the various fees would have to be aggregated, so that the cradle to grave costs of a patent could easily exceed \$400,000 (not in present discounted terms).<sup>10</sup>

The above discussion has focused on the acquisition and maintenance of patent rights. Patent holders also face the costs of enforcing, defending or challenging patent rights. These types of costs could easily dominate the costs of acquiring and renewing patent rights if litigation activity does arise. However, data on litigation and other enforcement activities are not widely available. Moreover, firms face uncertainty about the costs of litigation. In the Berger survey, 70 per cent of respondents could not provide estimates of the funds budgeted for handling litigation; 16 per cent of them allocated no funds for handling litigation; 9 per cent under €25,000; 4 per cent between €25,000 and 200,000; and 1 per cent allocated more than €200,000 for handling litigation in a given year.

Table 2, below, presents some statistics on litigation costs that are available.<sup>11</sup> These costs include attorney fees, technical investigations, expert witness fees and court costs, and vary by the complexity of the case and by the type of proceeding (jury trial or bench trial). Part A of the table shows the median cost of litigation for nine countries in 2006. Part B of the table provides somewhat more detail for the United States, in particular by the damages involved. For example, in 2009, the litigation costs of a case involving

<sup>10</sup> Berrier also calculated the lifetime costs of a patented invention in 52 countries and estimated this to be almost \$500,000 (in nominal, non-present discounted value terms): Berrier, "Global Patent Costs must be Reduced" (1996) 36(4) *IDEA: The Journal of Law and Technology* 473.

<sup>11</sup> The sources of data are American Intellectual Property Law Association, *Report of the Economic Survey* (Washington, D.C.: AIPLA, 2009); European Patent Office, *Assessment of the Impact of the European Patent Litigation Agreement (EPLA) on Litigation of European Patents* (Munich: EPO, 2006); and World Intellectual Property Organization Arbitration and Mediation Center, "A Cost Effective Alternative" [2010] *WIPO Magazine*, IP Litigation Costs, Special Edition, pp.19–22.



\$25 million or more in damages were almost \$6 million (in real 2005 dollars). For cases under \$1 million, it is not inconceivable that the costs of litigation could exceed the amount at stake in some situations. Thus patent procurement and maintenance costs are relatively small compared to the costs of enforcement.

Table 2: Cost of patent litigation<sup>12</sup>

	First instance	Appeal
<i>A. Median cost of patent litigation</i>		
China	\$0.15M	\$0.048M
France	\$0.10M – \$0.19M	
Germany	\$0.064M	\$0.09M
Italy	\$0.064M – \$0.19M	\$0.039M – \$0.09M
Japan	\$0.29M	\$0.097M
Netherlands	\$0.077M – \$0.26M	\$0.064M
Spain	\$0.13M	
United Kingdom	\$0.97M – \$1.93M	\$0.19M – \$1.93M
United States	\$3.9M	\$0.15M – \$0.24M
<i>B. Median cost of patent litigation by case</i>		
United States		
<i>By total damages involved</i>	<i>2001</i>	<i>2009</i>
Under \$1 million	\$0.55M	\$0.72M
Between \$1 million and \$25 million	\$1.65M	\$2.73M
Over \$25 million	\$3.31M	\$5.47M

## Economics of patenting costs

Thus far, the economic literature on patenting costs is very small. More research is needed on the determinants of fees and the impacts of fees on innovation, technology diffusion, and social welfare. This section provides a brief survey of work to date.<sup>13</sup>

One of the key issues is how patenting costs affect the demand for patents. Is, for example, the demand for patents price-elastic; that is, are patent filings sensitive to fees? On the one hand, patent demand could be price-inelastic if inventors regard patent protection as a necessity (for example, when marketing the invention or engaging in cross-licensing negotiations) and if few alternative mechanisms for protecting their inventions exist (e.g. inventor certificates or utility models). On the other hand, patent demand could be price sensitive if the costs of patenting are a large share of an inventor's budget (which may especially be a factor for small inventors or inventors that seek broad international coverage) and if inventors do have other options, such as keeping their inventions a trade secret or relying on first-mover advantages, reputation, and brand name recognition.

<sup>12</sup> The figures are in *millions* of real 2005 US dollars. Part A is for data in 2006 and Part B for data as shown.

Source: *WIPO Arbitration and Mediation Center* (2010), *AIPLA* (2009) and *EPO* (2006).

<sup>13</sup> For a more in-depth survey of the economics literature on patenting costs, see Gaetan de Rassenfosse and Bruno van Pottelsberghe de la Potterie, "The Role of Fees in Patent Systems: Theory and Evidence", Center for Economic Policy Research (CEPR) Discussion Paper No.7879 (2010); and Bruno van Pottelsberghe de la Potterie and François Didier, "The Cost Factor in Patent Systems" (2009) 9(4) *Journal of Industry, Competition, and Trade* 329.

Note that the issue of the price elasticity of demand for patents is also of interest to patent offices that depend on patent filings or renewals as a source of income. For example, if patent demand is not fee sensitive, increases in fees could help raise revenues; otherwise, a significant drop in patenting activity could lead to less revenue being generated.

The empirical studies to date vary by type of dataset and measure of patenting costs, among other things. Most of them find that the demand for patents is *price-inelastic*; for example, Adams et al.,<sup>14</sup> Landes and Posner<sup>15</sup> and Wilson<sup>16</sup> using US data and filing fees as their measure of patenting costs, Gallini et al.<sup>17</sup> and Park<sup>18</sup> using multi-country data and a measure of costs that includes filing, translation, and agent costs, and de Rassenfosse and van Pottelsberghe de la Potterie<sup>19</sup> using data on EPO contracting states and trilateral filings (i.e. at the EPO, US and Japanese patent offices) and a measure of patenting costs that include costs up to the grant (such as search and examination fees) but not agent and translation fees.

Park,<sup>20</sup> using a multi-country data set and a measure of costs that includes filing, translation, and agent fees, finds the demand for patents to be price-inelastic for the pooled sample, but when individual countries are examined, there are cases where the demand for patents is *price-elastic*; for example, in the United States, Denmark, and the Netherlands. Thus there is room for more investigation. The empirical studies thus far have not incorporated longer-term costs, such as renewal fees.<sup>21</sup> Patent filings may be more sensitive to a broader measure of patenting costs—one that incorporates expected maintenance costs, enforcement costs and the costs of broad international coverage (e.g. the costs of protecting a patent family). Furthermore, if patent demand were price-inelastic, the costs of patenting would not significantly account for trends in patenting, since a given percentage change in costs would be associated with a smaller percentage change in the volume of filings. However, Eaton et al.<sup>22</sup> have studied patenting at the EPO and estimate that more than 60 per cent of the growth in EPO filings during the 1990s can be attributed to the decline in EPO fees over this period.

Another key debate is a normative one: how should fees be set? Are relatively lower or higher fees better for innovation and welfare? Recall that patent applicants incur fees before realising the commercial value of their invention. Cornelli and Schankerman<sup>23</sup> provide an analysis of optimal renewal fees. Variations in renewal fees can be used to change the effective life of a patent. Uniform patent terms (i.e., say, terms that do not depend on patent value) are inefficient since they give too much incentive to patent inventions of low value and too little to those of high value. Cornelli and Schankerman show that renewal fees that increase with the life of the patent are optimal, as they help weed out the less valuable patents. The patent owners of less valuable innovations will self-select by not renewing. At the same time, this rising fee schedule does not dissuade inventors who are uncertain about the value of their innovations from applying

<sup>14</sup> Kay Adams, Douglas Kim, Frederick Joutz and Gus Mastrogianis, “Modeling and Forecasting U.S. Patent Application Filings” (1997) 19(5) *Journal of Policy Modeling* 491.

<sup>15</sup> William Landes and Richard Posner, “An Empirical Analysis of the Patent Court” (2004) 71(1) *University of Chicago Law Review* 111.

<sup>16</sup> Timothy K. Wilson, “Patent Demand—A Simple Path to Patent Reform” (2008) 2(5) *International In-House Counsel Journal* 806.

<sup>17</sup> Nancy Gallini, Jonathan Putnam and Andrew Tepperman, “Intellectual Property Rights and the Propensity to Patent” in Jon Putnam (ed.), *Intellectual Property Rights and Innovation in the Knowledge-Based Economy* (Ottawa: Industry Canada, 2005).

<sup>18</sup> Walter G. Park, “Technology Trade and NAFTA”, American University, Department of Economics, Working Paper (2007).

<sup>19</sup> Gaetan de Rassenfosse and Bruno van Pottelsberghe de la Potterie, “Per un Pugno di Dollari: A First Look at the Price Elasticity of Patents” (2007) 23(4) *Oxford Review of Economic Policy* 558; Gaetan de Rassenfosse and Bruno van Pottelsberghe de la Potterie, “On the Price Elasticity of Demand for Patents”, Center for Economic Policy Research (CEPR) Discussion Paper No. 7029 (2008).

<sup>20</sup> Park, “Impact of the International Patent System on Productivity and Technology Diffusion” in Lippert (ed.), *Competitive Strategies for the Protection of Intellectual Property*, 1999, pp.47–72.

<sup>21</sup> Dietmar Harhoff, Karin Hoisl, Bettina Reichl and Bruno van Pottelsberghe de la Potterie, “Patent Validation at the Country Level—The Role of Fees and Translation Costs” (2009) 38(9) *Research Policy* 1423 does examine how the costs of validation, translation, and renewal fees affect the propensity of EPO patent applicants to validate their EPO granted patents in the designated contracting states. The study finds that higher validation costs are associated with a decline in validation, controlling for other factors.

<sup>22</sup> Jonathan Eaton, Samuel Kortum and Joshua Lerner, “International Patenting and the European Patent Office: A Quantitative Assessment” in Organization for Economic Cooperation and Development, *Patent, Innovation, and Economic Performance* (Paris, France: 2004), pp.27–52.

<sup>23</sup> Francesca Cornelli and Mark Schankerman, “Patent Renewals and R&D Incentives” (1999) 30(2) *Rand Journal of Economics* 197.

for a patent. However, Marco and Prieger<sup>24</sup> and Wilson<sup>25</sup> discuss the disadvantages of low entry fees, namely that they create congestion. Too many patent applications increase patent pendency (i.e. the time to prosecute applications) and can reduce the quality of patent examination and increase the odds of invalid patents being issued. Delays could also reduce the returns to patent protection. Moreover, Gans et al.<sup>26</sup> argue that when patent offices must be self-financing, the structure of fees is biased towards raising front-end fees (such as application fees) and lowering back-end fees (such as renewal fees). Patent offices are more apt to raise revenues this way because lower renewal fees raise the expected profits to the patent holder and increase the attractiveness of seeking patents. Patent offices can then extract some of the increased expected profits by raising entry fees. But the inefficiency of this fee structure is it discourages the entry of good patents while prolonging the life of bad patents.

A third issue of interest is the determinants of patenting costs. As indicated in the previous section, enforcement costs are especially significant, but very little work on the drivers of litigation costs has been conducted. Towns<sup>27</sup> focuses on the increased use of contingency fees in patent litigation; that is, where lawyer fees are contingent upon the success of a court case and where the fees are a percentage of the award. Attorneys working on such a basis may have perverse incentives to increase the returns on their cases. Another culprit behind increased litigation costs is the role of jury trials in patent litigation. PricewaterhouseCoopers<sup>28</sup> found that in the 1980s, about 85 per cent of patent court cases were bench trials and 15 per cent jury trials; by the late 2000s, about half were bench trials and the other half jury trials.<sup>29</sup> The increased use of jury trials may be a contributing factor to the rise in patent litigation costs. The median award from a jury trial is over US\$10 million compared with less than US\$1 million for a bench trial. This gives parties greater incentives to spend more in jury trials. Patent holders, as plaintiffs, may have a preference for jury trials since their success rate in a jury trial (80 per cent) is higher than that in a bench trial (55 per cent). Furthermore, the decision of a jury trial is more likely to be appealed, which further raises court costs.

## Policy instruments

This section discusses some policy proposals for altering patenting costs, abstracting from the normative issue of whether costs should be lowered or raised. Each of the main categories of costs will be dealt with.

### *Official and maintenance fees*

Official fees depend on the operation of patent offices and on regulations, among other factors. Currently, in a number of patent offices, the revenues generated from fees exceed the costs of operation, yielding these offices surpluses. In many jurisdictions, these surpluses are diverted to the treasuries of national governments. Patentees end up subsidising the activities of other branches of government. Ending surplus diversion could either allow patent offices to reduce the fees for their services or use the surpluses to fund activities that directly benefit patentees, such as training and hiring examiners and investing in new technology. Likewise, the EPO and the national patent offices of the contracting states share the revenues

<sup>24</sup> Alan Marco and James Prieger, "Congestion Pricing for Patent Applications" (2009), at <http://ssrn.com/abstract=1443470> [Accessed October 12, 2010].

<sup>25</sup> Wilson, "Patent Demand—A Simple Path to Patent Reform" (2008) 2(5) *International In-House Counsel Journal* 806.

<sup>26</sup> Joshua Gans, Stephen King and Ryan Lampe, "Patent Renewal Fees and Self-Funding Patent Offices" (2004) 4(1) *Topics in Theoretical Economics* Article 6.

<sup>27</sup> William Towns, "U.S. Contingency Fees: A Level Playing Field?" [2010] *WIPO Magazine*, IP Litigation Costs, Special Edition, No.1, pp.3–5.

<sup>28</sup> PricewaterhouseCoopers, *Patent Litigation Study* (2009), at <http://www.pwc.com/us/en/forensic-services/publications/2009-patent-litigation-study.jhtml> [Accessed October 12, 2010].

<sup>29</sup> Russell L. Parr, *Intellectual Property Infringement Damages: A Litigation Support Handbook, 1998 Cumulative Supplement* (New York: Wiley & Sons, 1998) also finds that the share of jury trials increased since the 1980s.

from renewal fees (earned from EPO patents), and some of national patent offices' share could be diverted to national governments. Thus, increasing the EPO's share of the renewal fee revenues could be used to help reduce EPO procedural and renewal fees.

There are also formalities and regulations associated with patent applications that increase the costs of applications. The Patent Law Treaty of 2000 is designed to streamline those formality requirements, such as the certification and notarisation of signatures and documents like power of attorney, assignments and change of name and address. Regulations that restrict patent agents from representing their clients in different jurisdictions or having an address for service in different countries, or that mandate the use of representatives for filing translations and paying renewal fees also add to the cost of patent procurement. Rules that require patent search and examination to be repeated in different patent offices also add to the expense. Currently, mutual recognition of search and examination results meets with obstacles owing to differences in laws across countries. A compromise could be for patent offices to share a common search database or conduct concurrent search and examination, where examiners from different offices confer with one another or divide the workload. Neither step requires mutual recognition of search and examination results.

### *Patent agent fees*

Patent representation fees depend on the market for agents. There are occupational licensure rules that affect the supply of eligible agents. Other regulations make this market less competitive; for example, rules which restrict representation in different patent jurisdictions. Mutual recognition of the qualifications of legal representation is a larger international trade-in-services issue. One small step would be to permit extensive legal representation for routine procedures; for example, filing patent applications and translations, validating patents and paying renewal fees. Another measure to reduce agent fees is to minimise the need to revise patent applications. Clients are charged for the rewriting of applications. This requires that applications be better prepared; for example, to eliminate vague claims or claims that are too broad. To assist applicants, the patent offices could provide guidelines and materials to help inventors assemble their own patent applications. Applicants would then require less attorney time to fine tune their applications.

### *Translation costs*

Translation costs are a large share of the cost of patent procurement. However, patent translations are seldom considered, and even when they are, they are usually consulted many years after filing. According to AIPLA/CIPA,<sup>30</sup> the consultation rate of translations is less than 2 per cent in many regions (that is, the number of requests for inspection of translations as a percentage of the stock of translations that were filed). This suggests that it is effectively the language of the examination that is more important to the interpretation of patent rights than the language into which the patent is finally translated. Moreover, in the EPO, deliberation before it has to be in one of the three official languages (English, French and German). Hence translations into non-official EPO languages are not utilised as far as examination goes.

One proposal to reduce translation costs would be to allow abbreviated translations; for example, the translation of an enhanced abstract of the patent and its claims, and then a translation of the patent specifications prior to enforcement—or a translation on demand by a third party.<sup>31</sup>

For EPO patents, where the translation costs are quite burdensome, it would be helpful to require translation only if the application is not in one of the three official EPO languages. Indeed, the recent London Agreement of 2000 allows EPC contracting states to the agreement to waive the requirement for

<sup>30</sup> American Intellectual Property Law Association and Chartered Institute of Patent Agents, *International Symposium on Reducing Patent Costs, Proceedings Vol. 1* (London: CIPA, 1997).

<sup>31</sup> This was one of the original Community Patent Convention proposals.

translations of European patents if (1) a state has an official language in common with one of the official languages of the EPO, or (2) a state does not have an official language in common with one of the official languages of the EPO but:

“the European patent has been granted in the official language of the EPO prescribed by that State, or translated into that language ... These states may however require that a translation of the claims into one of their official languages be supplied.”

### *Litigation costs*

The following proposals pertain to containing the costs of litigation by limiting jury trials, introducing specialised patent courts, resorting to alternative dispute resolution mechanisms and reforming procedures governing the determination of damages.

In the United States, the case of *Markman v Westview Instruments* (1996) set a precedent which limits the role of juries. Thus, patent litigators have the option to request a *Markman* claim construction hearing.<sup>32</sup> The idea behind this is that a patent infringement case involves two steps: first, the construction of a claim; and secondly, the determination of whether some product or process infringes that claim. The significance of the *Markman* case is that this first step—claim construction—is a matter of law (for a judge to decide) and not a matter of fact (for a jury to decide), and determining what the claims mean can virtually decide a case. Hence patent cases may be increasingly resolved through pre-trial motions by judges so as to obviate the need for juries.

A *Markman* hearing may also mean less need for discovery. Claim construction is based on intrinsic evidence (i.e. the claims themselves, patent specification, prior art, and prosecution history), rather than extrinsic evidence (expert testimony, testimony of patentees, third parties, and secondary documents). Extrinsic evidence (and discovery to obtain them) is needed when the meaning of claims cannot be construed by intrinsic evidence alone. Thus the adoption of *Markman* type hearings in other countries may be a useful means for reducing patent litigation costs.

The establishment of specialised patent courts might also help reduce court costs on the grounds that patent trials are complex. For example, in a *Markman* hearing, a judge must rule on the claim construction of a technical document. But instead of a trial, parties to a case could seek alternative dispute resolution (ADR). In the United States, non-profit organisations and court-sponsored programmes exist to mediate or arbitrate patent disputes. The International Chamber of Commerce (ICC) and WIPO provide ADR forums. Litigation costs can also be contained with a practice known as case management. The idea is to expedite adjudication with predetermined timetables. Canada introduced case management procedures in 1998 (through new Federal Court of Canada rules) which set strict time-limits, compulsory pre-trial conferences and compulsory settlement discussions.

Finally, in some court systems, liability and damages are determined in the same trial. This can be costly because the party that brings suit undertakes heavy expense to prepare an analysis of damages even before infringement, if any, is found. Thus, a cost saving procedural reform would be to separate the determination of infringement and the awarding of damages.

### **Concluding remarks**

Further research is needed in order to better understand the determinants of patenting costs, the effects that costs have on innovation and technology transfer, the optimal policy towards patenting costs, and the measures that reduce enforcement costs. To better understand the burden of patenting costs, it would be

<sup>32</sup> For details see Chris R. Ottenweller, “A Quick Strike at Litigation Costs”, *IP Magazine*, July 1997.

useful to relate them to the value of patent rights and the size of the relevant market. It would be useful to see how this burden affects the entry of small inventors into an industry or how it affects the ability of firms in developing countries to access markets in developed countries.

Further analysis could also be done on the effects of litigation costs on the efficacy of patent protection. High litigation costs may result in greater patent infringement if infringers (or imitators) do not find the patent owner's threat of going to court credible when enforcement costs are high and the probability that the patent owner will prevail is not certain. Or high litigation costs may discourage challenges of patent validity and allow patent owners to exercise greater market power.

More information is also needed on the operation of patent offices, their objective functions, and how they administratively set fees. As pointed out earlier, patent applicants have various ways in which to apply for global patent protection—some more costly than others. What is not well understood is how applicants choose their routes for global patent protection. Total cost is a factor, but not the only one, that determines their decisions.

Lastly, much more progress can be made in patenting cost research if more comprehensive data were available, especially longer time series or historical data across industries and countries.

# Intellectual Property Enforcement in Smaller UK Firms: Findings from a Survey in 2009–2010

**Christine Greenhalgh**

*St Peter's College and Oxford Intellectual Property Research Centre*

**Robert Pitkethly**

*St Peter's College and Oxford Intellectual Property Research Centre*

**Mark Rogers\***

*Harris Manchester College, Oxford University and Economics and Strategy Group, Aston University*

☞ Enforcement; Intellectual property; Small and medium-sized enterprises

## Introduction

The value of intellectual property assets (IP) depends critically on firms being able to enforce their rights at a reasonably low cost. However in an extensive review of the literature on IP enforcement in the United Kingdom, Weatherall et al.<sup>1</sup> concluded:

“We still know relatively little about the extent of infringement and use of enforcement procedures ... Statistically sound studies ... that attempt to quantify the amount and seriousness of infringement ... have not been performed in the UK....”

In 2009 the Intellectual Property Institute was commissioned by the Strategic Advisory Board for Intellectual Property Policy to undertake this research, aiming to begin to bridge this gap in primary research for the United Kingdom on the subject of IP infringement and enforcement.<sup>2</sup> This study has its focus on smaller firms, following earlier research commissioned by the UK IP Office, which showed that only a small sub-set of smaller firms are patent or trade mark active.<sup>3</sup> In an earlier study using US patent data, Lanjouw and Schankerman<sup>4</sup> had concluded that smaller patentees are at a significant disadvantage as they experience

\*The authors are grateful to the Strategic Advisory Board for IP Policy for their financial support and to the former director of the Intellectual Property Institute, Paul Leonard, for administration of the research contract. The full report from which these findings are drawn has two further co-authors, Jeremy Phillips and Joshua Tomalin, and we would like to acknowledge their considerable contributions to the research. This paper was presented at the 5th Annual Conference of the European Policy for Intellectual Property group (EPIP), Maastricht, September 2010.

<sup>1</sup> K. Weatherall, E. Webster and L. Bently, *IP Enforcement in the UK and Beyond: A Literature Review*, SABIP Report EC001 (May 2009).

<sup>2</sup> The full report from which the findings in this paper are taken is C. Greenhalgh, J. Phillips, R. Pitkethly, M. Rogers and J. Tomalin, *Intellectual Property Enforcement in Smaller UK Firms — A Report for the Strategic Advisory Board for Intellectual Property Policy*, UK Intellectual Property Office (2010). We are grateful to the UK Intellectual Property Office for permission to report selected findings here.

<sup>3</sup> See M. Rogers, C. Helmers and C. Greenhalgh, “An Analysis of the Characteristics of Small and Medium Enterprises that Use Intellectual Property”, Report for UK Intellectual Property Office (October 2007), at <http://users.ox.ac.uk/~manc0346/research.html> [Accessed October 12, 2010]; M. Rogers, C. Greenhalgh and C. Helmers, “The Association between the Use of IP by UK SMEs in 2001 and Subsequent Performance in 2002 to 2004”, Report for UK Intellectual Property Office (2007), at <http://users.ox.ac.uk/~manc0346/research.html> [Accessed October 12, 2010].

<sup>4</sup> J.O. Lanjouw and M. Schankerman, “Protecting Intellectual Property Rights: Are Small Firms Handicapped?” (2004) 47(1) *Journal of Law and Economics* 45.

a higher litigation risk, with no compensating factors such as more rapid resolution post-suit. This raises the question as to whether smaller firms are dissuaded from using IP systems because of difficulties in enforcing their rights, particularly against larger firms.

Investigating the role of IP infringement and enforcement is a complex issue since it involves elements of law, management and economics. There are added difficulties when we come to investigating smaller firms (defined as micro firms or small and medium sized enterprises (SMEs)). There are very large numbers of SMEs and micro firms in the UK economy, many of which have relatively short life spans. Understanding how IP interacts with the performance of these firms is a major challenge. Some firms will use IP directly, while others will be indirectly affected by the IP of others. These challenges mean that the project design needed to be broad enough to discover information on the prevalence of disputes across large numbers of firms, yet sufficiently in-depth to investigate specific legal and management issues.

### **The sample design**

For this project we used as our sampling base all micro firms and SMEs in the United Kingdom. There were around 1.9 million active micro firms (with fewer than 10 employees) and 0.2 million active SMEs in the United Kingdom in recent years. From our earlier study we could identify which of these firms had recently been IP active in patents and trade marks, as we had searched and matched information from the UK and European IP records for all these firms. Information on copyright active firms is much more limited. Since copyright protection is automatic, with no registration required, we cannot identify copyright intensive firms from official databases.

Policymakers are interested in both IP active firms and non-IP active firms, so the survey aimed to cover both of these groups. Clearly, there are a vast number of non-IP active firms and it is costly to survey even a small proportion. Nevertheless, by sampling some of these firms we can gain insights into the prevalence of disputes for such firms and also whether such firms choose not to use IP owing to high enforcement costs. There is also considerable interest in the IP active firms. Such firms have obviously made a decision to use the IP system and there is evidence that such firms survive longer and grow faster than others.<sup>5</sup> These issues mean that the survey design was multifaceted, since it had to consider both micro firms and SMEs, and both IP active and non-IP active firms. In addition, the survey had to focus on firms that had been trading for a period of years (so that there was a greater likelihood that they had been involved in an IP dispute). In the light of this the following design was used.

Five different target groups were identified for the sample design:

1. patentees;
2. trade markers;
3. non-patentees (from patent intensive industries);
4. non-trade markers (from trade mark intensive industries);
5. firms in copyright/design intensive industries.

<sup>5</sup> C. Helmers and M. Rogers, "Innovation and the Survival of New Firms across British Regions", Oxford University Working Paper (December, 2008), at <http://www.economics.ox.ac.uk/index.php/staff/papers/helmerts> [Accessed October 12, 2010]; C. Helmers and M. Rogers, "Does Patenting Help High-Tech Start-Ups?", IPRIA Working Paper No.6 (2009), at <http://www.ipria.org/publications/wp/wp2009.cfm> [Accessed October 12, 2010].



It was also decided that firms had to be alive in 2002 and still trading in 2003 or 2004 in order to be included in the sample frame.<sup>6</sup> This gave a five or more year period in which a dispute could have occurred. For (1) to (4) it was agreed to survey a minimum of 300 firms in each group. For (5), copyright/design intensive industries, where we do not have information on which firms are IP-active, the target sample was a minimum of 600 overall.<sup>7</sup>

## The survey results

### Response rates

The survey involved both an online survey and a phone survey. In total, 1,858 micro firms and SMEs were contacted. The online survey received 170 respondents. This represents a 9.1 per cent response rate, which is normal for this type of research. The online responses were augmented by a phone call survey that only asked whether the firm had “experienced an IP dispute in the last five years”. There were 225 responses to the phone call survey. The combined response rate for the online and phone surveys was 20.1 per cent. Further details of the response rates for different sections of the sample are given in Table 1.

Table 1: Sample sizes and response rates<sup>8</sup>

Sample	Survey size	Survey response	Response rate	Answered dispute question in survey	Telephone response on dispute	Total responses for dispute question	Response rate to dispute question
Patentees	318	43	13.5%	36	43	79	24.8%
Trade markers	326	33	10.1%	31	57	88	27.0%
Non-patentee: SME	153	9	5.9%	8	25	33	21.6%
Non-patentee: Micro	95	3	3.2%	3	24	27	28.4%
Non-patentee: SIC24+73*	66	7	10.6%	5	9	14	21.2%
Non-trade marker: SME	169	7	4.1%	4	6	10	5.9%
Non-trade marker: Micro	126	4	3.2%	4	7	11	8.7%
Creative industry: SME	302	39	12.9%	37	31	68	22.5%
Creative industry: Micro	303	25	8.3%	20	23	43	14.2%
Total	1858	170	9.1%	148	225	373	20.1%

From the online survey the vast majority (80 to 87.5 per cent) of smaller firms (SME or micro firms) rate IP rights as important (or very important, or essential) to their business. This is true for firms in different sectors that predominantly use patents, or trade marks, or copyright and designs. Even so, only a minority of firms (25 per cent) had some kind of insurance to help them meet the costs of any IP disputes.

<sup>6</sup>Information on all active (i.e. trading) firms was taken from FAME October 2005 (Update 196). This contains all information at Companies House shortly before this date (i.e. financial year 2003 or 2004). Since the exit rate for smaller firms is high this decision means that substantial numbers of such firms may have ceased to trade by November 2009, which is when we contacted firms for the survey. In general, although we attempted to contact firms that had ceased to trade, our survey contains firms that were alive from 2002 to 2009.

<sup>7</sup>For each of the groups the initial sample of firms taken from the population was considerably larger in order to achieve the target sample size when addresses and contact details had been found. “Copyright/design intensive industries” were defined as the “creative industries” as specified in the Department of Culture Media and Sport report, *Creative Industries Economic Estimates, Statistical Bulletin* (January 2009). Full details of our samples are given in Greenhalgh et al., “Intellectual Property Enforcement in Smaller UK Firms”, 2010, Appendix 8.

<sup>8</sup>Source: Greenhalgh et al. (2010), Table 1. \*SICs 24: Chemicals and 73: R & D Services were targeted to ensure sufficient representation of these very patent intensive sectors.

### *Experience of infringement*

In this research project an IP dispute is defined as any infringement, whether or not this ended in formal legal proceedings. Across all survey responses around 24 per cent of firms had been involved in an IP dispute (see Table 2). The prevalence of IP disputes appears to be roughly the same for SMEs and micro firms (see Table 3). Even so, the prevalence of IP disputes varied between the different groups of firms that were being sampled. For patentees, our survey found around 40 per cent of firms had experienced a dispute in the last five years. For trade mark users, we found around 34 per cent had experienced a dispute. In contrast, firms that did not use patents or trade marks were much less likely to have a dispute—this proportion was around 7 per cent and 5 per cent respectively of such firms in patent and trade mark intensive industries. In the creative industries, which are more likely to use copyright or design rights, we found that almost 20 per cent have experienced an IP dispute within the last five years. It was more common for firms to be complainants about an infringement than to be the defendant, accused of infringing. Firms were asked whether they thought IP disputes were going to become less likely or more likely in the future. Around 50 per cent of firms thought there would be “no change”, with 33 per cent responding that disputes would become “more likely” and 17 per cent either thinking “less likely” or undecided.

Table 2: Responses to “has your firm been involved in an IP dispute?”<sup>9</sup>

Group	No dispute	Yes dispute	Total	95% Confidence Intervals for % with dispute	
Patentees	49	32	81		
%	60.5	39.5	100	28.8	50.2
Non-patentees	63	5	68		
%	92.7	7.4	100	1.1	13.6
Trade markers	59	31	90		
%	65.6	34.4	100	24.6	44.3
Non-trade markers	18	1	19		
%	94.7	5.3	100	0.00	15.6
Creative industries	90	21	111		
%	81.1	18.9	100	11.6	26.2
Total	279	90	369		
%	75.6	24.4	100	20.0	28.8

Table 3: Experience of IP disputes by firm size<sup>10</sup>

Firm size	No dispute	Yes dispute	Total
Micro firms	132	45	177
%	74.6	25.4	100
SME (Small and medium-sized enterprises)	147	45	192
%	76.6	23.4	100
Total	279	90	369
%	75.6	24.4	100

<sup>9</sup> Source: Greenhalgh et al. (2010), Table 2. These data combine the responses from the online and telephone surveys.

<sup>10</sup> Source: Greenhalgh et al (2010), Table 3.

*Size of the parties in dispute*

Details about the disputes were only provided by respondents to the online survey. Respondents to the online survey gave various amounts of information on 46 IP disputes, with details of the other firm's size being reported in 44 replies. As can be seen in Table 4, the disputes were almost equally likely to be with firms of a similar size or smaller as to involve larger firms. The patent disputes showed a small excess with larger firms, whereas for trade mark and copyright/design disputes there was a prevalence of disputes with same size or smaller firms. However, given the very small sample sizes in each group, it is hard to make firm conclusions on this point about differences by type of IP.

Table 4 : Size of other party in disputes<sup>11</sup>

Size of other party	Patent dispute	Trade mark dispute	Copyright dispute
Much smaller	1	2	0
%	5.6	13.3	0.0
Smaller	2	5	5
%	11.1	33.3	45.5
Same size	5	2	2
%	27.8	13.3	18.2
Larger	5	2	4
%	27.8	13.3	36.4
Much larger	5	4	0
%	27.8	26.7	0.0
No. of disputes	18	15	11
%	100	100	100

*Resolution of disputes*

How were these IP disputes resolved? Forty-three respondents gave details of the methods used to try to achieve a resolution. An exchange of letters between solicitors was used in 37 cases, by far the most commonly attempted solution (86 per cent). In 15 out of these 37 instances the dispute was thereby resolved. Other methods of resolving IP disputes were varied and tended to polarise between direct negotiations between firms and full-blown high court proceedings. Thus high level negotiation between firms was used in 15 cases (35 per cent), but the use of mediation, requests to the UK IP Office, and cases in the small claims or county courts were extremely rare. In total, six of the disputes (14 per cent) ended up in the high court.

This phenomenon of relatively low litigation rates, particularly in larger firms, has also been highlighted for the United States by Lanjouw and Schankerman.<sup>12</sup> They argue that firms with a portfolio of patents have the option to settle by trading their IP assets. Another factor that encourages private resolution of disputes by large firms is that of frequent interaction between the same companies in concentrated markets, a feature known to induce the development of co-operative behaviour.

<sup>11</sup> Source: Greenhalgh et al. (2010), Table 6. Percentages here are by column.

<sup>12</sup> Lanjouw and Schankerman, "Protecting Intellectual Property Rights: Are Small Firms Handicapped?" (2004) 47(1) *Journal of Law and Economics* 45.

Table 5: Methods of dealing with IP disputes<sup>13</sup>

	High level negotiation	Exchange of letters	Request UKIPO	Mediation	Small claims	Patent county court	Patent high court
Patent disputes:							
Total responses	16	16	16	16	16	16	16
Number of cases used in	7	15	1	0	0	0	5
Of these, ended dispute in	3	5	0				4
Success rate of method	42.9%	33.3%	0	n/a	n/a	n/a	80.0%
Trade mark disputes:							
Total responses	15	15	15	15	15	15	15
Number of cases used in	4	14	3	1	1	1	1
Of these, ended dispute in	1	5	1	1	0	1	1
Success rate of method	25.0%	35.7%	33.3%	100%	0%	100%	100%
Copyright/design disputes:							
Total responses	12	12	12	12	11	11	12
Number of cases used in	4	8	0	0	0	0	0
Of these, ended dispute in	2	5					
Success rate of method	50.0%	62.5%	n/a	n/a	n/a	n/a	n/a

Table 6: Satisfaction of outcome by party in dispute<sup>14</sup>

	Complainant	Defendant	Total
Dispute is ongoing	6	4	10
%	18.2	36.4	22.7
Not satisfied with outcome	7	0	7
%	21.2	0	15.9
Yes satisfied with outcome	20	7	27
%	60.6	63.6	61.4
Total	33	11	44
	100	100	100

Around 23 per cent of the disputes had yet to reach a resolution. For the more than three-quarters of disputes that had been resolved there was an overwhelming preponderance of satisfaction with the outcome (see Table 6). Thus, when firms were asked whether they were “satisfied” with the outcome of their dispute, around 80 per cent of those whose disputes had reached a conclusion said “yes”.

The survey data also allow us to investigate whether smaller firms in disputes with larger firms are unsatisfied with the outcome. For the 34 disputes in Table 6 that have been resolved, 18 of these were with firms larger than respondent’s firm, and 16 were with same size or smaller firms. The answer to the

<sup>13</sup> Source: Greenhalgh et al. (2010), Tables 7, 12 and 16.

<sup>14</sup> Source: Greenhalgh et al. (2010), Table 18.

satisfaction question for each of these two groups was roughly equal (with around 80 per cent responding “yes”). Hence, there is no direct statistical evidence to support the idea that smaller firms struggle to obtain a satisfactory outcome in IP disputes with larger firms.

## The interviews and case studies

From the above evidence, the overall impression gained is one of a relatively trouble-free system of IP acquisition and enforcement, but with this activity being confined to a minority of the large population of smaller firms. In order to check this view we can turn to the personal reports of individuals, since the online survey research was complemented by a series of interviews with a selection of managers. These interviewees were people who had replied to one of the surveys and ticked the box indicating that they would be amenable to a follow-up interview.

For these interviews we began with a structured series of questions, but later in the conversation we also permitted the interviewees to comment freely on their most pressing concerns. Thus, as well as providing more detailed comment and examples of the experiences of SMEs in enforcing their IPRs, the interviews also highlighted a number of issues that concerned SMEs, whichever form of IPR they were primarily interested in using. Given that most of these respondents were self-selected, we must take note of the fact that this group could be biased towards those with a problem to report or an axe to grind about the IP system in general. Certainly the overall impression drawn from this part of the survey was much less positive concerning the experiences of smaller firms in enforcement of their IP rights.

The most common theme cited was that of the high financial costs of IP litigation and, in particular, the costs of professional advice. Costs appeared to be a significant deterrent to all but the most determined SMEs when considering taking cases into court. A few interviewees said that they had effectively stopped enforcing their IPRs because of the costs involved.

The indirect costs of management time, and the diversion of other resources from the core business of any firm that becomes involved in an extended IP related dispute, were also seen as considerable, as these can seriously damage the development of the firm quite apart from any direct financial costs. Damage to reputation and the commercial consequences of failure are added risks of undertaking high stakes litigation.

Respondents tended to dismiss insurance as either too expensive—just like the costs it was intended to mitigate—or as something they were unaware of. It does not appear to be a panacea to cure the ills of IP litigation by SMEs. These responses were reflected in the online survey, which found that three-quarters of respondents did not have litigation insurance. Of these uninsured firms, 33 per cent said that it was “too costly” while 29 per cent were unaware of the possibility of getting such insurance.

The case study research focused on infringement in the United Kingdom. However, even if this was often resolved fairly simply with just an exchange of letters, the UK infringement could be the tip of an iceberg. Attempting to identify and prevent infringement overseas was even more costly than enforcement using UK litigation and thus often beyond the resources of SMEs, even when they had valid but infringed IPRs in the countries concerned.

Most of the “solutions” to the problems SMEs faced in dealing with IP litigation revolved around acquiring the resources needed to outlast the firm’s opponents and thus counter the prevailing opinion that the larger party would usually win by turning any litigation into a war of attrition that a smaller SME could not win. Some interviewees speculated on possible forms of government support. These primarily comprised either hopes for some form of legal aid for SMEs or for support to improve systems of communication and advice for SMEs regarding IPRs.

Major IP litigation that ends up in court is very rare. Yet the survey data shows that some degree of dispute regarding IP is relatively common. Many of the SMEs interviewed found that despite the cost of obtaining the IPR or advice about it, they could protect their IP simply and at low cost. At the other extreme there were firms for which obtaining IPRs had been expensive and who faced a whirlpool of litigation

costs when enforcing them, particularly against larger or overseas competitors, in addition to the risk of losing the IPRs and even the company itself. This might be expected but what was more surprising was that there was little evidence of a middle way. IP enforcement seems to be either a small scale, easily resolved dispute or an expensive, time-consuming minefield.

### **Prospects for improving IP enforcement options for smaller firms**

Clearly for the firm the value of an IP right depends on having the ability to enforce it. Taking the wider view of the economy and society, IP rights systems aim to generate incentives to innovate and create new products, services and creative works. This incentive structure will be undermined if IP rights cannot be defended. In the extreme, a system with high costs and/or no valid protection would lead to less innovation and to a slower rate of diffusion of innovation than one where rights can be enforced at reasonable cost. The slowdown in innovation would arise as firms would strive to use trade secrecy as their main route to protection of ideas, so the information transmission arising from the published documentation for patents would be lost.

While private firms are expected to take action to maximise their profits, the cost benefit analysis becomes more complex if steps are taken to include government subsidy directed to the enforcement of IPRs. Policymakers must try to achieve the right balance as, despite the need to ensure enforceability, there must also be a limit to how many resources are devoted to the system of IP enforcement. For example in seeking to balance the ability to enforce IP rights across firms of different size, there is a need to design policy that does not add too much to the social costs of enforcement in total. If too many costs to government are incurred as a result of making grants to SMEs to pay legal fees, then society may be supporting an excess of litigation. A better policy could be to discover cheaper enforcement procedures that are attractive to smaller firms.

Our surveys and interviews have shown that SME and micro firms use a variety of actions to identify infringement and implement the enforcement of their IP rights. We can classify these actions into three types:

1. *Monitoring and early prevention* of infringement—undertaken by firms searching for products and activities likely to be infringing of their IP rights and acting quickly to warn off potential infringers.  
Once infringement was detected then the routes taken were:
2. *Civil and private actions* short of legal proceedings—including solicitors' letters, mediation, alternative dispute resolution (ADR) and arbitration.
3. *Full-blown legal proceedings*—through the various courts, as described above.

We found that the prevalent methods were (1) with (2), while route (3) was relatively rare. On one interpretation this looks as though firms were minimising costs, but within route (2), why were so many firms acting through the exchange of letters by solicitors, but not requesting opinions from the UK IP Office or using its mediation services? Equally for the few firms that took route (3), why were so few acting through local courts and virtually all concentrated into the Patents High Court?

There have been earlier proposals<sup>15</sup> to make mediation or arbitration compulsory for IP disputes, including one by IPAC,<sup>16</sup> but perhaps simply widening the advertising of mediation and opinion services is a better policy? At least one interviewee when discussing trade marks suggested there should be a way to obtain

<sup>15</sup> Noted in Weatherall et al., "IP Enforcement in the UK and Beyond", SABIP Report EC001, May 2009.

<sup>16</sup> Intellectual Property Advisory Committee (IPAC), "The Enforcement of Patent Rights" (November 2003).

an initial assessment from the UK IP Office of the merits of pursuing litigation, but the present system of opinions is reserved for patent cases. This restriction might be looked at again in the context of widening the take up of such services.

Our study asked firms about their use of litigation insurance schemes. Only a minority of firms had such insurance and the general line of reasoning among those that did not was that it was too expensive. Lanjouw and Schankerman have suggested the need for better litigation risk assessment as a means of revitalising the IP litigation insurance market, which they argue is unprofitable for insurance companies owing to the use of prices related to average risk and not related to company characteristics. However, given that their empirical analysis for the United States found that firms with smaller patent portfolios were more likely to be involved in litigation, this higher risk would attract higher premiums to smaller firms with few patents.

Would there be a role for subsidies to litigation insurance? While lawyers continue to command high fees in all aspects of legal services, especially commercial law, their basic supply price to the litigation market will remain at a high level. In this situation the only way of cheapening insurance to the potential litigant is to arrange a government subsidy to smaller firms, but this has the effect of devoting more resources to the courts, driving up fees to lawyers. In comparison with any alternative cheaper procedures that may deliver a settlement, litigation essentially involves deadweight losses of court costs, lawyers' fees and more management time. In contrast, efforts to direct firms into the use of cheaper routes to settlement than litigation, such as arbitration, are resource-saving.

Nevertheless there are enforcement cases where no settlement can be achieved without recourse to the courts. The so-called *Jackson Review*<sup>17</sup> published in 2010 made a number of IP-specific recommendations in its review of civil litigation costs in the United Kingdom. If adopted these would have the effect of making the choice of litigation by smaller firms less expensive and less risky, and this should encourage these firms to pursue litigation without risking excessive costs. The detailed recommendations relating to IP litigation can be summarised as follows:

- Consideration should be given to the introduction of small claims and fast-track procedures for resolving disputes before the Patents Court and the Patents County Court (which, the review recommends, should be renamed the Intellectual Property County Court).
- The recovery of costs in fast-track proceedings in the Intellectual Property County Court should be at a fixed rate.
- The Intellectual Property County Court Guide should be amended to give clear guidance on the requirements for statements of case, illustrated by model pleadings.
- The small claims track in the Intellectual Property County Court would be for IP claims with a monetary value of less than £5,000 and the fast track for IP claims with a monetary value of between £5,000 and £25,000.
- One or more district judges, deputy district judges or recorders with specialist patent experience should be available to sit in the Intellectual Property County Court, in order to deal with small claims and fast track cases.
- Consultation between IP court users, practitioners and judges should seek to ascertain whether there is support either for (1) an IP pre-action protocol or (2) the Guide to give guidance regarding pre-action conduct (i.e. to standardise the formal pre-trial steps which parties have to take).

<sup>17</sup> Judicial Communications Office, Review of Civil Litigation Costs: Final Report (January 2010) (*Jackson Review*).

Many of these recommendations are now being implemented, though it remains to be seen exactly how or whether all of them will be.<sup>18</sup>

<sup>18</sup>The Civil Procedure (Amendment No.2) Rules 2010 came into force on October 1, 2010 and implemented some streamlined procedures and a fixed scale of costs for the Patents County Court (PCC). The UK Intellectual Property Office has (December 2010) just concluded a consultation on the level that claims for damages should be limited to in the PCC, which will inform the level to be set eventually.



# Mitigating “Anticommons” Harms to Research in Science and Technology: New Moves in “Legal Jujitsu” against Unintended Adverse Consequences of the Exploitation of Intellectual Property Rights on Results of Publicly and Privately Funded Research

**Paul A. David\***

*Stanford University*

☞ Economics and law; Licensing; Patents; Research and development; Technology pools

## Introduction and overview

Most of the discussion and debate among legal scholars and economists concerning the so-called “anticommons” has been restricted to questions about the existence and seriousness of the obstacles to discovery, invention and innovation that Heller and Eisenberg<sup>1</sup> suggested could result from “over-patenting” in the biomedical research area. But the anticommons, as a conceptualisation of the perverse resource allocation effects of the distribution of private ownership rights, has a considerably wider potential range of empirical relevance, and warrants commensurately more careful study. This article underscores that analytical point, first by considering a stylised model of the impediments imposed upon the conduct of research by the burdensome licensing charges that arise from the dispersed distribution of ownership rights in a multiplicity of research tools that are complementary.

To make more transparent the generic character of the argument, the exposition in this heuristic analysis will focus on multiple database resources as the “research tools” of interest, individual access rights to each of which are held by different IP right owners. Adopting that approach both recognises the emergence and growing role of digital databases as critical facilities of the research infrastructure in many scientific and technical domains, and serves to demonstrate the generality of the phenomenon of “multiple marginalisation” that emerges from the uncoordinated exercise of market power by individual rent-seeking right holders in setting licensing charges for their intellectual property rights.

Having briefly examined the relationship between that “core” phenomenon and other parts of the “anatomy of the anticommons”, I turn next to consider whether market processes themselves could correct the pathology. This part of the discussion briefly exposes several serious limitations of what may be viewed as the likely “spontaneous,” profit-driven institutional responses that could emerge to mitigate the anticommons—in imitation of the private copyright clearance agencies and music performance rights collection societies. As it is unreasonable to expect that effective remedial developments of that kind will be forthcoming, there is a stronger case for pursuing new policies that would promote the “contractual construction” of scientific research commons, by common-use licensing agreements among the owners

\* Ecole Polytechnique & Telecom Paris Tech, United Nations University-MERIT (Maastricht); pad@stanford.edu.

<sup>1</sup> M.A. Heller and R.S. Eisenberg, “Can Patents Deter Innovation? The Anticommons in Biomedical Research” (1998) 280 *Science* 698.

of IP arising from publicly funded scientific projects. This “bottom-up” approach offers a path toward more far-reaching institutional changes that would mitigate some of the unintended consequences of the spread of efforts to claim and exploit intellectual property rights based upon publicly funded university research results.

### Understanding the “anticommons”—A brief anatomical tour

There are three analytically distinct layers of the troublesome object that has been labelled “the anticommons”. Each layer is associated with a different kind of problem that may arise from the distribution of perfect exclusion rights over resources, rights of the sort that are conveyed by legal property ownership—and by intellectual property monopolies in particular. Searching to locate the owners of relevant rights, negotiating with those right owners from whom access rights are needed and paying the pecuniary charges for the licences that are granted are the three layered activities and each may impose costly burdens on enterprises that require access to the use of such assets when they are both numerous and in the hands of many other parties.

It is important to distinguish among these potential sources of costs for scientific and technological research enterprises in which legally protected property rights restrict access to the use of required informational resources that represent “inputs”. Their economic implications are differently affected by the structure of productive relationships among the resources that enter into the research process, and particularly by the degree of technical complementarity among various “research assets” that fall under the control of diverse owners of exclusion rights (such as are conveyed by IPR ownership). Furthermore, dealing separately with these parts of the anatomy of the anticommons acknowledges that such inefficiencies in the allocation of research resource as they would occasion may differ in seriousness, be amenable in different degrees to market solutions, or, failing that, require distinctive institutional remedies.

We may start “peeling the onion” of the anticommons with most immediately accessible layer, *search costs*. These are entailed in order to determine whether particular “tools” described in the scientific research literature—such as databases, or fast algorithms for mass spectrographic analysis or specific biotechnology techniques (enzyme restriction methods, polymerase chain reaction, monoclonal antibodies and others that are less well known)—are in the public domain or under patents, and if so who owns the rights to use them. The necessary searches that projects might conduct can be time-consuming, and they mount in cost when many such tools are needed and the rights to use each of them can be in the hands of different owners. Similarly, finding all the specialised annotated databases containing the chromosomal locations of genetic mutations, or extended series of satellite images showing the locations and durations of plankton blooms and other oceanographic phenomena, and identifying whether each map or image is available in the public domain, or under copyright protections owned by various parties, would be quite burdensome when they are not collected and made available by a single licensing intermediary.

The *transactions costs* constitute the next layer and are distinct from search costs, because they arise only after one has identified the owner(s) of the IPR and begun to seek a licence, or an agreement to transfer materials. Under the heading of transaction costs belong the time spent by lawyers or other negotiating agents—including the interested researchers who may need to personally contact members of other research groups at a firm or university that holds the IPR; they may have to work out a research collaboration as a way of arranging for cross-licensing, to gain access data or techniques or transfers of materials between laboratories.

The “transactions costs” aspects of the anticommons problem received particular emphasis in the testimony gathered during 1997–98 Tools from 29 biomedical firms and 32 academic institutions by the NIH Working Group on Research, according to Eisenberg’s analysis of that testimony<sup>2</sup>:

“The exchange of research tools with the biomedical research community often involves vexing and protracted negotiations over terms and value. Although owners and users of research tools usually manage to work out their differences when the transactions matter greatly to both sides, difficult negotiations often cause delays in research and sometimes lead to the abandonment of research plans ... The result has been burdensome and frustrating case by case negotiations over exchanges that in an earlier era might have occurred between scientists without formal legal agreements.

... The foregoing discussion suggests some features of a market for intellectual property that may impede agreement upon terms of exchange, including high transactions costs relative to likely gains for exchange, participation of heterogeneous institutions with different missions, complex and conflicting agendas of different agents within these institutions, and difficulties in evaluating present and future intellectual property rights when profits are speculative and remote.”

If a number of research tools and inputs are required, the sunk costs for each agreement that is negotiated may yield little of value to the project if they are strict complements of another “tool” for which no access agreement can be concluded. “Hold-ups” occur when owners refuse to deal, or wait until all the other properties have been assembled and seek to extract all the available “rent” in exchange for completing the tool-package. When the components of the package are in many hands, the risks of this rise, since it is more difficult to determine the likelihood that one of the IPR owners—for one is all it takes—will behave in this strategic matter. In some sense, the latter amounts to a second order search cost problem. Search and transactions costs, as they have been defined here, are incurred before any deals can be concluded, and it should be acknowledged that specialised intermediaries could undertake to carry out the search and transaction negotiations. Economies of scale and scope, and free entry into that business therefore would work to contain these costs even as the number of parties increased.

Yet, where entry is blocked by monopoly rights to the use of inventions, as can occur when there are critical patents on research tool, the “hold-up” problem takes an exacerbated form. Lemley and Shapiro’s analysis of “patent holdups” demonstrates that in a bargaining setting the threat to obtain a permanent injunction, preventing a perceived infringer from using the patent can be expected to greatly enhance the patent holder’s negotiating power, leading to licensing agreements at royalty rates that exceed a natural benchmark range based on the value of the patented technology and the patent’s strength.<sup>3</sup>

“Royalty stacking” refers to the fact that what may be small royalty charges on each of a number of separately protected items of intellectual property (whether patents or copyrights) can “stack up” to collective a significantly high cost on the product or service that requires their use. The circumstances in which this is likely to occur involve intellectual property, or other privately held resources the ownership of which is distributed. When those elements are strongly complementary in use, this creates the core anticommons phenomenon that has the potential to critically burden research and innovation projects—namely, the effect on the price of access to the entire bundle of tools (or component inputs of a multi-element system) when royalties are set separately by the owners of each of the constituent elements in the bundle.

The source of the problem of royalty-stacking is not simply that there are a number of elements, for each of which a fee is demanded, but that the elements forming the bundle of access rights required by the user are each held by a different owner, and the owners do not act in concert when setting their royalty

<sup>2</sup>R.S. Eisenberg, “Bargaining over the Transfer of Proprietary Research Tools: Is This Market Failing for Emerging?” in R. Dreyfuss, D.L. Zimmerman and H. First (eds), *Expanding the Boundaries of Intellectual Property* (New York: Oxford University Press, 2001).

<sup>3</sup>M.A. Lemley and C. Shapiro, “Patent Hold-up and Royalty-Stacking” (2007) 85 *Texas Law Review* 1991–2048. Available at: <http://faculty.haas.berkeley.edu/Shapiro> (last accessed October 26, 2010.)

rate. Instead, they in effect ignore the effects of the royalties the other owners will be trying to extract from the same user. To restate this key point in slightly different terms, the distribution of exclusion rights to multiple items means that they may be priced in a way that disregards the negative pecuniary externalities of raising the price on any single item. The form of royalty stacking, referred to as “multi-marginalisation” severely compounds the patent hold-up problem (and IPR hold-ups more generally, as will be seen) when the constituent elements of a system are not substitutes for each another. Consequently, when a collection of research tools and information resources are gross complements, such that the incremental benefit of any one of them to the user is increased by using more of the others, and the IPR controls on access to the use of each are held by different owners, the resulting inefficiency in resource allocation will be the dual of the inefficiency that results when goods subject to congestions externalities are left in the public domain.

This duality has been shown to exist analytically by Buchanan and Yoon,<sup>4</sup> who responded to the challenge in Heller’s original paper on “The Tragedy of the Anticommons”.<sup>5</sup> Heller had remarked that there was no formal analysis that proved his intuition that dispersed property rights might impede the workings of markets. Buchanan and Yoon set up a simple model in which the pricing of strictly complementary components by their owners ignores the negative income effects (pecuniary externalities) that their supply price would have upon the demand for the project as a whole. The combined effect of all the vendors’ independent decisions is found to be to so raise the price of each item in the bundle of commodities that the quantity demanded of the entire bundle will be driven not only below the efficient use level that would obtain if every item was priced at its marginal cost, but lower than what would result if a single monopolist held all the items and priced them to maximised her profits on the whole lot.

Although there has been much discussion regarding the seriousness in practice of the “anticommons problem” as an inhibitor of commercial innovation, a considerable body of empirical evidence has accumulated which shows that royalty staking and multiple-marginalisation of complementary good (use rights subject to IP protections) are not merely theoretical possibilities but actual problems in certain branches of industry and in biomedical science. Most of this positive evidence pertains to situations where many patents read on the same product, as Lemley and Shapiro have illustrated using cases involving software patents in the fields of third generation cellular telephones and WiFi, where royalty staking exacerbated patent hold-up and further problems in standard-setting contexts where hundreds or even thousands of patents read on a single product standard.

Ziedonis has provided systematic econometric evidence of royalty stacking in the US semiconductor industry,<sup>6</sup> and Noel and Schankerman make a parallel case for its presence in the software industry.<sup>7</sup> There have been conflicting views on the question of whether there actually are anticommons effects on biomedical innovation arising from the patenting of research tools in the biomedical sciences, as Eisenberg and Nelson have argued<sup>8</sup> and Schacht’s<sup>9</sup> discussions of the role of patents in biomedical research, as well as in the software industry, are specific in pointing out the dangers of royalty stacking in those areas, but whether these result in clear-cut anticommons impediments to biomedical innovations is another matter. Walsh, Arora and Cohen reported that interviews with industry researchers revealed they deployed a variety of ways to work around patents on research tools, including licensing, “inventing around” and outright infringement.<sup>10</sup> A set of parallel interviews with university scientists found no striking instances of basic biomedical research projects having been stifled by patents on biomedical research tools.

<sup>4</sup> J.M. Buchanan and Y.J. Yoon, “Symmetric Tragedies: Commons and Anticommons” (2000) 43(1) *Journal of Law and Economics* 1.

<sup>5</sup> M.A. Heller, “The Tragedy of the Anticommons: Property in the Transition from Marx to Markets” (1998) 111 *Harv. L. Rev.* 621.

<sup>6</sup> R.H. Ziedonis, “Don’t Fence Me in: Fragmented Markets for Technology and the Patent Acquisition Strategies of Firms” (2004) 50 *Management Science* 804.

<sup>7</sup> M. Noel and M. Schankerman, “Strategic Patenting and Software Innovation”, Centre for Economic Policy Research Discussion Paper No. 5701, London School of Economics (2006).

<sup>8</sup> R.S. Eisenberg and R.R. Nelson, “Public vs. Proprietary Science: A Fruitful Tension?” (2002) 131(2) *Daedalus* 89.

<sup>9</sup> Wendy H. Schacht, *Patent Reform: Issues in the Biomedical and Software Industries*, Congressional Research Service Report for Congress (Washington, D.C.: 2006).

<sup>10</sup> J.P. Walsh, A. Arora and W.M. Cohen, “Working Through the Patent Problem” (2003) 299 *Science* 1021.

Yet the latter was the case in significant part because the interviewees had simply ignored the patents that would pose inconvenient obstacles. Further, as David has pointed out,<sup>11</sup> Walsh, Arora and Cohen’s search for instances in which researchers simply abandoned ongoing projects when they found themselves blocked by the costs of obtaining patent licences for key tools is an unrealistically extreme test of the anticommons hypothesis; it presupposes that the problem could not be foreseen in the research planning stage, well before funding was sought or research actually got underway. Were it foreseen, those researchers who were not prepared to simply ignore obstructing patents would be more likely to have modified their research design, or alter the objectives of the project so as to avoid the foreseen intractable obstacles to obtaining required research tools.

Murray and Stern, however, by studying scientific papers that are paired with associated US patents, find evidence suggesting that there are modest anticommons effects on the exploitation in applied research of the results of fundamental research findings that provided novel research tools: following the granting of patents on inventions described in previously published journal articles, the frequency of scientific citations to those papers undergoes a significant decrease.<sup>12</sup> In biomedical services, as distinct from research activities, genetic testing is a branch of the health care industry where royalty-staking clearly has been identified as a problem, as the report by Walsh, Cho and Cohen has noticed.<sup>13</sup> In the case of diagnostic kit patents, especially the Myriad patents on the tests for heritable breast cancer, the effects on the price of suites of tests each of which is patented has been to push the costs of “bundled tests” so high as to curtail the demand, with the result that the number of labs offering these testing services has decreased. This has brought some negative externalities in the form of a slowing of research to improve the tests’ diagnostic accuracy. Undesirable as that is, it does not constitute a research anticommons problem per se, because it arises (downstream) in a final service industry. Nevertheless, it remains to be seen whether or not there are upstream developments in genetic testing that are being blocked by the unwillingness of patent holders who commercially supply these high-priced services to license the basic research tools that are needed to create new tests.

### **The generalised “research data anticommons”—a heuristic model**

For convenience in showing the symmetry between the exhaustion of the value of a finite resource that is over-used, because there are no exclusion rights in the hands of any of the potential users of a tangible resource, and loss of the value of a bundled of resource whose differentiated but complementary parts are owned by so many monopolists that a resulting high-priced bundle as a whole remains unutilised, Buchanan and Yoon construct an artificial case: a physical space that can be used as an urban parking lot.<sup>14</sup> Under one regime access to the spaces are unrestricted (and unpriced), and the lot is completely congested, so that its value to those needing to park is destroyed. In the other case, to occupy any space requires purchasing many types of (differently coloured) tickets, one from each of many different exclusive owners of tickets of a distinct colour. The price of the effective permission to park would rise until nobody would use the spaces, and the value of the resource thereby is destroyed.

The connection between the effects on scientific research of the distribution of IPR and this formal analysis of the anticommons is perhaps a little too strained to effectively convey the generality and the implications of “multiple marginalisation” for the allocation of resources among research projects of

<sup>11</sup> P.A. David, “The Economic Logic of ‘Open Science’ and the Balance between Private Property Rights and the Public Domain in Scientific Data and Information: A Primer” in J. Esanu and P.F. Uhler (eds), *The Role of the Public Domain in Scientific Data and Information: A National Research Council Symposium* (Washington, D.C.: Academy Press, 2003).

<sup>12</sup> See F. Murray and S. Stern “Do formal Intellectual Property Rights Hinder the Free Flow of Scientific Knowledge? An Empirical Test of the anti-Commons Hypothesis” (2007) Vol.63(4) *Journal of Economic Behavior and Organization* 648–687.

<sup>13</sup> J.P. Walsh, C. Cho and W.M. Cohen, *Patents, Material Transfers and Access to Research Inputs in Biomedical Research* (Final Report to the National Academy of Sciences’ Committee on Intellectual Property Rights in Genomic and Protein-Related Inventions, National Academy of Sciences, Washington, D.C., September 20, 2005).

<sup>14</sup> Buchanan and Yoon, “Symmetric Tragedies: Commons and Anticommons” (2000) 43(1) *Journal of Law and Economics* 1.

different kinds. Multiple marginalisation should be seen not only as potentially impeding the use of patented or copyrighted research tools, and thereby blocking some research projects, but, more generally, as degrading the exploration of large data-fields—or “discovery spaces” formed by the federation of databases—which have become particularly important in many exploratory research domains.

To fix ideas here, one can take as a concrete example the haplotype map, or “HapMap”, as an emblematic database tool that has been created by the National Human Genome Research Institute (NHGRI) and other national funding agencies when they undertook the International Haplotype Mapping Project in 2002.<sup>15</sup> The scientific purpose was to allow biomedical researchers to find genes and genetic variations that affect health and disease. The DNA sequence of any two people is 99.9 per cent identical, but the variations may greatly affect an individual’s disease risk. Sites in the DNA sequence where individuals differ at a single DNA base are called single nucleotide polymorphisms (SNPs—referred to colloquially as “snips”). Sets of nearby SNPs—on the same chromosome—are inherited in blocks; the pattern of SNPs on a block is called a haplotype. Blocks may contain a large number of SNPs, yet a few SNPs are enough to uniquely identify the haplotypes in a block. The HapMap is a map of these haplotype blocks and the specific SNPs that identify the haplotypes are called “tag SNPs”. By reducing number of SNPs required to examine the entire genome for association with a phenotype—from the 10 million SNPs that exist down to roughly 500,000 tag SNPs—the HapMap provides a means of greatly reducing the costs and effectiveness of research in the field of genetic medicine. By dispensing with the need for typing more SNPs than the necessary tag SNPs, it raises the efficiency and comprehensiveness of genome scan approaches to finding regions with genes that affect diseases.

One may then imagine the situation of distributed exclusion rights that could arise from the independent patenting of tagged sequences by separate research groups, working in different universities and firms. But, even supposing that the SNPs individually were left in the public domain, multiple owners of rights to exclude researchers from searching for particular “tag SNPs” could arise where legal protections were afforded to database owners who had made an investment in assembling the contents. Deep-linking and database federation can be impeded by the legal protection of database rights afforded by national legislation conforming to the EU’s 1996 Directive on the Legal Protection of Database Rights, as these apply to both copyrighted or uncopyrightable materials. Access costs charged by each collection of “tag SNPs” would then tend to impede the research use of extensive “discovery spaces” for exploratory research in genomics, proteomics and related epidemiological data, even where owners were prepared to license extracting content from them.<sup>16</sup>

To examine this a little more formally, consider a simple model of a research production project: the output is results,  $R$ , produced under cost-minimising conditions on a budget of  $G = \sum [p\{i\}][b\{i\}] + X$ , according to the production function  $R = F(S, X)$ , where  $X$  is a vector of inputs of experimental time and equipment and  $S$  is the output of a search activity, according to search function:  $S = S(b\{1\}, b\{2\}, \dots, b\{B\})$ , in which  $b\{i\}$  is the information extracted from database  $i$ .

We may suppose that the search function,  $S$ , takes a special form described by a constant elasticity of substitution (CES) production function, in which the inputs  $b\{i\}$  enter symmetrically. The latter—which says they are equal in the intensity of their use in the search—is assumed for convenience, as is the condition of first-degree homogeneity: neither increasing nor decreasing returns to scale in the search. In other words, the informational output of the search  $S$  will be doubled by doubling the amount of information extracted from each of the  $B$  databases that are examined.

<sup>15</sup> See <http://www.genome.gov/10001688> [Accessed November 8, 2010].

<sup>16</sup> See “IPR Aspects of Internet Collaborations, EC/Community Research Working Paper”, EUR 19456, April 2001, for the remarks on the importance of “discovery spaces” by Graham Cameron, Director of the European Bioinformatics Institute. In a meeting of the EC working party (on January 22, 2001), Cameron stated that to construct anything resembling the existing EBI federated database structure would be presented by quite infeasible under the access restrictions that had come to prevail in the field of biogenetics, an observation discussed further by P.A. David, “Will Building ‘Good Fences’ Really Make ‘Good Neighbours’ in Science? Digital Technologies, Collaborative Research on the Internet and the EC’s Push for Protection of Intellectual Property,” MERIT Research Memoranda 2001-004.

Further, the specification of the search production function  $S$  allows for substitutions among material from different databases, indicating the ease of substitution by the elasticity of substitution parameter  $\sigma$ :  $\sigma = 0$  then corresponds to the condition of strict complementarity in which no substitutions are possible and the materials would be extracted from the different databases would be in fixed proportions to one another, regardless of their relative prices;  $\sigma = 1$  corresponds to the (Cobb-Douglas) case in which a project’s cost-minimising search will allocate invariant shares of its total search budget to each of the  $B$  databases, and, given the assumption of symmetry among them in the search production function, it implies that the relative amounts of data from any pair of databases would vary inversely with the relative unit prices of the data to be extracted from each.

For expositional purposes we restrict this discussion of the model’s implication to the case in which all research projects have identical search strategies, constrained by the same search technology, and the same form of derived demands for database contents. From the (common) CES production function for “search” one obtains these derived demands for access to database contents for each project, as a function of unit extraction charges, the project’s real budget level and the elasticity of substitution among the  $B$  databases. Assuming database owners have legal monopolies and set profit-maximising royalty rates for data extraction independently (as discriminating monopolists), one may solve for the resulting relative prices that will emerge as the Nash solution from the interactions of the effects of their price-setting the project derived demand schedules for one another’s data. The resulting prices then determine each project’s consequent cost-minimising search, and, given its budget constraint, the informational output that will enter its research production, and hence affect its research output.

The basic qualitative features of the results that have been discussed in the context of the simpler example in Buchanan and Yoon<sup>17</sup> turn out to hold in this setting. Even if the  $b_{\{i\}}$  are not strict complements, and there is symmetric non-zero elasticity of substitution between them, when database rights are separately owned and priced independently to maximise the owners’ separate revenues, the larger is the number of required databases ( $B$ ), the more severely degraded will be  $S$ . Hence  $R$  (research output) for given funding levels will be reduced—so long as  $S$  and  $X$  are not infinitely substitutable. Of course, the lower the elasticity of substitution among the different database inputs in the search activity, the more marked would be the adverse income effects on the overall research project’s output of the mark-ups charged by database monopolists—given its fixed budget constraint. If the elasticity of substitution between the search activity and other inputs is unitary, then the effects of the independent pricing strategies of the database owners translate into degraded search output, against which there can be offsetting increases in the intensity of other inputs. The outcome from an economic welfare efficiency viewpoint can be shown in this case, as in the standard multiple-marginalisation analysis, to be inferior to that which would obtain under joint monopoly ownership of rights to the required (database) inputs.

The foregoing results may be interpreted to support the intuitive notion that the incidence of the anticommons problem will be particularly heavy in the case of exploratory science, such as that in bioinformatics, but also in design fields such as advanced computer software, where many libraries may be searched for modular algorithms that have been found to interoperate in unproblematic ways with an existing code base. By contrast, narrowly focused searches, say, for particular targets in a SNP’s database might be less impacted. Moreover, commercially oriented R & D projects in which the “research” portion of the budget is small in relation to the development costs, would be far less likely to be adversely affected because even if it is not possible to substitute  $D$  for  $R$ , the impact of the elevated search costs on  $R$  will scarcely be noticeable in the overall costs of the innovation.

Perhaps the most interesting implications of this generalised model of “multiple marginalisation” in the market for legally protected scientific research data are those concerning the differential incidence of the search-degradation on exploratory research, by comparison with focused commercial

<sup>17</sup> Buchanan and Yoon, “Symmetric Tragedies: Commons and Anticommons” (2000) 43(1) *Journal of Law and Economics* 1.

applications-oriented R & D. This points to the need for a more nuanced approach in empirical efforts to assess the ways in which this and other cost-imposing dimensions of the anticommons problem would manifest themselves. Reconsidered from that angle, the conclusions drawn from the questions posed to academic researchers by the pioneering survey- and interview-based studies of the impact of patented research tools in the biomedical area seem to be overly sanguine, in supposing that the existence of a “serious anticommons” effect would take the form of the blocking or abandonment of ongoing research projects. That such events are reported to be “as rare as the White Tiger” will be seen not to be surprising, and consistent with more subtle but cumulatively distorting long-term effects on the advance of fundamental science upon which the ability to sustain innovative will be based.<sup>18</sup> Of course, the apparent readiness on the part of the academic biomedical researchers who were surveyed to simply ignore the question of whether they might be infringing patented tools also could account for the rarity with which they reported that their research projects were actually blocked by “patent thickets”.

### **The limits of spontaneous order: Anticommons ills that markets can and cannot cure**

Before moving to the conclusion that protection of exploratory scientific research requires special measures to counteract the potential harms from anticommons effects, especially where database protections compound the effects of patent laws, it is appropriate to inquire whether the problems created by the distribution of IP ownership cannot be solved by the same means. That question can be treated in two specific connections, considering first the idea that the existence of transferable rights would allow the problems of search and negotiation costs to be mitigated by the development of institutionalised solutions modelled on copyright collection societies, and secondly, that these might also be a palliative for the “royalty stacking” created by uncoordinated pricing of bundles of patents that constitute “thickets”.

The second connection is simply a more general formulation of the latter claim—namely that owners of complementary intellectual property rights may well have private profit-incentives to exploit those rights in a collectively managed “pool”, and therefore could act spontaneously to mitigate the worst inefficiencies of multiple marginalisation. But the proposed copyright collecting society-like mechanisms on closer inspection turn out to be inadequate to deal with the core source of the inefficiency arising from distributed exclusion rights to complementary research assets that are protected by patents, or by technical means such as encryption in digital rights managements system.<sup>19</sup>

Why can’t private “intermediating” organisations emerge and profit by providing a market solution for scientists’ anticommons problems? The answer is that the proposal to encourage the organisation of profit-oriented collection societies is based upon an inadequate analogy with the problems in music copyrights and performance rights that induced the formation of such institutions. This “solution” aims to reduce costs of search and transacting, and lower the costs of rights enforcement, by using economies of scale and scope in search, and reutilising the information in repeated licensing transactions. By making the use of IPR less costly, collecting societies could actually encourage greater research production—by inducing widespread patenting of research tools. In addition, the collection society has an incentive to write contractual provisions (e.g. grant backs), in order to induce non-cooperating owners to share use of

<sup>18</sup> See, for a critical discussion, Walsh, Arora and Cohen, “Working Through the Patent Problem” (2003) 299 *Science* 1021; and P. A. David, “The Economic Logic of ‘Open Science’ and the Balance between Private Property Rights and the Public Domain in Scientific Data and Information: A Primer,” in J. Esanu and P. F. Uhlir (eds) *The Role of the Public Domain in Scientific and Technical Data and Information: A National Research Council Symposium*, (Washington, D.C.: Academy Press, 2003). (Available as SIEPR Discussion Paper 02-03, at: <http://siepr.stanford.edu/publicationsprofile/445>).

<sup>19</sup> This draws upon the argument made by Michael Spence in a 2006 comment, (privately communicated) and subsequently published in M. Spence, “Clearing House Mechanisms: Conceptual Framework: Comment on a Paper by Esther Van Zimmerman” in G. Van Overwalle (ed), *Gene Patents and Clearing Models*, (Cambridge: Cambridge University Press, 2009).



their exploitation right in exchange for royalties. While accomplishing all that does sound like a good thing, it may be too good to be realistic. There are quite a number of reasons why private “intermediating” institutions are not the best, or even the second-best solution for scientists’ anticommons problems.

First, there are likely to be feasibility and cost problems with the generic “collections society solution” that don’t cause comparable difficulties with the copyright collecting organisations because they deal with a form of IP that is very different from the contents of patents and database rights:

- Copyright authors typically want their products distributed widely, but this is not so generally the case with patents.
- Copyrights in songs, in texts and even images are more likely to be substitutes than is the case with patents, and scientific data.
- Copyright collections societies target specific use-markets, but uses of research tools are much wider and more difficult to predict, so pricing decisions are more difficult.

Secondly, while there most likely would be cost savings in patent searches and the location of specialised scientific databases, and in identifying the right holders who will grant non-exclusive licences, it is possible that the consequences of these could be perverse. Spence points out that by making the use of IPR easier for universities and other public research organisations, a collections society approach could also encourage strategic uses of licensing terms that would disadvantage rival research projects, or encumber researchers in rival institutions.<sup>20</sup> The view that universities would not behave that way seems overly sanguine in ignoring the competitive pressures under which many of these institutions are operating today. Some US universities holding biomedical patents have not been hesitant to write letters pointing out infringements, and requesting that the letter-recipients apply for licences. In the United Kingdom several universities have been drawn into conflicts with one another over competing claims to the same database that, in various stages of its development, was hosted on their websites by a researcher whose career exhibited the mobility one might expect of a talented contributor to the biogenetics literature.<sup>21</sup>

Next, one has to ask whether there will be an improvement on the existing situation in the public sector—where, according to Walsh, Arora and Cohen, academic biomedical researchers say they just ignore patents.<sup>22</sup> Compared to the state of non-compliance and non-enforcement, collection societies could make things much worse from the viewpoint of public research productivity—while improving compliance with the law. There is a trade-off here, but some might argue that the most effective way to remove a bad law is to enforce it vigorously.

Fourthly, and by no means least in significance, the historical record of the music copyright and performance right collections societies reveals a potential for abuse of market position.<sup>23</sup> Bundling of wanted and unwanted licences is an attractive strategy for the society, so competition authority supervision would be needed on that score, as well as on the grounds that the interests of members of those societies shift in the course of their development towards attempting to exclude variant content that could be substituted for that of the existing right holders. It may well be the case, however, that the existence of more than one cluster of complementary research tools is a reflection of the useful adaptation of tool-sets to variant problems that are specific to different research domains, or to special research environments. Forcing users to pay for redundant alternatives is an abuse, but so is denying them access to alternatives

<sup>20</sup> See Spence (2009)

<sup>21</sup> See, e.g. the case of the “PRINTS” database, related by T. K. Attwood “Mobile, Metamorphosing Academic Databases—Capturing IP on the move” in Workshop Report on Managing IPR in knowledge-based economy—Bioinformatics and the influence of public policy European Commission DG Research—Fifth Framework Programme (2001). For comments on this instance of ambiguous ownership of a database created by an institutionally mobile research scientist, see P. A. David and M. Spence, “Towards Institutional Infrastructures for e-Science: The Scope of the Challenges”, A Report to the Joint Information Systems Committee of the Research Councils of Great Britain, Oxford Internet Institute Report No.2. September 2003, p.42 and Appendix 5 (available at: [http://www.oii.ox.ac.uk/resources/publications/OIIRR\\_E-Science\\_0903.pdf](http://www.oii.ox.ac.uk/resources/publications/OIIRR_E-Science_0903.pdf)).

<sup>22</sup> Walsh, Arora and Cohen, “Working Through the Patent Problem” (2003) 299 *Science* 1021.

<sup>23</sup> See, e.g. M. A. Einhorn, “Transactions Costs and Administered Markets: License Contracts for Music Performance Rights,” (2006) 3(1) *Review of Economic Research on Copyright Issues* 61–74.

that are not always redundant in order to raise the rent that can be extracted from those that are provided. True, the collections societies in the field of music performance rights are restrained from excessive pricing by the adverse effects on revenue, but that is in large part because other copyright material is available as substitutes. This condition is less usual in the case of patents, and, especially when some patents in the bundle were complements, there may be unjustifiably big mark-ups.

The burden of this analysis therefore is that substantial doubt surrounds the wisdom of an implicit policy position that prefers letting “anticommons problems” be remedied by the workings of new institutions engendered by forces in the markets for valuable intellectual property. Thus some positive policy action would appear to be called for, particularly in view of the distribution of IP rights to exploit research results arising from publicly funded R & D projects that is being produced by the workings of the Bayh-Dole Act of 1980 in the United States, and kindred legislative and administrative measures introduced in the EU and elsewhere. The proposals in the following section offer a preliminary response to that challenge.

### **Common-use contracting in IPRs—clearing pathways through some “mental thickets”**

A discussion of suitable policy measures would aim to (1) clarify the meaning and practical significance of the idea of legally creating an “information commons” for scientific and technical research communities by means of common-use contracting; (2) inquire into the conditions under which these are likely to emerge spontaneously as “clubs” or “pools” among holders of IPR in research tools and databases, rather than having to be pro-actively encouraged by public agencies; and (3) consider specific policy measures that would be appropriate and effective in promoting participation of universities and other public research organisations in IPR licensing arrangements of that kind. It is possible on this occasion only to touch upon some of the salient points under each of those headings.

To make space for the “commons solution” one needs to clear away economists and lawyers’ misconceptions about “the commons”, and stop textbook repetitions of the travesty of the “Tragedy”, like this one:

“The *anticommons* is a play on words and refers to the ‘tragedy of the commons’ which is taught in freshman economics. In the tragedy of the commons peasants in early modern Britain overgrazed shared pastures (‘the commons’) because the absence of private property eliminated incentives to conserve.”<sup>24</sup>

The historical reality is totally different. Contrary to the historical fantasy of a “common pool problem” promulgated in the influential essay by Garrett Hardin,<sup>25</sup> this “tragedy” never was: from the 13th century onwards, the records of Europe’s agrarian communes detail regulations adopted “by common consent” of the *villeins* (tenants) to control the exercise of rights of common grazing on the fallow fields, the meadows and the stubble-fields (the post-harvest grain-fields) of the village’s arable land. Internal management accompanied exclusion of strangers. Elinor Ostrom’s research<sup>26</sup> on governance arrangements for common property resources has shown the relevance of this for modern tangible resource management in developing economies; indeed, her findings mirror the extensively documented historical experience of successful management of common property resources when access could be effectively denied to outsiders (“strangers”). For example, by the “early modern era” in Britain, and equally in the more densely settled arable farming regions of northern Europe, the management of common grazing rights prescribed

<sup>24</sup> S. Scotchmer, *Innovation and Incentives*, (Cambridge MA.: The MIT Press, 2004) p.88.

<sup>25</sup> Garrett Hardin, “The Tragedy of the Commons” (1968) 162 *Science* 1243.

<sup>26</sup> See, e.g. E. Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (New York: Cambridge University Press, 1990); E. Ostrom, J. S. Walker, and R. Gardner, *Rules, Games, and Common-Pool Resources* (Ann Arbor: University of Michigan Press, 1994).

*stinting*: tenants in the village were allocated “stints” that specified the numbers of specific animals that commoners could put on the fallow or common pasture lands, apportioning these rights in relation to the size of their holdings in the arable field, and sometimes in the meadowland.

The commons in tangible exhaustible resources is not a defunct institution, for collective ownership of exhaustible resources did not, and does not, translate automatically into a chaotic struggle for possession among neighbours, nor does it result in the egalitarian distribution of use-rights. Even in Western Europe today, such arrangements based upon de jure common use rights (*res communes*) dating from the Middle Ages have survived in the Swiss Alps and Northern Italy—e.g. the Magnifica Comunità di Fiemme, in the valley of Avisio (Trento)—where they still govern the use of tens of thousands of hectares of alpine forests, pasture and meadow land. Moreover, a growing number of contemporary empirical studies in the developing world—following Ostrom—also are showing how common pool resources can be managed successfully under a variety of common property regimes.

### **Selective implementation of common-use contracting: Efficient IPR pooling agreements**

The case for efficient patent pools<sup>27</sup> rests on overcoming the obstacles to research and innovation posed by the growth of “thickets” and designed complementarities in claims that create blocking patents. It is recognised that pooling creates a potential for anti-competitive behaviour, notably the bundling together of essential strong and high-value patents with weak and inessential low-value patents as a means of extracting greater royalty revenues. Consequently, some means of defusing generic antitrust objections to pooling would advance the case for efficient pooling.

An empirical procedure for establishing the likelihood that an inefficient patent cluster, i.e. a “thicket”, had formed would go some way to addressing this issue, and it is therefore relevant to notice Clarkson’s proposal and practical demonstration of the method of using network analysis to discover patent thickets and disqualify them as ineligible for efficient pool status.<sup>28</sup> Nevertheless, dual pricing policies by foundations running “public research commons in information” (PRC-i) would be potentially subject to abuse, and competition among those proposed foundations will be quite limited if they are successful in internalising complementarities. Therefore, that there would be a need for continuing monitoring of the PRC-i foundations and vigorous antitrust supervision seems an inescapable conclusion.

To create “research commons” by common-use licensing of intellectual property is not an unprecedented idea, however. Indeed, it has been gaining adherents recently in a variety of practical forms. Free and Open Source Software (FOSS) is by now a familiar approach to ensuring access to software tools, using copyright licensing terms: GNU GPL (the “copyleft” principle) requires distributors of code to do so on the same open source, royalty free, attribution basis on which they received the code, providing contributors of software licensed in this way with the prospective benefits of having reciprocal access to the code that others will build upon it. Less well known than FOSS, Science Commons<sup>29</sup> was launched under the aegis of Creative Commons in 2005, with the goal of bringing to the world of scientific endeavours the benefits of openness and sharing the goal of bringing the openness and sharing that have made Creative Commons licences a success in the arts and cultural fields. Its projects enlist their own technical and legal experts, and mobilise others to design strategies and tools for faster, more efficient Web-enabled scientific research—through common use licensing of data contributed to repositories, cross-licensing of patented research tools and pre-commitment to standard materials transfer licensing on RAND terms.

<sup>27</sup> See, e.g. J. Lerner and J. Tirole, “Efficient Patent Pools,” June 2004 94(2) *American Economic Review* 691–711.

<sup>28</sup> G. Clarkson, “Objective Identification of Patent Thickets”, *Harvard Business School Working Paper*, version 3.9 (2004).

<sup>29</sup> See <http://sciencecommons.org> [Accessed November 8, 2010].

Science Commons' Neurocommons Project,<sup>30</sup> a collaboration between Science Commons and the Teranode Corporation, is building on open access scientific information and data—content that is digital, online, free of charge and free of most copyright and licensing restrictions—to build a semantic web for neuroscience research. A semantic web can be conceptualised as a graph or network of connections among distinct bodies of information and/or data that is grounded on a set of common standards to describe and name the relationships that are contemplated and described in text: relational statements in the life sciences might take forms such as “this gene is active in this disease”, “is related to this protein”, “which is folded in this way”, etc. Using the standard allows one to republish content of this kind in a format that researchers can use software (running search engines, browsers, statistical analysis) to search, evaluate, form new links and integrate with content in other specialised knowledge domains. This initiative aims to create an efficiently usable, managed, open access commons that will empower neuroscience researchers, and to create a demonstration model of the way this can be done that will be portable, and thus help to transform other complex fields of research activity.

Other “commons-like” initiatives provide public domain access to otherwise patentable material under licensing conditions that restrict users from appropriating the benefits by utilising it to obtain IRP on new, commercially valuable research products, or, alternatively retain ownership but irrevocably allow others to freely use patents that are placed in the commons but select those contributions to be those having applications in a particular desired sphere. Considering just two cases, first, the well established HapMap Project, and then the very recently formed and still experimental Eco-Patent Commons, will be sufficient to exhibit the range of diversity in these promising developments.

### *HapMap project*

The HapMap project followed the precedents established by the Human Genome Project<sup>31</sup> by rejecting protection of the data under copyright or database rights, and establishing a policy requiring participants to release individual genotype data to all the project members as soon as it was identified. It was recognised that any of the teams with access to the database might be able to take that data and, by combining it with their own genotype data, generate sufficient information to file a patent on haplotypes whose phenotypic association with disease made them of medical interest. To prevent this, a temporary “click-wrap” licence was created—the IHMP Public Access License—which does not assert copyright on the underlying data, but requires all who accessed the project database to agree not to file patents where they had relied in part on HapMap data.

The HapMap thus represents a special case of legal jujitsu, where a copyleft strategy has been mutually imposed on database users by an enforceable contract in the absence of IPR ownership. Technological protection of the database at a level sufficient to compel users to take the “click-wrap” licence makes it possible to dispense with the legal protection of asserting copyright in order to use “copyleft” licences.

### *Eco-Patent Commons*

The Eco-Patent Commons, launched in January 2008 by IBM, Nokia, Pitney Bowes and Sony in partnership with the World Business Council for Sustainable Development, was founded on the commitment that anyone who wants to bring environmental benefits to market can use the patents that are contributed to the commons to protect the environment and enable collaboration between businesses that foster new innovations. This appears to be a response to the perception that technology transfers unencumbered by

<sup>30</sup> See [http://neurocommons.org/page/Main\\_Page](http://neurocommons.org/page/Main_Page) [Accessed November 8, 2010].

<sup>31</sup> HGP; see <http://www.genome.gov/10001688> [Accessed November 8, 2010].

licensing restrictions and royalties will be an important mechanism in the diffusion of new technologies that can contribute to mitigation of climate change, and encourage downstream inventions that build upon or work in a complementary manner with those in the commons.

According to its website,<sup>32</sup> the objectives of this undertaking are “to provide an avenue by which innovations and solutions may be easily shared to accelerate and facilitate implementation to protect the environment and perhaps lead to further innovation”, and “promote and encourage cooperation and collaboration between businesses that pledge patents and potential users to foster further joint innovations and the advancement and development of solutions that benefit the environment”. Since its launch, 100 “eco-friendly” patents have been pledged by 11 companies who retain ownership of their pledge patents, and bear the associated costs, but make the patents freely available for use by third parties.

An initial study of 92 of these pledged patents by Hall and Helmers<sup>33</sup> finds that the participating firms appear to be doing more or less what they claim, pledging valuable “green” patents (more valuable than the average patent in their respective portfolios), although about one-fifth have expired, and one-seventh have not yet issued. Because, under the regulations, third parties do not need to notify the owners of the pledged patents when they use them, it will be difficult to statistically evaluate the Eco-Patent Commons’ effectiveness in diffusing green technologies and stimulating upstream innovation by non-pledging firms, or for the pledging firms to quickly identify new technologies that are being built on the patents they contribute to the pool. It is too early to assess the success of this initiative but it demonstrates at least that there are contexts in which private corporations are prepared to act on the premise that they will benefit along with others by sharing resources that are building blocks for innovations that—as is the case with climate change mitigating technologies—have potential to yield large “public goods” spillovers.

### **A summary of the argument, and where it leads us**

This article has advanced the case for a particular approach to restoring a healthier balance between proprietary arrangements governing the commercial exploitation and private appropriation of research results, as an incentive mechanism to drive invention and innovation, and the provision of open data and information infrastructures that emulate features of the public domain that are particularly hospitable for and efficient in active and collaborate research aimed at increasing the stock of reliable scientific knowledge. National funding agencies should be urged to agree individually and jointly to exercise their authority over the conditions governing the use of public research funds in order to require that data created on such projects be placed in open repositories, and to impose common-use licensing of IPR in complementary research “tool sets”. These agencies should set management rules for the irrevocable assignment of IPR to regulated PRC-i when such rights arise directly from projects that draw significant public funding.

The argument for this course of action has been developed here in seven steps, or propositions:

- **Prop.1:**

Scientific and technical research in the modern world entails the production of data and information (which are international public goods) by means of the same class of international public goods.

- **Prop.2:**

There are three pure types of institutional solutions—property, patronage and (public) provision—for the allocation problems in the production and distribution of information that arise from the latter’s public goods properties.

<sup>32</sup> See <http://www.wbcsd.org> [Accessed November 8, 2010].

<sup>33</sup> B.H. Hall and C. Helmers, “Innovation in Clean/Green Technology: Can Patent Commons Help?”, Discussion Paper presented at the EPIP Annual Meeting, held in Maastricht, the Netherlands (September 20–22, 2010).

- **Prop.3:**

Each of the “3 Ps” offers an imperfect solution, and most of the successful modern economies employ all of them in some degree, but the mixture has shifted towards property.

- **Prop.4:**

The “property solution” (IPR) creates legal monopoly rights to exploit the new information, and may improve the market allocation of resources in information production through the incentive effects; but commercial exploitation of the rights itself inhibits information use—and the “deadweight burden” that is incurred in scientific and technological research itself is likely to be particularly heavy for society.

- **Prop.5:**

Information disclosed and left in the public domain enables the efficient growth of knowledge through the conduct of “open science” research, so long as (a) patronage is available and (b) “enclosures” of the public domain does not impede access to the research tools.

- **Prop.6:**

There are conditions under which IPR in research tools is particularly damaging to scientific progress, these have come to be referred to loosely as “the anticommons”—which needs to be precisely defined; in those conditions, “common-use” pooling of information resources is likely to be both socially more efficient, and a dominant strategy for researchers.

- **Prop.7:**

IPR owners can contractually construct “information commons” that emulate public domain conditions that will be sustainable against opportunistic “enclosure”; and in the case of a non-exhaustible resources (information), there is good reason not to exclude any contributor of IPR to the research commons—so long as the additions also are complements of the rights from which the existing PRC-i has been formed.

Some closing remarks are now in order, with regard to the political economy aspects of the proposed programme of ameliorative actions. The policy thrust of the argument that has been advanced here may be seen as tantamount to (indirectly) reforming the workings of the Bayh-Dole and Stevenson-Wydler Acts in the United States, and parallel legislative measures that were subsequently introduced in a number of OECD countries. It calls for the development of specific institutional arrangements for the administration of “scientific research commons” (SRCs) formed by IP right holders that would need to address five key issues. These include:

- conditions of eligibility to participate;
- limitations upon the scope of legally protected content that can be placed within the commons;
- principles for the management and pricing of licences granted to non-commoners for use of intellectual property rights contributed to, and arising from the utilisation of pooled research assets;
- relationships among independent SRCs and between SRCs formed by universities and other public sector research organisations that presently maintain technology licensing/transfer offices;
- the implications of competition policy safeguards against the creation of inefficient pools, and the abuse of patent cartel power.

The foregoing is in a sense a way to describe the features of the destination at which I advocate we should seek to arrive. What it does not indicate is whether this is a feasible route for making such a journey from where we now find ourselves. It surely is important to design a transformative process that has favourable transition dynamics. Thus each commons would provide positive externalities to those who join, and those who are already participating, to the extent that the new use-rights are complements of those already in the pool. But in general these benefits will be more attractive to universities with small and less coherently structured IP portfolios, and offer less to the comparatively few institutions that have many patents and effective, well-funded TLO operations.

On the other hand, the question is whether the immediate portfolio return consideration of those research universities and their TLO staffs will prevail over the interests of their researchers in pursuing fundamental scientific research unencumbered by the need to overcome or avoid obstacles created by the dispersed distribution of patent holding on research tools. In general, it may be supposed that the interests of leading researchers that have a demonstrated capacity to gain public funding will weigh heavily with all but the most myopic and reckless university administrators. This is a hopeful notion, because it implies that even when influential academic scientists are prepared to simply ignore other institutions’ patents, public funding agencies could set conditions for grant recipients to pool patents on relevant tools that their institution owns with those held by other public grant recipients. This could be done as a condition for eligibility to submit grant proposals, which would create a strong incentive for university compliance if they sought to retain the scientists that had promising trajectories of research in that field.

The problem with this approach, however, is that it is not clear that such researchers will be ubiquitously distributed among the research universities, so where they were not currently present, patent-holdings at those institutions could contain “unpooled” blocking patents. Across-the-board pooling requirements would address that defect, but at the expense of mobilising opposition from all those with less to gain from securing their star researchers’ eligibility to compete for public research funding.

Another potential problem with bottom-up coalition formation on behalf of the commons building goal concerns the interests of the university technology licensing professionals who have become a potentially important lobbying force in the United States, and may be emulated elsewhere. There will be winners and losers if the business now conducted in many small TLOs is consolidated in the hands of a smaller number of regional- and domain-specific independent foundations. The public research funding agencies and major private charities have crucial roles to play in bringing the handful of large but important research institutions that have been gainers under the existing regime into the new scientific research commons. That probably is not the best place to begin, however.

In short, this journey of institutional reform, like many journeys worth undertaking for “the arrival” rather than the intrinsic pleasures of travel, is almost certain to have some travail. In order to succeed it will demand sophisticated reconnoitring of the difficult political terrain to be traversed, careful attention to questions of sequencing and very considerable patience and persistence. But it ought not to be deferred.

# Compulsory Licensing as an Antitrust Remedy

Jay Pil Choi

*Professor, School of Economics, University of New South Wales and Department of Economics, Michigan State University*

☞ Abuse of dominant position; Compulsory licensing; Computer industry; Essential facilities; Intellectual property; Interoperability

Intellectual property (IP) laws confer an exclusive legal right to one's invention in order to foster creation of new knowledge and provide incentives for technological innovation. Thus the owner of intellectual property rights (IPRs) is entitled to maximise the market value of his IP unless the holder runs foul of the antitrust laws by attempting to leverage its IP to products outside the scope of the patent.<sup>1</sup> The holder of a patent, for instance, can either make sole use of the invention or license others to use the invention at a negotiated price. In general, the IP holder is not obligated to license his IP to others including potential competitors. However, there are some exceptions in which a government forces the IP holder to grant use of his IP to others in return for some royalties. For instance, the World Trade Organization (WTO)'s Agreement on Trade-Related Aspects of Intellectual Property Rights, known as TRIPS, allows for compulsory licenses of patents under certain conditions.<sup>2</sup> Compulsory licensing can also be used to remedy an alleged violation of competition laws. In this article, I focus on issues related to compulsory licensing as an antitrust remedy, with a focus on the software industry and the interoperability problem.

To motivate the analysis, consider the recent antitrust cases concerning Microsoft in the United States and Europe. One of the issues in the cases evolved around the interoperability information. Microsoft was alleged to deny disclosing interface information which rival work group server operating system vendors needed to interoperate with Microsoft's dominant Windows PC operating system. The Consent Decree in the United States requires Microsoft to "make available for use by third parties on reasonable and non-discriminatory terms certain technology used by server operating system products to interoperate with a Windows operating system product".<sup>3</sup> The European Commission went one step further by requiring Microsoft to disclose:

"complete and accurate specifications for the protocols used by Windows work group servers in order to provide file, print, and group and user administrations services to Windows work group networks."<sup>4</sup>

A similar issue has arisen in an antitrust investigation against Qualcomm in Korea in which the Korean Fair Trade Commission is concerned with the possibility that non-disclosure of ADSP (application digital signal processor) interface information may restrain competition in the mobile multimedia software market.

<sup>1</sup> In the 1970s the US Antitrust Division of the Department of Justice issued a list of nine licensing practices that could be viewed as anti-competitive restraints on trade, which became to be known as the "Nine No-No's". The current stance on this issue is reflected in the *Antitrust Guidelines for the Licensing of Intellectual Property* jointly issued by the Department of Justice and the Federal Trade Commission in 1995. See Richard Gilbert and Carl Shapiro, "Antitrust Issues in the Licensing of Intellectual Property: The Nine No-No's Meet the Nineties" [1997] *Brookings Papers on Economic Activity: Microeconomics* 283.

<sup>2</sup> WTO Agreement on Trade-Related Aspects of Intellectual Property Rights art.31.

<sup>3</sup> Microsoft Consent Decree Compliance Advisory—August 1, 2003, available at <http://www.justice.gov/atr/cases/f201200/201205a.htm> [Accessed October 12, 2010].

<sup>4</sup> *Microsoft v Commission of the European Communities*, COMP/C-3/37.792 at [999], available at <http://ec.europa.eu/comm/competition/antitrust/cases/decisions/37792/en.pdf> [Accessed October 12, 2010].



Compulsory licensing as an antitrust remedy can be justified when a dominant firm denies its rivals access to essential resources that it controls with an exclusionary intent to harm competition. However, this type of intervention also runs the risk of interfering with one of the fundamental principles of the market economy: the freedom of market participants to choose their trading partners. To reflect this tension, prior court cases involving compulsory licensing in the United States as well as Europe have been at times contradictory and do not offer clear guidelines. As a result, it is important to identify circumstances under which such an intervention is justified. When justified, it is of equal importance to devise a framework to implement compulsory licensing with a minimal burden on innovation.

Below I discuss the rationale behind compulsory licensing and potential pitfalls in administering it as an antitrust remedy. I also briefly touch upon the precedents and current legal status of the doctrine. Then I discuss a more specific case of the software market. Compulsory licensing can be considered as an application of the essential facilities doctrine to IP. More specifically, I point out important characteristics of intellectual property that would warrant a different approach to the interoperability problem in the software industry.

## **Compulsory licensing as an application of the essential facilities doctrine**

The essential facilities doctrine specifies conditions under which the owner of an “essential” or bottleneck facility must provide access to it. The facility can be a physical facility such as railroad or electricity transmission grid, but it can also be intangibles such as IP. To say the least, the essential facilities doctrine has been controversial among economists and legal scholars because the doctrine can potentially be in tension with IP laws; the IP owner, in principle, has no duty to license his IP to third parties. Thus it is more or less a consensus that requiring a firm to contract with a third party against its will should be used only under *exceptional circumstances*. Below I discuss some of the arguments for and against the invocation of the essential facilities doctrine.

### **Rationales for the essential facilities doctrine**

Despite many adverse impacts discussed below, there can be circumstances under which the essential facilities doctrine can be rationalised. Needless to say, the essential facilities doctrine would be justified if the beneficial effect of ensuring competition outweighs any potential adverse impacts. Some of the economic arguments proposed for the doctrine are as follows.

#### *The infant industry type argument*

There is an economic argument in the international trade literature that providing *temporary* protection to the infant domestic industries and shielding them from international competition can create an environment in which they can grow and be competitive in the international market. This argument is essentially dynamic and a similar type of the argument can be made in the context of essential facilities. Forced access to competitors may create a level playing field in which they can grow to eventually develop their own facilities which would not have been possible without the initial access, and thereby dynamic efficiency can be achieved. Of course, the difficulty with this argument would be how we can identify such cases.

#### *Second-best variety arguments*

There are also a variety of arguments that can be considered as variations of the second-best argument. The theory of the second best in economics shows that if the initial condition of the economy already has some type of distortions, it is possible that adding additional distortion can improve the situation. Applied

to the current context, imagine that the owner of the facility is already regulated owing to various imperfections in the economy. Then, adding additional constraint of forced sharing of the facility with third parties may not require additional inefficiency while promoting competition. Another argument is that if the monopoly power or the ownership of the essential facility was not the result of business acumen, but rather a giveaway by the government, the doctrine can be certainly justified because there is no issue of discouraging ex ante investment.

## **The essential facilities doctrine and its potential adverse impacts**

### *Adverse impacts on investment incentives*

The first problem with forcing a monopolist to share a facility is its adverse impacts on investment incentives for potential monopolists *and* competitors. As a result, the application of the essential facilities doctrine can entail serious dynamic efficiency loss. This problem can be especially harmful in innovative industries.

The incentive for a monopolist to invest in efficient facilities is obviously determined by the returns it can receive from them. Forcing a firm to share its facility without adequate compensation deprives the firm of reaping the rewards of its own investments. The incentive to invest in a facility that creates efficiency would be reduced if its competitors were, upon request, able to free ride and share the benefits of that investment. Thus the mere fact that a monopolist's facility confers it an advantage vis-à-vis its competitors cannot be grounds for requiring access to the facility. This is especially true in dynamic industries in which process and product innovations are the main vehicle of competition to achieve advantages over rival firms.

It is universally accepted that preserving innovation incentives is one of the most critical factors in improving social welfare. For instance, in a classical study on the importance of innovations for social welfare, Robert Solow estimated that about 80 per cent of the increase in gross output per worker-hour in the United States could be attributed to technical progress.<sup>5</sup> This implies that maintaining incentives to innovate should be a top priority in antitrust policy goals.

The promotion of innovations, however, requires sacrificing static efficiency due to the public good nature of knowledge. To quote Arrow, "any information obtained, say a new method of production, should, from the welfare point of view, be available free of charge", which "insures optimal utilization of the information".<sup>6</sup> This logic follows from the fact that once it is created, the marginal cost of duplicating information is essentially zero. However, without any compensation to the creator of new information, there would be no incentives to innovate in the first instance. Thus there is an inherent tension between static and dynamic efficiency in the achievement of optimal allocation for information goods. IPRs that confer on the creator of information exclusive monopoly rights are a manifestation of society's willingness to sacrifice some short-term gains in the form of greater access to a facility in the pursuit of more facility innovations over time that will be available to utilise. In this sense, the essential facilities doctrine has detrimental effects on innovation incentives, ultimately hurting consumers owing to the delay or non-availability of innovative products.

The application of the essential facilities doctrine also provides perverse incentives for potential competitors; the right to share the facility creates incentives to free ride on the monopolist's investment and thus discourages potential competitors from developing their own alternative facilities. The incentives to free ride on the monopolist's facility without incurring their own investment costs also imply that the claim of "essential facility" by potential competitors sometimes need to be taken with a dose of scepticism.

<sup>5</sup> Robert M. Solow, "Technical Change and the Aggregate Production Function" [1957] *Review of Economics and Statistics* 312.

<sup>6</sup> Kenneth J. Arrow, "Economic Welfare and the Allocation of Resources for Invention" in NBER, *The Rate and Direction of Inventive Activity* (Princeton: Princeton University Press, 1962), p.616.

### *The need for the supervisory role of antitrust agencies*

Another problem with the application of the essential facilities doctrine is its need for ongoing regulatory supervision in the style of public utilities regulation. Simply requiring a monopolist to share a facility does not automatically lead to better competition in the absence of judicial oversight of the access price.

To understand this better, consider the two extreme cases. If the monopolist charges an infinitely high access price, the intervention has no bite since the situation is economically equivalent to the pre-intervention situation where the access is simply denied. If the access is free, however, the monopolist is not compensated properly and there would be no incentives to invest in and maintain the facility, as discussed above. The essential facilities doctrine thus necessarily requires the antitrust authority to take the role of a central planner or a public utility regulator who is entrusted to set the optimal access price. This is a task that is ill suited for antitrust agencies. It is well documented, both theoretically and empirically, that implementation of price regulation is replete with all sorts of information and incentive problems. Determining the optimal access price is a complex process that requires detailed knowledge of the cost structure in the specific industry regulated. Arguably, antitrust authorities do not possess the necessary information and expertise to determine what the optimal access price should be. To make matters worse, the difficult task of setting the optimal price becomes more complicated when taking into account that the price may vary over time owing to changing environments. This problem would be especially acute in dynamic industries that are characterised by constant innovations and new product developments. In industries with rapidly evolving technologies, it would be impractical to write a licensing contract that covers all future contingencies. This implies the need for continuous involvement of antitrust authorities in the licensing process with compulsory licensing, a task out of antitrust authorities' expertise. In particular, one risk associated with compulsory licensing is gaming of the system by potential licensees in the implementation process. For instance, in the *Microsoft* case in Europe, the Commission declared Microsoft's licensing royalty excessive and fined the company further partly based on the lack of licensing. However, this type of intervention has the unfortunate side effect of further encouraging the licensees to hold out to elicit better licensing terms with the help of antitrust authorities, and thus undermines the original intent of compulsory licensing.

In addition, the regulation of access pricing in a rapidly changing environment inevitably imposes unnecessary costs of regulatory uncertainty. It is well established in the economics literature that an increase in uncertainty decreases investment.<sup>7</sup> Thus more uncertainty created by regulation would lead to fewer incentives to invest in creating the facility in the first place. Consistent with this point, recent surveys by the Economist Intelligence Unit and Ernst and Young also reveal that firms view regulatory risk as the greatest threat to their businesses.<sup>8</sup> Thus applying the essential facilities doctrine for the purpose of promoting ex post static efficiency has an adverse consequence of undermining ex ante investment incentives, which can lead to a serious loss of dynamic efficiency, especially in innovative industries.

### **Legal precedents for the essential facilities doctrine**

Owing to the concerns about dynamic efficiency discussed above, the essential facilities doctrine has been controversial among economists and legal scholars. Legal precedents also reflect the above discussed concerns about the potential pitfalls of the essential facilities doctrine.

In the United States, the Supreme Court has never recognised the essential facility doctrine as an independent theory of antitrust liability even though there are some advocates of the doctrine who argue that there are decisions decided on other grounds, but can be viewed as supporting the essential facilities

<sup>7</sup> See, for instance, John V. Leahy and Toni M. Whited, "The Effect of Uncertainty on Investment: Some Stylized Facts" (February 1996) *Journal of Money, Credit and Banking* 64.

<sup>8</sup> Available at <http://eiu.com> and <http://www.ey.com> [Both accessed October 12, 2010].

doctrine.<sup>9</sup> For instance, the concern about the supervisory role of antitrust agencies and potential collusion is expressed in the US Supreme Court *Trinko* decision.<sup>10</sup> According to the opinion of the court delivered by Justice Scalia:

“Enforced sharing also requires antitrust courts to act as central planners, identifying the proper price, quantity, and other terms of dealing—a role for which they are ill-suited. Moreover, compelling negotiation between competitors may facilitate the supreme evil of antitrust: collusion.”

Concerning the adverse impact of the doctrine on investment incentives and no duty for dominant firms to license third parties, the *Bronner* decision in Europe states that:

“[T]he incentive for a dominant undertaking to invest in efficient facilities would be reduced if its competitors were, upon request, able to share the benefits. Thus, the mere fact that by retaining a facility for its own use a dominant undertaking retains an advantage over a competitor cannot justify requiring access to it.”<sup>11</sup>

The same principle is also enunciated in *Antitrust Guidelines for the Licensing of Intellectual Property* (1995) jointly published by the Department of Justice and Federal Trade Commission in the United States. According to the *Guidelines*, market power does *not* “impose on the intellectual property owner an obligation to license the use of that property to others”.

Case law in Europe, in particular, however, recognises that there may be *exceptional circumstances* under which interference with IPRs may be justified. In Europe, *Magill*<sup>12</sup> established the exceptional conditions that would warrant intervention by competition authorities. The conditions, which were reaffirmed later in *IMS Health*,<sup>13</sup> are as follows:

- The information in question is indispensable to compete in the relevant secondary market.
- The refusal of access to essential elements would prevent the emergence of a new product which is not offered by the dominant firm and for which exists a demand.
- There is no objective justification for the refusal.

It is worth mentioning that the previous decisions in *Magill* and *IMS Health* emphasised the criterion of a *new product* as a central condition for the denial of access to essential elements to be abusive. To quote *IMS Health*, refusal may be considered abusive:

“only where the undertaking which requested the licence does not intend to limit itself essentially to duplicating the goods or services already offered on the secondary market by the owner of the intellectual property right, but intends to produce new goods or services not offered by the owner of the right and for which there is a potential consumer demand.”<sup>14</sup>

The emphasis on new products with a “forward looking” view is also echoed in the interoperability requirement mandated by Judge Kollar-Kotelly in the US *Microsoft* case. The basic premise of the consent decree approach in the United States is that “[p]arties negotiating a consent license focus less on past harm and more on future competition and future innovation”.

<sup>9</sup> Thomas F. Cotter, “The Essential Facilities Doctrine” in Keith N. Hylton (ed.), *Antitrust Law and Economics* (Cheltenham UK: Edward Elgar Publishing, 2010), p.157.

<sup>10</sup> *Verizon v Trinko* 540 U.S. 398 (2004).

<sup>11</sup> *Oscar Bronner GmbH & Co KG v Mediaprint Zeitungs- und Zeitschriftenverlag GmbH & Co KG* (C7/97) [1998] E.C.R. I-7791; [1999] 4 C.M.L.R. 112 at [57].

<sup>12</sup> *Radio Telefís Éireann v Commission of the European Communities* (C-241/91 P) [1995] E.C.R. I-743; [1995] 4 C.M.L.R. 718.

<sup>13</sup> *IMS Health GmbH & Co OHG v NDC Health GmbH & Co KG* (C418/01) [2004] E.C.R. I-5039; [2004] 4 C.M.L.R. 28.

<sup>14</sup> *IMS Health* [2004] E.C.R. I-5039; [2004] 4 C.M.L.R. 28 at [49].

Overall, the doctrine in the current state is in a grey area with a considerable amount of legal uncertainty even though there are some legal cases that potentially delineate the circumstances under which the essential facilities doctrine can be applied. In the United States, the situation is more agnostic: even the existence of the doctrine is not clear, let alone the specific conditions under which it can be applied. In contrast, the doctrine seems to be a rather accepted principle in Europe even though the application of it requires very stringent conditions. The more favourable disposition in Europe perhaps reflects a more sanguine view and optimistic belief about the competition authorities' ability to regulate and implement mandatory access to essential facilities.

Taken together, one common denominator that comes out from legal precedents and economic theory seems to be that the essential facilities doctrine should be invoked very rarely, and only in the most extraordinary circumstances in which market evidence clearly indicates that the conduct has a *specific intent* to monopolise, and when there are no justifiable efficiency reasons for it, considering the potential risks associated with the doctrine discussed above. Otherwise, the shadow of the doctrine would undermine investment incentives, create unnecessary regulatory uncertainty and entail high administration costs that could easily outweigh any static efficiency gain. Areeda and Hovenkamp go even further. They state that “the essential facility doctrine is both harmful and unnecessary and should be abandoned”.<sup>15</sup>

## Implementation of compulsory licensing for interoperability information

In the IP context, an obligation to make essential facilities available is equivalent to a requirement for compulsory licensing. I now discuss more specific issues of compulsory licensing relevant to the software industry. Especially when compulsory licensing is applied to interoperability information, there are additional complications to consider in its applications.

### “Implementation” v API information

For physical facilities it may be relatively easy to specify what constitutes essential facilities and thus what should be available to third parties. For IP, the separation may not be as simple as physical facilities. In addition, IP tends to be “lumpy” and making available part of information without revealing the rest may be difficult.

More specifically, the essential facilities cases in the software industry tend to concern interoperability of different software. Interoperability defines the ability of two products to work together. There can be different ways to achieve interoperability depending on the nature of the two products involved. In software, one way to achieve interoperability is through the exposure of the API information. The European Commission makes a distinction between “implementation” of actual code and “interface specification” in its decision against Microsoft:

“A specification is a description of what the software product must achieve, whereas the implementation relates to the actual code that will run on the computer.”<sup>16</sup>

It is argued that for the interoperability requirement, what needs to be revealed is merely interface information without access to implementation details concerning the actual codes.

However, the extent to which interoperability can be achieved through the API depends crucially on the design of the software involved. In some cases, there may be clear separation between the API and implementation information. In other cases, the design of software may make it technically difficult to

<sup>15</sup> Phillip E. Areeda and Herbert Hovenkamp, *Antitrust Law: An Analysis of Antitrust Principles and Their Application*, 3rd edn (New York: Aspen Publishers, 2006), p.196.

<sup>16</sup> COMP/C-3/37.792 — *Microsoft* at [24], available at <http://ec.europa.eu/comm/competition/antitrust/cases/decisions/37792/en.pdf> [Accessed October 12, 2010].

expose the API information without revealing the knowledge of inner workings of the actual code, i.e. “implementation” information. Alternatively, if the compulsory licensing of the API information is foreseen by a dominant firm, it may not develop innovative software products or delay the introduction of them unless it can come up with an API that limits the divulgence of its implementation information.

Moreover, when the boundary of these two types of information is blurry, there can be disputes concerning the extent of information needed to ensure interoperability, as witnessed in the European *Microsoft* case. In addition, “interoperability is a matter of degree”<sup>17</sup> and the term interoperability itself can be interpreted with different meanings by technicians in various contexts, as pointed out by the European Commission,<sup>18</sup> which makes the implementation of mandatory interoperability in the software industry more difficult than the case for physical facilities.

### *Difficulty of restricting the use of disclosed information*

When the essential facility at issue is a physical one, it is relatively straightforward to specify and control the extent of access available to third parties. For instance, if the essential facility is an electricity grid in certain geographic areas, the access can be limited to the electricity grid in those areas. In contrast, if the essential facility is IP, it may be difficult to limit the use of it in other areas or related fields. This concern can be especially pertinent with the recent trend towards globalisation and multinational firms that operate in many geographic areas. To use the example of the *Microsoft* case in Europe, it would be impractical to enforce that the interoperability information shared with third-party vendors of Windows server software be limited to the products sold only in Europe. Thus compulsory licensing enforced in Europe can affect competitive conditions in other areas as well. This also raises the possibility of “forum shopping”. With multiple antitrust authorities in different jurisdictions, competitors of the essential facility owner have incentives to bring the case to the antitrust authority with most sympathetic ears.

### *Determination of access fee*

When compulsory licensing is imposed as an antitrust remedy, it rarely imposes a specific term for the licence, other than the requirement that a royalty be “reasonable”.<sup>19</sup> The question then becomes what should be a “reasonable” royalty rate that can be charged by the IP owner. There is no simple answer to this. One simple and easily implementable method would be to charge the rates other licensees pay for the same, or comparable, IP.<sup>20</sup> However, if there is no sound standard for comparison because there is no precedent of licensing this information, which would be the typical situation in compulsory licensing cases, the determination of a reasonable royalty rate becomes much more difficult.

When there is no proper standard for comparison, it is necessary to devise a framework to determine the proper royalty rates that would ensure proper remuneration for the development of the IP at issue and at the same time maintain fair competition in the complementary component market.

The question of how an owner of a bottleneck facility should set the access price for rival suppliers of a complementary component has been investigated by many economists in the context of regulation. A typical situation considered for optimal access pricing is as follows. There is a vertically integrated dominant firm that controls the supply of a key input to its competitors. The rival firms must have a unit of access

<sup>17</sup> COMP/C-3/37.792 — *Microsoft* at [33], available at <http://ec.europa.eu/comm/competition/antitrust/cases/decisions/37792/en.pdf> [Accessed October 12, 2010].

<sup>18</sup> COMP/C-3/37.792 — *Microsoft* at [32], available at <http://ec.europa.eu/comm/competition/antitrust/cases/decisions/37792/en.pdf> [Accessed October 12, 2010].

<sup>19</sup> For instance, in the European *Microsoft* case, the Commission authorised Microsoft to charge competitors a “reasonable” royalty for using its IPRs on interface between client and server programs.

<sup>20</sup> “The royalties received by the patentee for the licensing of the patent in suit, proving or tending to prove an established royalty” is indeed one of the 15 factors in the determination of “reasonable royalty rates” even though it is used for patent infringement cases. See *Georgia-Pacific Corp v United States Plywood Corp* 318 F. Supp. 1116, 6 U.S.P.Q. 235 (S.D.N.Y. 1970).

to the key input in order to provide a unit of the final product. This issue arises in a variety of regulated industries characterised by natural monopoly cost conditions with large fixed costs such as local telecommunications, electricity, electricity transmission and gas transportation. The optimal royalty rate in the compulsory licensing of IP can be analysed similarly in the antitrust context for an owner of an unregulated “essential facility” that also produces a complementary component. To this end, it would be advisable to borrow insights from the extensive literature on the optimal regulation of access pricing to essential facilities, if possible.

However, there are many alternative mechanisms to determine access prices, which can differ depending on the regulator’s objectives, constraints, available instruments, and informational requirements in implementing them. Unfortunately, there is no consensus among economists concerning what constitutes the optimal terms under which rival firms can access an incumbent firm’s bottleneck facility.<sup>21</sup> In addition, the main component of software cost is in the development stage, which may be more difficult to ascertain than the operating cost of physical facilities.

## Concluding remarks

The essential facilities doctrine still remains controversial. Antitrust authorities face a difficult task of balancing ex post competition against ex ante incentives to develop innovative products. To reflect the difficulty of this problem, there does not seem to be any consensus among academics and practitioners on the conditions under which it may be invoked, let alone how to set the terms of access. The legal precedents also lack clear standards and are in a murky situation. Compulsory licensing—an application of the doctrine to IP—adds additional complications in terms of its implementation owing to the special properties of information vis-à-vis physical facilities.

Despite the desirability of legal certainty concerning conditions under which compulsory licensing can be imposed as an antitrust remedy, achieving this goal seems to be elusive. Beyond the general principle that the use of compulsory licensing should strike the right balance in the trade-off between the assurance of the static competition by requiring the IP owner to provide access information and the promotion of dynamic efficiency by fostering innovations, it seems to be difficult to come up with a simple and predictable legal standard because each case presents its own unique characteristics in terms of industry conditions and technology involved. An appropriate antitrust rule certainly needs to accommodate the specifics of the case. Even a rule applied to the same industry may need to change over time with the evolution of the relevant technologies to reflect changes in the underlying conditions. Thus the application of essential facilities to the software industry in the form of compulsory licensing requires extra caution owing to its difficulty in implementation and potentially adverse effect on innovation incentives.

<sup>21</sup> From the purely theoretical perspective, the so-called Ramsey pricing that chooses the incumbent’s final product prices and access charges simultaneously maximises social welfare. However, this entails the regulation of the final product price in addition to access charges. Moreover, the optimal Ramsey pricing rule prescribes access charges that are discriminatory. Despite the theoretical justifications, this rule is hardly used in practice and I do not discuss this one further. See Mark Armstrong, “The Theory of Access Pricing and Interconnection” in M.E. Cave, S.K. Majumdar and I. Vogelsang (eds), *Handbook of Telecommunications*, Vol.1 (Amsterdam: North-Holland, 2002), pp.297–384.

# Open Source Software: Economics, Innovation, Law and Policy

**Rishab Aiyer Ghosh\***

*Head, Collaborative Creativity Group, United Nations University; Maastricht Economic Research Institute on Innovation and Technology (UNU-MERIT)*

© Copyright; Developing countries; Economics and law; Open-source software; Patents; Technology transfer

## **Kumasi, Ghana—freedom to tinker**

“I can make any car. Ask me,” said Frank Darko, one of an estimated 80,000 mechanics in Suame Magazine, an industrial slum outside Kumasi, Ghana. “A Mercedes Benz?” asked the BBC reporter.<sup>1</sup> “I need the engine but the body I can build it. It would take me two or three weeks to complete it, if you bring the engine and chassis,” Darko replied. As the BBC noted:

“Few of Mr Darko’s customers want Mercedes Benz and few want their cars built from scratch. But many bring cars, trucks, buses and trailers so badly damaged that in any other country they would be a write-off. In the hands of Mr Darko and others like him, life is breathed back into hulks of scrap metal and fashioned with heat and hammers into something, well almost new.”

Did anyone teach Mr Darko how to build a car? Developing countries are full of highly skilled people who learnt how to do things through systems that are not completely informal, but are also not formal in the sense that schools and universities are. Learning how to build a car, for Mr Darko and the hundreds of thousands like him across Africa, Asia and Latin America, required being among other people skilled at building cars—and working with cars that could be opened up, tinkered with and understood.

In the past two decades, open source software has emerged from something that a few hackers in European and American universities tinkered with, to a leading model for software development used by the biggest and most innovative companies in the world. The value of free software is estimated at over \$40 billion in terms of the effort put in to develop it. But, unlike proprietary software, sold per copy for licence fees, this is all available, to everyone, at no charge. Perhaps more important than the lack of a price-tag is the freedom such software comes with—unlike proprietary software, open source software can be opened up like a car, tinkered with,<sup>2</sup> understood and changed to produce something new and different.

Unsurprisingly, therefore, the hundreds of thousands of open source developers around the world state that their main reason for participating in this system is to learn and develop new skills. Like the mechanics of Kumasi, these skills are learnt outside any formal system of education—but studies have shown that the skills are valued by employers, often even more than university degrees. This is true in the United

\* ghosh@merit.unu.edu.

<sup>1</sup> Orla Ryan, “Making Mercedes in Ghana”, BBC News, Kumasi, November 13, 2006, at <http://news.bbc.co.uk/2/hi/6133730.stm> [Accessed October 12, 2010].

<sup>2</sup> Ed Felten, Professor of Computer Science and Public Affairs at Princeton University, is credited with the phrase “freedom to tinker”, a topic covered extensively on his eponymous blog at <http://www.freedom-to-tinker.com/> [Accessed October 12, 2010].



States, Europe and Japan, where the majority of open source software, like the majority of all software, is developed; but it is also a finding from surveys conducted among developers and employers in poorer economies in Africa, Asia and Latin America.

An economic justification for intellectual property is that it incentivises the creation and flow of knowledge. The phenomenon of open source software and similar open knowledge systems shows that other incentives are possible, and may even have benefits over traditional models of implementing IP-based incentives (open source software uses copyright licensing, and can even involve strict enforcement, as this article discusses, but eschews royalties). What is extremely important about open knowledge systems like free software is that not only are they methods of skills and technology transfer from the economically rich world to the economically poorer one, but that they also allow people in developing countries to participate in the knowledge economy as producers and contributors, rather than as mostly consumers.

This article will summarise how open source software development works in economic terms, with a focus on aspects related to knowledge flow; show its contribution to innovation; describe its relationship to patents, copyright and enforcement; and conclude with a discussion of policy implications, in particular for economic development.

## Variegated motives and knowledge diffusion

To grossly oversimplify, the economics of open source software is this: contributors perceive benefits well in excess of their contributions,<sup>3</sup> and recognise that these benefits will not be sustained if they, and others, stop contributing.

Open source software often starts with some individual, well-organised group or firm, who release some initial kernel of software into the community—what I have described elsewhere as the “cooking-pot”<sup>4</sup>—under an open source software licence. The licence allows others to contribute to the software, who proceed to adapt it to their needs, make improvements and publish their changes back into the “cooking-pot”. Depending on the level of governance the originators build around the software, there may or may not be a semi-formal protocol around accepting modifications to an “official” version of the software. Some free software projects have an official version governed by a foundation (e.g. most GNU projects by the Free Software Foundation, Apache by the Apache Software Foundation, the Linux kernel by Linus Torvalds acting as “benevolent dictator”). The licensing model means that these governance structures depend on their voluntary acceptance by the community they serve, as contributors are free to distribute their modified versions of software. While most contributions are very small—following a power law distribution<sup>5</sup>—the potential for receiving small contributions from an infinite pool of talent is essential.<sup>6</sup> As Linus Torvalds told me in the first interview on the economics of Linux, “the large user-base has actually been a larger bonus than the developer base”.<sup>7</sup> The fact that individual contributions are relatively small in comparison to the ability to access the joint output of thousands is what keeps the “cooking-pot” sustainable: the minimal transaction cost of contributing, resulting from relaxed licensing requirements, allows a large number of loosely co-ordinated contributions to coalesce into coherent products.

<sup>3</sup> R.A. Ghosh, “Measuring Free Software: Cooking-pot Markets and Balanced Value Flows” in Rishab Ghosh (ed.), *Collaboration, Ownership and the Digital Economy* (Cambridge: MIT Press, 2005).

<sup>4</sup> R.A. Ghosh, “Cooking Pot Markets: An Economic Model for the Trade in Free Goods and Services on the Internet”, *First Monday*, Vol.3, No.3 (March 1998), at [http://www.firstmonday.org/issues/issue3\\_3/ghosh/](http://www.firstmonday.org/issues/issue3_3/ghosh/) [Accessed October 12, 2010].

<sup>5</sup> See, e.g., various studies cited by G. Robles and J.M. Gonzalez-Barahona, “Developer Identification Methods for Integrated Data from Various Sources”, *ACM SIGSOFT Software Engineering Notes*, Vol.30, Issue 4 (July 2005).

<sup>6</sup> If large contributions from a few individuals or firms were sufficient, there would be no need to release the software as open source; individuals would simply incorporate; firms would form a consortium.

<sup>7</sup> R.A. Ghosh, “Interview with Linus Torvalds: What Motivates Free Software Developers?”, *First Monday*, Vol.3, No.3 (March 1998), at [http://www.firstmonday.org/issues/issue3\\_3/torvalds/](http://www.firstmonday.org/issues/issue3_3/torvalds/) [Accessed October 12, 2010].

The low barrier to contribution means that motivations can be weak, and variegated. (Of course, larger contributors must be more strongly motivated.) Contributors are driven by many things, from the need to improve the software for one's own use, to generating recognition and reputation, to learning and developing technical and other skills. Larger contributors typically receive significant material benefits, such as being hired by firms owing to their open source contributions, although they will typically not state that these are motivating factors.<sup>8</sup> Contributing firms have other, equally diverse motives, including setting de facto standards, distributing maintenance and follow-on development costs to other firms, creating a market for complementary products and services, and signalling to potential employees their ability to foster talent and innovation.<sup>9</sup>

### Informal apprenticeships for technology transfer

The motivating factor I want to focus on here, though, is related to the use of open source software to provide incentives for the rapid diffusion of knowledge: learning and developing new skills. The Free/Libre/Open Source Software (FLOSS) study in 2002,<sup>10</sup> a comprehensive study of developers and users, first showed that the most important reason reported by developers for their participation in open source communities was to learn new skills. Further large-scale surveys in 2005–2006 in Europe, the United States, Japan<sup>11</sup> and in 2006–2008 several developing countries in Asia, Africa and Latin America<sup>12</sup> showed that these skills are valuable, help developers get jobs and can help create and sustain small businesses. The skills referred to here are not those required to use open source software, but those learnt from participation in free software communities. Such skills include programming (of course), but also skills rarely taught in formal computer science courses, such as copyright law and licences (a major topic of discussion in many free software projects). Teamwork and team management are also learnt—after all, the team management is required to co-ordinate the smooth collaboration of 3,000-plus people (for instance, developing the Linux kernel) who rarely see each other and have no employment relationship with the management is more intensive and far subtler than what is required to co-ordinate teams employed in a single software company.

Some findings from the FLOSS survey are appropriate here: 78 per cent of developers join the free software community “to learn and develop new skills”; 67 per cent continue their participation to “share knowledge and skills”. These learnt skills have economic value to developers—30 per cent participate in the free software community to “improve ... job opportunities”; over 30 per cent derive income directly from this participation and a further 18 per cent derive indirect income—such as getting a job unrelated to free software thanks to their previous or current participation in free software developer communities. Being a Linux kernel developer proves a certain level of skills in many ways far better than having a computer science degree from MIT, and employers benefit from such informally learnt skills.

Open source communities function like informal apprenticeships—but the apprentice/students and master/teachers contribute their own time “for free”, without any monetary compensation specifically for the training process. There is certainly a social cost, but it is borne by the participants themselves and not paid for *directly* by those who benefit (such as current or future employers, or society at large). One big

<sup>8</sup> Ghosh, “Measuring free software” in *Collaboration, Ownership and the Digital Economy*, 2005.

<sup>9</sup> R.A. Ghosh et al., *Economic Impact of Open Source Software on Innovation and the Competitiveness of the Information and Communication Technologies (ICT) Sector in the EU*, European Commission DG Enterprise (2006), paras 7.5 and 8.3, at [http://ec.europa.eu/enterprise/sectors/ict/files/2006-11-20-flossimpact\\_en.pdf](http://ec.europa.eu/enterprise/sectors/ict/files/2006-11-20-flossimpact_en.pdf) [Accessed October 12, 2010].

<sup>10</sup> R.A. Ghosh, R. Glott, B. Krieger and G. Robles, *Free/Libre and Open Source Software: Survey and Study*. Part IV: Survey of Developers (Maastricht: International Institute of Infonomics/MERIT, 2002), at [http://www.flossproject.org/report/FLOSS\\_Final4.pdf](http://www.flossproject.org/report/FLOSS_Final4.pdf) [Accessed October 12, 2010].

<sup>11</sup> R.A. Ghosh and R. Glott, *Free/Libre and Open Source Software: Policy Support. Skills Survey Interim Report* (Maastricht: MERIT, 2005), at [http://www.flosspols.org/deliverables/FLOSSPOLS-D10-skills%20survey\\_interim\\_report-revision-FINAL.pdf](http://www.flosspols.org/deliverables/FLOSSPOLS-D10-skills%20survey_interim_report-revision-FINAL.pdf) [Accessed October 12, 2010].

<sup>12</sup> Paul A. David, R.A. Ghosh, R. Glott, J. Gonzalez-Barahona, F. Heinz and J. Shapiro, *Free/Libre and Open Source Software: Worldwide Impact Study. International Report: Skills*. (Maastricht: MERIT, 2007), at <http://www.flossworld.org/deliverables/D31%20-%20Track%201%20International%20Report%20-%20Skills%20Study.pdf> [Accessed October 12, 2010].

reason this is possible is due to the externalisation of training costs into the software licensing model itself—the ability to use, study, modify and distribute all open source software, the *freedom to tinker*, makes skills development a process of learning by doing, rather like how Mr Darko learnt about cars.

Everyone can benefit equally from this training—any employer can hire someone informally “trained” through participation in the free software developer community. However, not everyone directly invests equally in it. As many “teachers” within the community have been formally trained at university or at work, with their training explicitly paid for, explicit costs are being borne for *some proportion* of community participants who have been formally trained; but learning benefits accrue to *all* community participants including those without formal training.

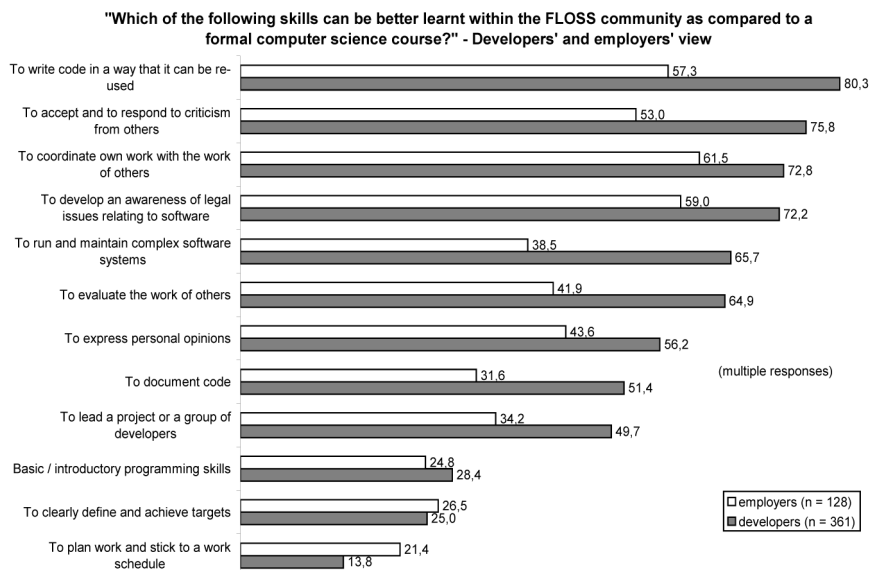
In the larger perspective, this training system where all participants benefit from the products of the system, but only some explicitly pay for it, represents a subsidy—or technology transfer—from those who pay for formal training to those who do not (or cannot). Within countries, this represents a technology transfer from big companies who often formally pay for training to small and medium-sized enterprises, who can less afford formal training expenses. Globally, this represents a technology transfer from the usually richer economies who can afford formal training, to the usually poorer ones who cannot.

There are also sectoral benefits, especially within poorer economies. Poor countries may have formal computer training during computer science degree courses, but perhaps not in other subjects, such as biology. Anecdotal evidence (in the case of biology, from India) suggests that the use of free software platforms during formal training in non-computer subjects may encourage informal learning of computer skills by students, thereby increasing their understanding of their own course subject (by better being able to conduct biology experiments through more sophisticated computer analysis). Open source software usage can thus provide students of other subjects to informally learn computer skills, programming skills and enhance their competence in their formal training.

More than programming skills, however, participation in open source communities teaches other skills that are often not learnt in formal computer science classes: management and teamwork, understanding of legal issues, and general linguistic skills. Interestingly, in parallel surveys of a large sample of community participants and HR managers at employer firms,<sup>13</sup> respondents indicated that several skills were better learnt through FLOSS community interaction than through formal courses (see Figure 1).

<sup>13</sup> Ghosh and Glott, *Free/Libre and Open Source Software: Policy Support. Skills Survey Interim Report*, 2005, at [http://www.flosspols.org/deliverables/FLOSSPOLS-D10-skills%20survey\\_interim\\_report-revision-FINAL.pdf](http://www.flosspols.org/deliverables/FLOSSPOLS-D10-skills%20survey_interim_report-revision-FINAL.pdf) [Accessed October 12, 2010] (EU); David et al., *Free/Libre and Open Source Software: Worldwide Impact Study*, 2007, at <http://www.flossworld.org/deliverables/D31%20-%20Track%201%20International%20Report%20-%20Skills%20Study.pdf> [Accessed October 12, 2010] (Asia, Africa, Latin America).

Figure 1: Skills learnt from FLOSS compared to formal courses (EU responses only)<sup>14</sup>



Clearly, open source software's licensing model provides a method of incentives for knowledge diffusion based on *reducing* rather than *increasing* transaction costs and knowledge access barriers—in contrast to traditional approaches towards IPR licensing. This knowledge diffusion effect is empirically shown to be valued by the individuals and firms that participate in the open source process; the appeal of open source software as a potentially low-cost method of providing technology transfer, skills training and access to knowledge in developing countries should also be obvious, and will be considered in the conclusion of this paper. First, however, we look at how this open model of knowledge diffusion relates to rapid innovation in the field of software.

## Palo Alto and San Francisco: Open source and innovation

After several years conducting research on the economics of open source software and similar collaborative systems for knowledge creation, I have recently been spending much time in San Francisco and the Silicon Valley as co-founder of a startup backed by Venture Capital investors. Making money—eventually—is clearly the most important thing in such an environment. So it was perhaps mildly surprising to find that open source software is ubiquitous in the highly competitive, highly innovative world of technology firms in the Bay Area.

Academics and policymakers still debate what the economic impact of open source is, and what role it plays in the world of information technology. Discussions abound regarding, for example, “mixed source”, conflating the clear, precisely defined IPR licensing distinction between open and “closed” source *software*, and business models where every business will naturally strive to have some differentiators unique to itself thereby being to some degree not perfectly “open”.

<sup>14</sup> Responses from developing countries in Africa, Asia and Latin America were gathered in later (2006–2007) surveys of over 1000 developers and over 700 employer firms and are therefore excluded from this table.)

Meanwhile, in Silicon Valley, there's no argument any more: "open" is the default for the world's most innovative companies. The degree of openness varies, naturally, with the dependence and role played by software. Open source software is the norm for platforms and development tools. Firms that develop and release software usually release it under open source licences either because they are building above existing open source software, or because it suits their business models to do so. Most firms, however, focus not on the release of software packages as much as the release of software-dependent *services*, where the software they build upon is, by default, open source. Packaged proprietary software, when found in Silicon Valley startups, is typically found on the systems used for office administration, or possibly for graphic design where Adobe's Photoshop still dominates. The exception to the open-source-everywhere rule is perhaps the very widespread use of Apple products, which involve beautifully designed hardware running fairly proprietary software. Even this exception is interestingly rooted in open source—Apple products from laptops to the iPhone all run the open source operating system FreeBSD, and are full of open source tools.

Some of the world's best open source software developers are based in the Bay Area, having moved there from elsewhere in the world to work at start-ups (or former startups that are big supporters of and highly dependent on open source software, such as Google or Facebook). Despite having a strong incentive to ensure their few employees are all focused on the company, start-ups typically allow their talent to contribute to open source software projects, sharing knowledge they are developing with others in the community and with potentially competing firms.<sup>15</sup>

Perhaps the preponderance of open source in California's high-tech firms should not be so surprising. The Bay Area's successful emergence as the epitome of innovation clustering is well known to be a result of openness in knowledge flow. Saxenian<sup>16</sup> explored in depth the reasons for why Silicon Valley, which was mostly farmland when the Route 128 corridor around Boston already had technology companies spun off from Harvard and MIT, developed rapidly then surpassed the Boston corridor (and every other place in the world) as the centre for high technology innovation. She found that Silicon Valley companies adopted open protocols and standards in contrast to the Boston corridor's preference for proprietary technologies; and that Silicon Valley had a high rate of employee mobility, with people frequently moving among big firms and new start-ups, sharing knowledge as they went. She ascribed these differences to a culture of openness.

In a later study, Gilson<sup>17</sup> explained how this culture of openness coincided with a serendipitous peculiarity unique to California law: from as far back as 1872, clauses in employment preventing employees from moving to competing firms were considered invalid and unenforceable.<sup>18</sup> Gilson found no other significant difference between Silicon Valley and Route 128; indeed, given how strictly California courts have interpreted the non-enforceability of non-compete clauses, it is not hard to see the law's causal relationship with frequent job-hopping and knowledge sharing. Fallick et al.<sup>19</sup> provide the empirical evidence for these explanations, showing that intra-industry employer-to-employer mobility in Silicon Valley is *90 per cent* higher than the mean across US information technology clusters. Interestingly, job-hopping does not occur

<sup>15</sup> Start-ups do not, apparently, encourage their employees to fill out survey questionnaires. There appears to be little survey evidence available on the software choices of Silicon Valley start-ups, although the amount of anecdotal evidence is extensive as start-ups tend to publicise their use of technology platforms extensively.

<sup>16</sup> AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, MA: Harvard University Press, 1994).

<sup>17</sup> Ronald J. Gilson, "The Legal Infrastructure of High Technology Industrial Districts: Silicon Valley, Route 128, and Covenants Not to Compete" (1999) 74 NYU L. Rev. 575, 578.

<sup>18</sup> Interestingly, non-compete employment clauses have also been generally unenforceable in India; the Supreme Court has ruled that they are void as a "restraint of trade" under s.27 of the Indian Contracts Act, coincidentally also from 1872. I am not aware of any study of the possible impact of this legal environment on India's software industry, although the high employee turnover there is well known. See Valerie Demont and Janaki Rege Catanzarite, "Non-compete Clauses Unenforceable in India", *JURIST*, April 2, 2010 (University of Pittsburgh School of Law), at <http://jurist.law.pitt.edu/sidebary/2010/04/non-compete-clauses-unenforceable-in.php> [Accessed October 14, 2010].

<sup>19</sup> Bruce Fallick, Charles A. Fleischmann and James B. Rebitzer, "Job Hopping in Silicon Valley: Some Evidence Concerning the Microfoundations of a High Technology Cluster" (2006) 88(3) *Review of Economics and Statistics* 472.

as much in other industries clusters. Fallick et al. note that the tendency to change jobs frequently within an industrial cluster should arise, and be encouraged by California-like legal frameworks, when the gains from new innovations are large and uncertain, and depend on rapid diffusion of knowledge. This is very much the case for software and internet services.<sup>20</sup>

Rapid diffusion of tacit knowledge is certainly achieved when people frequently move jobs, typically to a firm where they believe their ideas and knowledge will most quickly be put to good use, as tacit knowledge spreads through interaction.<sup>21</sup> But it is hard to think of a more rapid form of knowledge diffusion for software technology than interaction through open source software community participation, for tacit knowledge, and code contribution, for codified knowledge. Open source, therefore, seems to have become part of the “culture” of Silicon Valley, in that it is assumed as the default choice for platforms upon which to build new technologies, and as the default (though not the only) choice for new software that is created.

Given the concentrated and speeded-up pace of innovation in the Silicon Valley, the attributes of open source that make it suitable for innovative firms become enhanced and focused. These attributes include: distributing platform development costs to partners and competitors, allowing firms to focus R & D spending on differentiators; spreading maintenance costs for non-differentiating software technology to partners and competitors; reaping the benefits of follow-on innovations even for technologies developed in-house.<sup>22</sup> All these attributes can be seen applied in abundance throughout Silicon Valley firms. Most famously, perhaps, Google’s original large-scale expansion was built on commodity hardware running Linux and other open source software as a platform for its search engine. Google has strongly supported several open source projects and released large amounts of open source code,<sup>23</sup> and Linux is the basis for the open source Android smartphone platform.<sup>24</sup>

It’s a similar story for more recent start-ups. Facebook is built on several open source technologies, starting with the classic LAMP stack (the Linux operating system, Apache web server, MySQL database, web-based scripting with PHP). Twitter uses a different scripting language, but runs on open source. Of course, like Google, their business model does not rely on selling software—but that is partly the point. There are few new start-ups that have a business model based on selling software as a product, at least partly because it is a business model that is seen to be incompatible with the software development model most efficient for rapid innovation and knowledge diffusion today. There is still a lot of software development going on, of course, and a lot of it is even released as (open source) products. Two highly innovative developments released by Facebook include HipHop, which allows developers to rapidly code in PHP, the popular simple web scripting, but converts this into fast, secure, low-level C++ to actually run on Facebook’s servers—or anyone else’s, now that it is open source. Cassandra, a highly scalable

<sup>20</sup> Approaching from a different angle, J. Bessen and E. Maskin, “Sequential innovation, patents, and imitation”, Working Paper, Boston University School of Law and Princeton University (2006) suggest that social welfare is expected to be higher without a patent system in domains where innovation is substantially sequential in nature. Such is the case in software, where new innovations are typically built up from hundreds of smaller innovations from the past, and completely independent innovations are extremely rare; and although the distinction between proprietary software and open source software is essentially one of copyright rather than patents, from an economic perspective it is the use of the temporary state-granted monopoly right that matters; proprietary software is similar in effect to a patent system, and open source equivalent to the patent-less system Bessen and Maskin model. Bronwyn Hall, “The Use and Value of IP Rights”, presented at the UK IP Ministerial Forum on the Economic Value of Intellectual Property, London, June 10, 2009, at [http://elsa.berkeley.edu/~bhall/papers/BHH09\\_IPMinisterial\\_June.pdf](http://elsa.berkeley.edu/~bhall/papers/BHH09_IPMinisterial_June.pdf) [Accessed October 12, 2010] cites Belenzon’s empirical evidence to suggest that in domains with sequential innovation, even the original innovator benefits from the absence of patenting through receiving spillover follow-on innovation: see S. Belenzon, “Knowledge Flow and Sequential Innovation: Implications for Technology Diffusion, R&D and Market Value” (Nuffield College, Oxford University, 2006), available at <http://www.economics.ox.ac.uk/Research/wp/pdf/paper259.pdf>. Again, the parallel to open source software, where firms cite receiving value from developments made to their software by others, is apparent. See, e.g., Ghosh et al., *Economic Impact of Open Source Software on Innovation and the Competitiveness of the ICT Sector in the EU*, 2006, paras 7.7.4 and 8.3.

<sup>21</sup> R. Cowan, P.A. David and D. Foray, “The Explicit Economics of Knowledge Codification and Tacitness” (2000) 9(2) *Industrial and Corporate Change* 211.

<sup>22</sup> Ghosh et al., *Economic Impact of Open Source Software on Innovation and the Competitiveness of the ICT Sector in the EU*, 2006, para.7.7.4.

<sup>23</sup> As well as publishing detailed descriptions of core—indeed, patented—technologies, such as the MapReduce framework for distributed computing which has seen open source implementations by community developers and competing firms.

<sup>24</sup> It is surely a fascinating time when three of the leading smartphone platforms are built on open source operating systems, two of them developed by open source community developers rather than firms (Linux for Google’s Android, FreeBSD for Apple’s iPhone; the third, Symbian, was developed and released as open source by Nokia).

distributed database system Facebook created to handle its messaging infrastructure and then open sourced is an example of the rapid innovation in data storage and retrieval systems taking place, almost all of it open source. Facebook correctly expected that several other firms would have both the need to use technology like Cassandra and the ability and interest to further develop it; indeed, much of Cassandra's development now takes place outside Facebook. Cassandra is part of the "NoSQL" movement, the biggest recent innovations in database technology, and other storage and retrieval products such as CouchDB and MongoDB have been developed by the open source community, with community members starting firms to provide commercial support.

Lucid Imagination is a company started in 2007 by developers of Lucene and Solr, open source search engine technologies that are very widely used in enterprise information retrieval and public websites. Lucid provides commercial support and unusually for a Silicon Valley start-up reports earning revenue since its launch in 2009; it has raised \$16 million in VC funding; its main competitor is Google's enterprise search offering.

Packaged proprietary software accounts for less than 20 per cent of software spending,<sup>25</sup> and firms whose main business is selling such software employ under 7 per cent of software developers.<sup>26</sup> Most software spending, and most software developers' time, is on in-house software development, or on creating custom software solutions. As the absence of license fees is the only limitation on business models for open source software, it turns out that the economics of open source is the economics of the majority of software development. As it comes with the additional attribute of promoting the rapid diffusion of knowledge, open source has today become a key factor, taken for granted, in the part of the world synonymous with rapid, high technology innovation.

If open source manages to provide incentives for knowledge sharing, how does it interact with the intellectual property rights that are the more traditional methods for doing so?

## **Munich, Germany—enforcing open source licensing**

On November 3, 2003, Harald Welte, the Berlin-based author of netfilter/iptables, a module within the Linux kernel that provides firewall services, wrote on his blog:

"Over the last couple of months I found out that quite a number of companies is violating my copyright by not adhering to the GPL [General Public License] ... I've also received significant indication about quite a number of other cases where GPL'd source code was used to build proprietary software. If I only had the time, I would like to start a website with a database of all known GPL violations, the companies involved, their response, the legal proceedings (if any). I've started with registering the gpl-violations.org domain name."<sup>27</sup>

Thus started one of the stranger chapters in the history of IPR enforcement.

If "software piracy is theft" as the slogan from an industry association goes, referring to copyright infringement, then who would "steal" something that is being willingly shared for no money? Quite a lot of reputable IT firms, it turns out.

Siemens, Fujitsu-Siemens, Asus, Belkin, Cisco Systems, Samsung, Best Buy, Verizon Communications and Dell are among the big names that have been found infringing the copyright of open source software developers; but the list includes hundreds of other firms, from European software companies to Chinese hardware manufacturers. Most firms do this out of ignorance or carelessness, and change their infringing

<sup>25</sup> Ghosh et al., *Economic Impact of Open Source Software on Innovation and the Competitiveness of the ICT Sector in the EU*, 2006, p.124, Table 24.

<sup>26</sup> Ghosh et al., *Economic Impact of Open Source Software on Innovation and the Competitiveness of the ICT Sector in the EU*, 2006, p.78, Table 16.

<sup>27</sup> Harald Welte, "Companies Violating the GPL of Software under My Copyright". Blog post, November 3, 2003, at <http://laforge.gnumonks.org/weblog/2003/11/03/#20031103-start> [Accessed October 12, 2010].

behaviour when notified, or settle out of court. It is not very good publicity to be accused of stealing from the commons, after all. Some cases have gone to court, however, generally resulting in rulings against the infringers. The first such case was brought by Harald Welte and his lawyer Til Jaeger against the German subsidiary of Sitecom, a network equipment provider.

In 2004, the Munich court ruled<sup>28</sup> that Sitecom had violated the terms of the General Public License (GPL) under which Welte released his code as part of the Linux kernel; the court noted that although the GPL did not require a royalty, it did have several conditions, and in violating those conditions Sitecom had no licence to copy Welte's software, and was infringing his copyright. Importantly, the court did not rule on the necessity of Sitecom explicitly agreeing to the terms of the licence.

It is necessary to understand that open source developers claim and exercise rights over their creations, even if this is done through unconventional uses of the legal framework. Open source artefacts—software, documentation—are not public domain, in the legal sense of the term,<sup>29</sup> though they may be public goods in the economic sense. The freedom or openness refers to software to which the “Four Freedoms” adhere<sup>30</sup>: users have the freedom to use, freedom to study, freedom to modify and freedom to share this software.

However, software authors own their code—under the Berne Convention, all copyrightable works are automatically covered by the copyright of the original creator at the moment of creation. No registration or notice—not even a copyright notice attached to the work—is required. Since software authors<sup>31</sup> own their code, they are free to sell it, or indeed to “give it away”. They must do this explicitly, and can impose conditions. Conditions may, of course, perpetuate the “Four Freedoms”.

Although the community has evolved its own implicit and explicit, informal rules and norms, the legal foundation of the open source is in copyright law. Authors have the sole right to license their software to others, and software users must follow licence terms—otherwise they are infringing authors' copyright.

While software authors can safely “give it away”, this would literally be releasing software into the public domain and disclaiming all future rights to it. This is rare (and not even possible in some legal frameworks, e.g. in jurisdictions which provide for inalienable moral rights of the author). Instead, licences for open source follow two broad models: permissive and reciprocal, and both involve the release to licensees of human-readable source code (which can be studied and modified) in addition to (where applicable) machine-readable object code.

## Models of open source licensing

The *permissive* licensing model is fairly close to the public domain. It allows licensees broad rights to use, study, modify, distribute the software with few if any conditions. Most conditions relate to disclaimer of warranty issues. Examples of such licences include the Berkeley BSD licence, under which the popular operating system FreeBSD and its relations are distributed. FreeBSD is at the heart of the products made by Apple, and the permissive nature of this licence is what allows Apple to make proprietary modifications in its iPhone and Macbooks without releasing the changes back to open source developers, though Apple still does release some of it.

The other licensing model, accounting for a majority of open source software, is *reciprocal*. Quite different from the public domain, this model forms a “protected commons”. Licensees have broad rights to use and study the software. If they distribute the software, they must provide recipients access to the source code (providing them the freedom to study). They must also provide recipients with the software under the same terms, allowing recipients to further use, modify or distribute it. Licensees can only modify

<sup>28</sup> Welte v Sitecom, District Court of Munich: 21 O 6123/04, at <http://dejure.org/dienste/vernetzung/rechtsprechung?Text=21%200%206123/04> [Accessed October 12, 2010]. English translation at <http://www.groklaw.net/article.php?story=20040725150736471> [Accessed October 12, 2010].

<sup>29</sup> With no claim of (copy)right, works in the public domain can be used in any way by any one; see Edward Samuels, “The Public Domain in Copyright Law” (1993) 41 *Journal of the Copyright Society* 137.

<sup>30</sup> See Richard Stallman, “The Free Software Definition”, available at <http://www.gnu.org/philosophy/free-sw.html> [Accessed October 12, 2010].

<sup>31</sup> Or their employers or institutions of learning, as applicable.



the software if the modified software is also distributed under the same terms, ensuring that recipients of such a derived work can further modify it. This ensures reciprocity by forming a “protected commons”—authors are contributing their software into a commons with certain freedoms attached, and further modifications must be made available with the same freedoms protected.

The best known reciprocal licence is also the most widely used, accounting for over 66 per cent of open source software projects,<sup>32</sup> the GNU General Public License (GPL<sup>33</sup>). The GPL is the licence used by the Linux kernel and several other large software packages. Other widely used reciprocal licences include the Mozilla Public Licence,<sup>34</sup> used for the popular web browser Firefox and the Lesser GPL,<sup>35</sup> used by OpenOffice, the main competitor to the Microsoft Office productivity suite. Reciprocal licences are often called “copyleft”, owing to the way they seem to differ from traditional copyright licences.

The licensing model allows the Linux kernel to have thousands of separate copyright holders, for each separate contribution made—something that would be quite impractical if individual licensing agreements had to be made, an example of how open source licensing lowers transaction costs for collaboration.

The enforcement actions of Welte and others such as the Free Software Foundation and the Software Freedom Law Center are typically based on the fact that their software is included in the Linux kernel, and hardware manufacturers have included the Linux kernel in their products but have not made the software source code available even upon request from a purchaser of the hardware. The extent and scale of infringements might suggest that open source licensing has barriers that are *too* low; but open source copyright holders face no loss, and through successful enforcement actions instead increase the size and scope of potential contributors to the community.

## Geneva—development policy and the myth of access

In February 2003, at an UNCTAD Intergovernmental Meeting,<sup>36</sup> a participant asked whether it was not wise for developing countries who do not have software skills to avoid “difficult to use” open source software, and instead use “black box proprietary software that just works”. The Peruvian Congressman Edgar David Villanueva Nuñez, sitting beside me on the panel, responded that developing countries may indeed lack skills today, but if they simply used black box proprietary software that “just works”, and avoided open source software, they would be locked in and never develop the skills they lacked.

In the years since then, open source software has seen dramatic improvements in end-user interfaces and also “just works”. There is no need to look under the hood to see *how* it works. But it is still *possible* to do so.

Open source software is often initially chosen for its absence of licence fees, but other benefits become quickly apparent. One of them is the ability to adapt software for local needs. Proprietary software companies are usually global, concentrated in a few parts of the world. This is the nature of the software market, which, thanks to network effects and proprietary standards, tends towards natural monopolies. These global companies make investments on the basis of global returns, and may not pay sufficient attention to local needs.

The tendency of proprietary vendors to ignore local needs is especially marked in developing regions.<sup>37</sup> For example, they may pay little attention to the needs of Xhosa speakers in South Africa, who form a relatively small market in global terms. And since their software is proprietary, no local user or local

<sup>32</sup> <http://web.archive.org/web/20070930222250/http://freshmeat.net/stats/#license> [66% when accessed on July 17, 2006].

<sup>33</sup> <http://www.gnu.org/licenses/gpl-3.0-standalone.html> [Accessed October 12, 2010].

<sup>34</sup> <http://www.mozilla.org/MPL/MPL-1.1.html> [Accessed October 12, 2010].

<sup>35</sup> <http://www.gnu.org/licenses/lgpl.html> [Accessed October 12, 2010].

<sup>36</sup> [http://r0.unctad.org/ecommerce/events\\_0205\\_en.htm](http://r0.unctad.org/ecommerce/events_0205_en.htm) [Accessed October 12, 2010].

<sup>37</sup> Although not limited to them; famously, after a threatened boycott of Microsoft products the company was forced to develop “expensive” support for Nynorsk (New Norwegian) which was already supported by free software applications in 2002; see <http://dot.kde.org/972035764/> and <http://news.bbc.co.uk/2/hi/technology/2615363.stm> [Both accessed October 12, 2010].

business is in a position to add such support. Most open source software developers also have absolutely no interest in software usability for Xhosa speakers. However, the open source licensing model allows those with locally relevant motives to learn from and adapt their software. So local users—and, importantly for developing local ICT economies—small local businesses are entirely capable of providing services and adapting the software to local needs. In the case of Xhosa and several other southern African languages this has been done for Linux by the South Africa based project [translate.org.za](http://translate.org.za).

Such local adaptation supports the creation of new, local businesses, which are able to provide commercial support for and build upon open source software, thanks to the ability to access and modify the code base, with low entry barriers. The “deep” support that can be provided by such “deep” access to the code is available to all local businesses and all the value generated from this is retained locally, as no royalties or licences have to be paid.

As policymakers around the world consider how best to promote innovation and access to technologies, the legal innovation of open source software is an important ingredient to consider. As this article has shown, open source software provides a means of rapid diffusion of knowledge that is valued in the world’s most innovative high-technology clusters for its ability to drive and sustain innovation—while remaining, at the same time, accessible to less privileged communities around the world. In the context of global access to knowledge, open source software communities enable active participation, which can be more valuable than access alone. The challenge for scholars is to find measures of innovation that capture the knowledge diffusion resulting from such open systems, which are not visible in, say, patent statistics. The challenge for policy makers is to go beyond *access* to knowledge; in the words of Felipe Gonzalez, the former Prime Minister of Spain, speaking at a conference on free software: “Access [to ICTs] is not enough, it is the ability to create, to add value, that is important.”<sup>38</sup>

<sup>38</sup> Recorded in English by the author from simultaneous translation. Open Source World Conference, February 18–20, 2004, Malaga, Spain, at <http://www.opensourceworldconference.com/2004/>.

# Has the Shift to Stronger Intellectual Property Rights Promoted Technology Transfer, FDI, and Industrial Development?

**Lee Branstetter**

*H. John Heinz III College, School of Public Policy and Management, and Department of Social and Decision Sciences, Carnegie Mellon University and National Bureau of Economic Research*

**C. Fritz Foley**

*Harvard Business School and National Bureau of Economic Research*

**Kamal Saggi**

*Department of Economics, Vanderbilt University*

☞ Developing countries; Foreign investment; Intellectual property; International trade; Technology transfer

Has the global shift to stronger intellectual property rights been associated with positive effects? Even today, more than 15 years after the ratification of the TRIPS Agreement, opinions about the impact of stronger IPR are varied and continue to reflect issues that arose when TRIPS was debated. Opponents of strong IPR typically raise concerns that stronger IPR raises the costs of protected goods and reduces the accessibility of innovations. Proponents suggest that IPR protection fosters innovation in reforming countries. Proponents also argue that stronger IPR facilitates transfers of technology to reforming countries, increases foreign direct investment (FDI), and spurs industrial development. This article reviews recent research performed by the authors on the effects related to technology transfers, FDI, and industrial development, and it places the findings of this work in the broader context of the literature.

Before turning to the effects of stronger IPR on technology transfer, FDI, and industrial development, it is useful to review some findings about other effects that have been discussed and examined. Many representatives of developing country governments argue that stronger IPR has worked against the interests of developing countries. The reasons for this negative view of TRIPS typically stem from the obvious costs of strengthening a patent system: stronger patents confer a greater degree of monopoly power on the patent holder, and patent holders are often foreign-based multinationals. Research indicates that stronger IPR can indeed lead to higher prices for patent-protected goods and lower consumer welfare.<sup>1</sup> Developing country opponents also contend that stronger intellectual property rights may retard the process of industrial development. According to this view, weak IPR functions as a kind of infant industry policy—it allows indigenous firms to learn from, absorb and experiment with foreign technology at low cost. If one believes

<sup>1</sup> K.E. Maskus, *Intellectual Property Rights in the Global Economy* (Washington, D.C.: Institute for International Economics, 2000). See also P. McCalman, "Reaping What You Sow: An Empirical Analysis of International Patent Harmonization" (2001) 55 *Journal of International Economics* 161; and S. Chaudhuri, P. Goldberg and P. Jia, "Estimating the Effects of Global Patent Protection in Pharmaceuticals: A Case Study of Quinolones in India" (2006) 96 *American Economic Review* 1477.

that local firms must build a capacity to imitate before they can innovate, then it is possible that premature imposition of a strong IPR regime could actually hold back economic development rather than promote it.<sup>2</sup>

One argument advanced by proponents of stronger IPR is that stronger IPR stimulates innovation in reforming countries, accelerating growth and providing greater choice to consumers around the world. However, the notion that stronger IPR in developing countries will necessarily induce greater innovation has been questioned within the economics literature on both theoretical and empirical grounds.<sup>3</sup> If the major developed economies already possess strong patent rights and exporters in developing countries can obtain patents in the rich markets, then, in a reasonably integrated global economy, the accession of any one developing country to the strong patent bloc should have limited effects on the incentives for innovation.<sup>4</sup> Economic analyses of large samples of patent reforms have tended to find, at best, limited evidence that stronger IPR induces more local innovation in the short-to-medium run.<sup>5</sup> Economic historians have been able to demonstrate a connection between national patent laws and the *direction* of inventive activity in early industrial history; it has been much harder to document a connection in that era between national patent laws and the *scale* of local inventive activity.<sup>6</sup> Even studies that focus on industries where patent rights are regarded as effective mechanisms of appropriation typically find that they increase inventive output only in a limited number of special cases.<sup>7</sup> While patent reform in countries with limited innovative capacity might reasonably be expected to yield weak results, the extant literature also provides examples of countries with well-developed innovative capabilities that do not appear to have responded to stronger IPR with more innovative effort or increased innovative outcomes.<sup>8</sup> Of course, one can find examples of developing countries and particular industries in developing countries where local IPR reform is temporally coincident with a surge in local innovative activity.<sup>9</sup> There are empirical studies utilising data from multiple countries which find evidence that stronger IPR yields higher levels of innovative effort.<sup>10</sup> Nevertheless, the number of studies and cases in which this connection is absent or weak gives one pause in attempting to make a positive case for IPR reform based on its effects on local innovation.

## Do stronger patents promote international technology transfer, FDI and industrial development?

The evidence described above suggests that a shift to strong IPR generates some costs for reforming countries and that any benefits associated with increased local innovation are questionable. It is important to consider another source of positive effects. IPR reform may induce multinationals to deploy more and better technology in developing countries, and do so faster, than they would in a weak IPR regime. Some of this technology could eventually diffuse to local firms—especially local suppliers in whose technological competence the multinationals have a strong vested interest.<sup>11</sup> Developing countries may actually absorb technologies faster if such absorption is also in the interest of technology owners.<sup>12</sup> While the literature

<sup>2</sup> Maskus, *Intellectual Property Rights in the Global Economy*, 2000.

<sup>3</sup> L. Branstetter, "Do Stronger Patents Induce More Local Innovation?" (2004) 7 *Journal of International Economic Law* 359.

<sup>4</sup> G. Grossman and E.L.C. Lai, "International Protection of Intellectual Property" (2004) 94 *American Economic Review* 1635.

<sup>5</sup> J. Lerner, "150 Years of Patent Protection" (2002) 92 *American Economic Review* 221.

<sup>6</sup> P. Moser, "How Do Patent Laws Influence Innovation? Evidence from 19th Century World Fairs" (2005) 95 *American Economic Review* 1214.

<sup>7</sup> Y. Qian, "Do National Patent Laws Stimulate Innovation in a Global Patenting Environment? A Cross-Country Analysis of Pharmaceutical Patent Protection, 1978–2002," (2007) 89 *Review of Economics and Statistics* 436.

<sup>8</sup> M. Sakakibara and L. Branstetter, "Do Stronger Patents Induce More Innovation? Evidence from the 1988 Japanese Patent Reforms" (2001) 32 *RAND Journal of Economics* 771.

<sup>9</sup> S.-T. Lo, "Strengthening Intellectual Property Rights: Evidence from the 1986 Taiwanese Patent Reforms", Working Paper (2005).

<sup>10</sup> S. Kanwar and R. Evenson, "Does Intellectual Property Protection Spur Technical Change?" (2003) 55 *Oxford Economic Papers* 235.

<sup>11</sup> B. Javorcik, "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillover through Backward Linkages" (2004) 94 *American Economic Review* 605.

<sup>12</sup> P. Lin and K. Saggi, "Multinational Firms, Exclusivity, and the Degree of Backward Linkages" (2007) 71 *Journal of International Economics* 206. See also K. Saggi, "Trade, Foreign Direct Investment, and International Technology Transfer: A Survey" (2002) 17 *World Bank Research Observer* 191.

on this topic remains smaller than the literature linking IPR strength and innovation, patterns are emerging across different papers, data sets, and countries suggesting a reasonably robust and positive relationship between stronger IPR and technology transfers and FDI. If this relationship is strong enough—and a stream of recent studies suggests it is—then stronger IPR would promote industrial development.

### *Theoretical analysis*

It is important to point out that, in theory, the relationship between stronger IPR in the South, North-South FDI, and industrial development could be positive or negative. Since the 1960s, international economists have noted a “product cycle”: production of a manufactured good begins in the most advanced industrial economies, then shifts to less advanced ones as a product becomes more standardised.<sup>13</sup> Theoretical work on the impact of Southern IPR reform on North-South trade and FDI put this notion of a product cycle at the conceptual centre of a range of models. Important early research by Elhanan Helpman developed several variants of a North-South general equilibrium product cycle model in which Northern innovation expands the range of differentiated goods produced in the world while Southern imitation leads to North-South production shifting.<sup>14</sup> A robust finding of this analysis is that stronger IPR protection is never in the interest of the South. If stronger IPR in the South is treated as a reduction in the rate of Southern imitation and Northern firms do not shift production to the South through FDI, Southern IPR reform lowers the rate of Northern innovation and thereby limits the portfolio of products available globally. If North-South FDI is permitted, a reduction in Southern imitation leads to more FDI but hurts the South because Northern multinationals tend to charge higher prices than Southern imitators.

It would be difficult to overestimate the impact of Helpman’s early work on the theoretical literature that followed. Helpman’s model provided elegant theoretical underpinnings for the concerns being raised by developing country representatives during the Uruguay Round trade negotiations that eventually produced the TRIPS Agreement. He was able to derive closed form results for welfare changes that subsequent researchers have struggled to match. Nevertheless, the stark results of Helpman’s model flow out of a particular set of assumptions. Helpman assumes that FDI between North and South leads to an equalisation of wages across regions. While this is a standard outcome in many trade models, North-South wage convergence has certainly not yet been achieved in the real world, and, in fact, low wages in the South are a key driver of FDI. Helpman also assumes that there is no innovation whatsoever in the South. Changing these key assumptions can lead to quite different predictions regarding the effects of increased IPR protection in the South.

Lai extended Helpman’s model to allow both the level of FDI and Northern innovators to respond endogenously to changes in the strength of Southern IPR protection.<sup>15</sup> This model is further extended in work by the current authors, to the case where innovation, FDI and imitation are all endogenously determined.<sup>16</sup> In these extensions, in any equilibrium with a positive rate of imitation, North-South FDI does not lead to equal wages in the two regions. A lower wage in the South creates an incentive to move production of existing goods there, but multinationals seeking to benefit from this incur a higher risk of imitation. Imitation is a costly activity that requires deliberate investment on the part of Southern firms seeking to copy Northern products.<sup>17</sup> Stronger IPR protection in the South increases these costs, reducing imitation and lowering the risks faced by multinationals. Multinationals that move to the South employ the labour resources freed up by the decline in imitative activity. Production shifting allows for a reallocation

<sup>13</sup> R. Vernon, “International Investment and International Trade in the Product Cycle” (1966) 80 *Quarterly Journal of Economics* 190.

<sup>14</sup> E. Helpman, “Innovation, Imitation, and Intellectual Property Rights” (1993) 61(6) *Econometrica* 1247.

<sup>15</sup> E.L.C. Lai, “International Intellectual Property Rights Protection and the Rate of Product Innovation” (1998) 55(1) *Journal of Development Economics* 133.

<sup>16</sup> L. Branstetter, R. Fisman, F. Foley and K. Saggi, “Intellectual Property Rights, Imitation, and Foreign Direct Investment: Theory and Evidence”, NBER WP No.13033 (2007).

<sup>17</sup> G. Grossman and E. Helpman, *Innovation and Growth in the Global Economy* (Cambridge: MIT Press, 1991).

of Northern resources towards innovative activity. Under certain parameter assumptions, a strengthening of Southern IPR protection enhances Southern industrial development because the increase in North-South FDI more than offsets the decrease in Southern imitation.

In these theoretical extensions, it is possible that industrial expansion of the South could still be welfare reducing—if the prices charged by multinationals are sufficiently higher than prices charged by indigenous firms, the negative welfare effects engendered by those higher prices could outweigh the increase in Southern output, relative wages and terms of trade. Allowing for innovation, FDI, and imitation to all respond endogenously to Southern IPR changes complicates welfare analysis, and no paper yet circulated in the academic community has provided a full-fledged mathematical analysis of welfare effects under these conditions. However, it appears that a necessary condition for Southern welfare to rise with stronger IPR is that IPR reform accelerates industrial development, in part by inducing an increase in FDI.

### *Empirical evidence*

Recent evidence indicates that IPR reform has this effect. In previous work, two of the current authors identified substantive IPR reforms in 16 countries and demonstrated that US multinationals increased their technology transfer to their affiliates in reforming countries after reform.<sup>18</sup> Furthermore, the increase in technology transfer was significantly higher for affiliates of technology-intensive parents, who could be expected *ex ante* to be more responsive to reform. The magnitudes of these effects were quite large—reform induces an increase in the flow of technology of roughly 17 per cent per year, and, for the affiliates of technology-intensive parents, the increase is 30–34 per cent per year, depending on the specification. A similar pattern was found in the R & D spending of US multinational affiliates. These increased in the wake of reform and increased by larger amounts for affiliates of technology-intensive parents. In most countries, affiliate R & D is a complement to technology imports from the parent—one designed to modify parent technology to suit local tastes or conditions.<sup>19</sup> The similarities in the movement of R & D and technology transfer suggested that there was an increase in the quantity of technology provided to affiliates after reform rather than just the price charged for technology. Of course, demonstrating a multinational response to IPR reform is not sufficient to prove that it fosters industrial development. Multinationals could increase the technological intensity of their operations without increasing their scale, and an expansion of multinational activity could come at the expense of a decline in indigenous activity, resulting in a net decrease of industrial activity.

Recent research by the current authors addresses these broader issues.<sup>20</sup> This research shows that US multinationals expand their capital stock and employment compensation after IPR reform, and these effects are greater for the affiliates of technology-intensive parents. For these affiliates, post-reform increases in capital stock and employment compensation are on the order of 20 per cent. Additional regression analyses use industry-level data from the UN Industrial Development Organization to examine the impact of IPR reform on the level of industrial value-added. Controlling for country-specific time trends, the study demonstrates that industrial value-added expands rather than contracts following IPR reform, and these effects are especially large in technology-intensive industries.<sup>21</sup> The study also attempts to measure the speed with which countries are cycling into the production and export of new goods by counting, for their

<sup>18</sup> L. Branstetter, R. Fisman and F. Foley, “Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Data” (2006) 121(1) *Quarterly Journal of Economics* 321.

<sup>19</sup> W. Kuemmerle, “The Drivers of Foreign Direct Investment into Research and Development: an Empirical Investigation” (1999) 30 *Journal of International Business Studies* 1.

<sup>20</sup> L. Branstetter, R. Fisman, F. Foley and K. Saggi, “Does Intellectual Property Rights Reform Spur Industrial Development,” forthcoming, *Journal of International Economics*.

<sup>21</sup> Branstetter et al., forthcoming, *Journal of International Economics*.

16 reforming countries, the number of new 10-digit categories in which positive exports to the United States are recorded for the first time. The study concludes that this count is systematically higher after reform, suggesting an acceleration in the operation of the international product cycle.<sup>22</sup>

It is natural to wonder about the potential endogeneity of the IPR regime changes—are IPR reforms causing an increase in FDI, or is the underlying attractiveness of a market inducing both an increase in FDI and a combination of external and internal pressure for stronger IPR? In the aforementioned study, the authors are able to point to evidence that technology transfer, R & D spending, and affiliates' capital stocks do not expand much prior to patent reform.<sup>23</sup> After reform, there is a gradual expansion, addressing some of the endogeneity concerns. A second problem is the coincidence between IPR reform and other reforms and changes that would make a market attractive to foreign firms. Theoretical work by two of the current authors has demonstrated that a cut in the corporate tax rate, for example, could lead to the same kinds of shifts as stronger IPR.<sup>24</sup> Fortunately, Branstetter, Fisman, Foley and Saggi employ a rich set of firm- and country-level variables that control directly for many of the shifts other than IPR reform that could induce greater FDI, more rapid industrial expansion, and a more rapid cycling into the production and export of new goods.

Other authors have also found a positive relationship between US FDI and the strength of intellectual property rights.<sup>25</sup> Stronger patent rights in Eastern Europe and former Soviet Union states appear to have a positive effect on foreign FDI (from a range of host countries) in high-technology sectors.<sup>26</sup> IPR reform appears to increase international technology transfer from Japanese multinational firms to their affiliates, a result that parallels the findings of Branstetter, Fisman, and Foley.<sup>27</sup> Set against these findings, stronger IPR appears to have a negative effect on the location decisions of French multinationals.<sup>28</sup>

Fewer authors have attempted to assess the impact of IPR on industrial development more broadly, but a recent study by Hu and Png is also consistent with the findings of Branstetter, Fisman, Foley and Saggi.<sup>29</sup> Hu and Png find that patent-intensive industries in more advanced economies grow more quickly after IPR reform. They do not identify FDI as a causal mechanism nor do they directly measure FDI in their empirical work, but their finding that patent reform appears to have driven industry expansion through more rapid factor accumulation and increasing productivity is consistent with MNEs responding to IPR reform by increasing their capital stock and transferring technology to affiliates. The rise in developing country industrial activity could reflect far more than pure FDI effects. It is possible that some of the transferred technology could eventually diffuse to domestic firms, especially domestic suppliers in whose technical competence foreign firms have a vested interest. Evidence is also emerging that knowledge spillovers occur in developing countries through transfers of employees from MNEs to indigenous firms.<sup>30</sup>

Most theoretical North-South product cycle models of IPR reform predict an acceleration in Northern innovation as production flows to the South. In the models, this stems not just from stronger protection but also from a general equilibrium resource reallocation in the North from production to R & D. Perhaps not surprisingly, attempts to directly measure the impact of particular Southern IPR reforms on Northern

<sup>22</sup> Branstetter et al., forthcoming, *Journal of International Economics*.

<sup>23</sup> Branstetter et al., forthcoming, *Journal of International Economics*; Branstetter, Fisman and Foley, "Do Stronger Intellectual Property Rights Increase International Technology Transfer?" (2006) 121(1) *Quarterly Journal of Economics* 321.

<sup>24</sup> L. Branstetter and K. Saggi, "Intellectual Property Rights, Foreign Direct Investment, and Industrial Development", NBER WP No.15393 (2009).

<sup>25</sup> J.Y. Lee and E. Mansfield, "Intellectual Property Protection and U.S. Foreign Direct Investment" (1996) 78 *Review of Economics and Statistics* 181; P. Nunnenkamp and J. Spatz, "Intellectual Property Rights and Foreign Direct Investment: a Disaggregated Analysis" (2004) 140 *Weltwirtschaftliches Archiv* 393.

<sup>26</sup> B. Javorcik, "The Composition of Foreign Direct Investment and Protection of Intellectual Property Rights in Transition Economies" (2004) 48 *European Economic Review* 39.

<sup>27</sup> B. Ito and R. Wakasugi, "The Effects of Stronger Intellectual Property Rights on Technology Transfer: Evidence from Japanese Firm-Level Data" (2009) 34 *Journal of Technology Transfer* 145.

<sup>28</sup> T. Mayer and E. Pfister, "Do Stronger Patent Rights Attract Foreign Direct Investment? Evidence from French Multinationals' Location" (2001) 13 *Revue Région et Développement* 99.

<sup>29</sup> A. Hu and I.P.L. Png, "Patent Rights and Economic Growth: Evidence from Cross-Country Panels of Manufacturing Industries", Working Paper, National University of Singapore (2010).

<sup>30</sup> J. Poole, "Knowledge Transfers from Multinationals to Domestic Firms: Evidence from Worker Mobility", Working Paper, UC-Santa Cruz (2009).

innovation fail to find much discernible impact.<sup>31</sup> Most individual Southern countries are too small and the lags involved in such a resource reallocation are likely to be too long and variable for the data to identify much of an effect. It is nevertheless interesting to observe that the years following the ratification of the TRIPS Agreement have been ones in which innovative activity in the United States appears to have accelerated. TFP growth surged and remained at relatively high levels until the recent financial crisis, and the fraction of the labour force engaged in activities that connected to R & D has increased, even as the fraction of the labour force engaged in production labour has continued to decline.<sup>32</sup>

## Conclusions and policy implications

A substantial and growing body of work indicates that IPR reform is associated with an acceleration of industrial development. Earlier concerns that a shift to stronger IPR would freeze the industrial development of countries—or send it into reverse—now seem overblown. However, it is important to keep in mind that the empirical results described above are focused on one type of effect of stronger IPR and the results may not generalise to all countries. For example, the poorest countries attract little FDI, and a change in the IPR regime may do relatively little to induce large FDI flows simply because the degree of IPR protection is only one of many determinants of inward FDI.

Much remains to be done to extend recent research. Further empirical analyses could reveal what sorts of countries and industries obtain the greatest boost from IPR reform and whether increases in industrial development persist in the long run. Research that employs high quality price data in a way that allows analysts to conduct welfare calculations would be particularly informative. Additional work could also reveal the extent to which production shifting reshaped the Northern economies. Is the temporal coincidence of rising patent rates, higher R & D intensity, and accelerated productivity growth in the United States with the shift of production overseas a consequence of the mechanisms emphasised in these models described above?

There is also a clear need for more theoretical work in this area. Under what circumstances is the acceleration of industrial development induced by stronger IPR truly welfare enhancing? Under what circumstances are the benefits of more rapid industrial development undercut by other effects of stronger IPR? The mathematical challenges that theorists confront in building models that could address these questions are clear, but so are the potential benefits for policymakers and empirical researchers. Given the number of questions for which we still lack complete answers, this domain is likely to be an area of active research in economics for some time to come.

<sup>31</sup> W. Park, “North-South Models of Intellectual Property Rights: An Empirical Critique”, Working Paper (2010).

<sup>32</sup> See R. Gordon, “Exploding Productivity Growth: Context, Causes, and Implications” (2003) 2 *Brookings Papers on Economic Activity* 207; and S. Kortum and J. Lerner, “Stronger Protection or Technological Revolution? What Is Behind the Recent Surge in Patenting?” (1999) 28 *Research Policy* 1.



# The Strengthening of IPR Protection: Policy Complements

Ricardo H. Cavazos Cepeda

*OECD*

Douglas C. Lippoldt\*

*OECD*

✉ Developing countries; Economics and law; Intellectual property

## Introduction

The past two decades have witnessed an active period of global reform with respect to policies concerning protection of intellectual property rights (IPRs). This article<sup>1</sup> examines—from an empirical, economic perspective—policies that complement the generally strengthened framework for IPRs in developing countries during the years from 1990 to 2007.<sup>2</sup> This timeframe encompasses such international policy developments as the advent of the World Trade Organization’s (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), substantially increased adherence to agreements administered by the World Intellectual Property Organization (WIPO), and negotiation of numerous regional trade accords (RTAs), among other developments. Thus it provides an excellent opportunity to examine the interaction of various policy factors with change in the strength of IPR protection.

The core analytical approach is to consider relationships at the national level between a broad range of policy variables and economic outcomes in the context of strengthened IPRs. A four equation model is specified and estimated using three-stage least squares. From this macro approach, we aim to obtain information about the importance of institutional variables through consideration of developments over time in a panel of countries. Further confirming analysis is conducted using firm-level data to consider the economic performance of firms in light of the policy environment in which they operate. From this micro approach, we aim to obtain information about firm-level incentives and how these incentives eventually transform into tangible resources for the firm. The overall objective of both the macro and the micro exercises is to identify complementary factors operating in conjunction with the protection of IPRs to deliver positive economic outcomes.

The article is organised as follows. It begins with a very brief review of the recent literature and key citations from earlier work. This is followed by a presentation of the basic framework for the model. The empirical results of the macro and micro exercises are presented in the next three sections. This is followed by a conclusion that highlights the main findings. An appendix presents the figure and tables.

\* The views expressed are those of the authors and do not necessarily reflect those of the OECD or its member countries.

<sup>1</sup> The article builds on earlier OECD work on technology transfer and IPRs (W.G. Park and D.C. Lippoldt, “Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries”, OECD Trade Policy Working Paper No.62 (January 25, 2008)) and draws on an OECD Trade Policy Working Paper: Ricardo H. Cavazos Cepeda, Douglas C. Lippoldt, Jonathan Senft, “Policy Complements to the Strengthening of IPRs in Developing Countries”, OECD Trade Policy Working Paper No.104 (Paris: 2010). The authors acknowledge the kind assistance of Walter G. Park, American University, in making available the indicators for IPR strength used in this article. Jonathan Senft capably provided research assistance for the article.

<sup>2</sup> Expressions such as “strengthened protection of IPRs” or “IPR strength” are referenced and discussed at length in previous literature (e.g. see K.E. Maskus, *Intellectual Property Rights in the Global Economy* (Washington, D.C.: Institute for International Economics, August 2000) and K.E. Maskus (ed.), *Intellectual Property, Growth and Trade* (Amsterdam: Elsevier, 2008)), and in the next section of this article.

## Motivation and literature review

The last 20 years have seen sweeping reforms in the legal regime governing intellectual property in many countries (e.g. Figure 1 highlights the extent of the strengthening of patent rights in terms of laws on the books, on average, in OECD and non-OECD countries). The establishment of the WTO in 1995 was of particular importance from a trade perspective because it resulted in the inclusion of IPR issues within the ambit of the rules-based multilateral trade system. The entry into force of the WTO TRIPS Agreement that year established minimum standards for IPR protection, which now cover the 153 WTO member countries, though subject to some special and differential treatment for certain groups of developing countries. Moreover, many countries have implemented regional or bilateral trade accords securing additional IPR provisions that go beyond those found in the TRIPS Agreement.<sup>3</sup> As the globalisation process moves forward, reforming countries have also enacted rafts of other modernising legislation in parallel to IPR reform, for example, with respect to education and promotion of human capital accumulation. The interaction and coherence of these policies must be taken into account, if policymakers are to optimise the outcomes.

There are several mechanisms through which protection of IPRs can stimulate economic development and growth.<sup>4</sup> An appropriate IPR framework can incentivise innovation, increase trade and trade-related investment and boost intellectual property-intensive economic activity. This is because such a framework can help to ensure clarity of ownership and enable right holders to appropriate benefits from their property. Trade and foreign direct investment (FDI) are fundamental factors in this process as they are two of the main market-mediated channels by which ideas and intangible assets are disseminated internationally.<sup>5</sup> Technology transfer via these channels can facilitate the gradual accumulation of knowledge capital in firms, sectors and economies.<sup>6</sup> Thus reform of IPR protection may be cited as one part of a general strategy for promoting economic development, in combination with other reforms.<sup>7</sup>

As for factors that drive IPR reform, Kanwar and Evenson consider the possibility that countries with more technological development will have stronger IPR regimes.<sup>8</sup> However, controlling for other factors, they find that there is at best weak evidence supporting such a claim. While it may be true that some developing nations offer weaker protection, these researchers conclude this may be primarily due to a lack of human or financial capital that limits the ability to add protection. Noting that previous studies tended to assume determination of the strength of IPR protection as exogenous, Eicher and Garcia-Penalosa<sup>9</sup> developed an analysis that endogenises the strength of rights to show how private incentives to protect IPRs may affect economic development. Their model explains endogenous differences in IPR protection on a country basis and compares IPR protection to private investment incentives. This comparison is relevant since protection of IPRs helps to reassure stakeholders that they will be able to appropriate economic benefits of their investment in innovative activity, which can be of high risk. In other words, those with a stake in intellectual property protection are found to drive the process of IPR reform.

<sup>3</sup> C. Fink and P. Reichenmiller, "Tightening TRIPS: The Intellectual Property Provisions of Recent US Free Trade Agreements" (Rep. No. Trade Note 20) (Washington, D.C.: World Bank, 2005).

<sup>4</sup> Maskus, *Intellectual Property Rights in the Global Economy*, 2000.

<sup>5</sup> K. Maskus, "Encouraging International Technology Transfer", Issue Paper No.7, UNCTAD-ICTSD Project on IPRs and Sustainable Development (May 2004).

<sup>6</sup> For a detailed explanation about knowledge capital, see P.M. Romer, "Increasing Returns and Long-Run Growth" (1986) 94(5) *Journal of Political Economy* 1002; and G.N. Grossman, and E. Helpman, "Comparative Advantage and Long-Run Growth" (1990) 80(4) *American Economic Review* 796; G.N. Grossman, and E. Helpman, "Trade, Knowledge Spillovers, and Growth", NBER Working Paper 3485 (October 1990).

<sup>7</sup> Park and Lippoldt, "Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries", 2005.

<sup>8</sup> S. Kanwar and R. Evenson, "On the Strength of Intellectual Property Protection that Nations Provide", (2009) 90 *Journal of Development Economics* 50.

<sup>9</sup> T. Eicher and C. Garcia-Penalosa, "Endogenous Strength of Intellectual Property Rights: Implications for Economic Development and Growth", *European Economic Review*, October 2007.

Strengthening of IPR protection has been shown to correlate with increased trade, though the literature is laced with nuance regarding specific conditions, variation and causality. Fink and Primo Braga<sup>10</sup> set the tone early on: they found that IPR protection is positively associated with international trade flows, in particular manufactured non-fuel imports. Since then a number of studies from the subsequent literature have also found a positive association of IPR protection to trade, including with respect to high technology products.<sup>11</sup> The relationship of IPR strengthening to FDI inflows appears to be even stronger than is the case for trade, according to a growing number of studies.<sup>12</sup> While some countries with weak IPRs may nonetheless experience substantial inflows of FDI (e.g. by firms seeking to access a particular resource or sell into a large market for their product), it is clear that the weak IPRs tend to distort the nature of the FDI or limit the flows to less than would otherwise be the case. The increased trade and FDI that are associated with IPR strengthening—particularly with respect to patent rights—appear to embody substantial technology transfer.<sup>13</sup>

IPR reform is also associated with increasing domestic innovation, capitalising on the increased stock of intellectual property in the economy while also generating new intellectual property in its own right. For example, Park and Lippoldt highlight the growth in innovative activity as measured by domestic patent filings, albeit with some variation across countries and sectors.<sup>14</sup> Branstetter et al. find that royalty payments made by affiliates to parent firms for the use of intangible assets generally tend to increase as patent regimes are strengthened, in part owing to technology transfer.<sup>15</sup> They also find that IPR reform is associated with increased research and development (R & D) spending by affiliates, a development that usually complements increased technology transfer and technology imports from the parent. The expanded availability of intellectual property in the economy may stimulate local innovation, in part, through technology spillovers among innovators.<sup>16</sup> In other words, local innovators may be introduced to technologies first through the technology transfer that takes place in an environment where protection of IPRs is assured; then, they may build upon those ideas to create an evolved product or develop alternate approaches. On the other hand, Maskus notes that without protection from abuse of their newly developed technologies, firms may be less willing to reveal technical information associated with these innovations.<sup>17</sup>

This is not to say that strong IPR protection is a “silver bullet” type of policy solution. Portions of the economic literature on IPR reform express concern from a development perspective, in particular with respect to access to technology, the ability for firms to “learn by doing”, and costs of doing business.<sup>18</sup>

<sup>10</sup> C. Fink and C.A. Primo Braga, “How Stronger Protection of Intellectual Property Rights Affects International Trade Flows”, Policy Research Working Paper Series 2051 (World Bank, 1999).

<sup>11</sup> E.g. Park and Lippoldt, “Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries”, 2008; Awokuse and Yin (2010); O. Ivus, “Do Stronger Intellectual Property Rights Raise High-Tech Exports to the Developing World?”, Working Paper of Department of Economics, University of Calgary (October 2008); C.-H. Yang and N.-F. Kuo, “Trade-Related Influences, Foreign Intellectual Property Rights and Outbound International Patenting”, *Science Direct*, Research Policy 37 (January 31, 2008).

<sup>12</sup> E.g. Park and Lippoldt, “Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries”, 2008; L. Branstetter, R. Fisman and C. Fritz Foley, “Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Panel” (February 2006) *Quarterly Journal of Economics* 321; T. Awokuse, and Hong Yin (2008), “Do Stronger Intellectual Property Rights Protection Induce More Bilateral Trade? Evidence from China's Imports,” American Agricultural Economics Association 2008 Annual Meeting, July 27-29, 2008, Orlando, Florida 6143.

<sup>13</sup> D. Lippoldt, “The Multilateral Trading System and the Strengthening of Intellectual Property Rights in Developing Countries: Trade and Investment Impacts” in Robert Bird and Subhash Jain (eds), *Global Challenges of Intellectual Property Rights* (Cheltenham, UK: E. Elgar Publishing, 2008).

<sup>14</sup> Park and Lippoldt, “Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries”, 2008. Patent filings are an incomplete indicator of R & D productivity. In some cases, for example, innovators may choose not to patent but rather to protect their innovations via trade secrecy or other means.

<sup>15</sup> Branstetter et al., “Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Panel” (February 2006) *Quarterly Journal of Economics* 321.

<sup>16</sup> Park and Lippoldt, “Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries”, 2008; Maskus, “Encouraging International Technology Transfer”, May 2004.

<sup>17</sup> Maskus, “Encouraging International Technology Transfer”, May 2004.

<sup>18</sup> The strengthening of IPR protection in developing countries is sometimes criticised as raising the cost of technology acquisition, imitation and learning-by-doing (e.g. C.M. Correa, “How Intellectual Property Rights Can Obstruct Progress”, *SciDev.Net* (April 4, 2005)). However, there are trade-offs; an environment with weak IPRs is not without costs. For example, such an environment weakens incentives for innovation, such that there is a cost to society at large. Where IPR protection is inadequate, local partners for imports, licensing and FDI may forgo support from their foreign partners (e.g. owing to the foreign partners’ reluctance to transfer proprietary know how and technical support). There is also a potential loss of export

For example, some observers worry that either through competition or strategic behaviour by firms, “patent thickets” may arise blocking the ability of others to exploit new technologies or limiting innovation in related areas.<sup>19</sup> Moreover, the limited availability of key complements, such as certain types of physical capital or technical expertise, is seen as potentially undermining the ability of some developing countries to take advantage of the opportunities provided by enhanced IPR protection. Thus, while patent reform is associated with increases in R & D when adopted in the relatively advanced countries,<sup>20</sup> this is not always the case in less advanced countries. For example, the introduction of pharmaceutical patents in less developed countries has sometimes failed to elicit a local innovation similar response.<sup>21</sup> The reservations raised in these and other such studies merit consideration, but need to be considered in the context of the growing body of empirical work pointing to a tendency for positive outcomes from the recent IPR strengthening in terms of change in certain broad economic indicators. Thus, an appropriate response could be to consider ways for policy to address these issues while also promoting a suitably strong environment for IPRs.

This brief literature review has provided illustrations highlighting the generally positive relationship of IPR reform to trade, FDI, technology transfer and innovation. However, it has also revealed evidence of some variation in the experience of countries. The existence of policy complements appears to be one dimension that seems to influence the effectiveness of IPR reform and the economic outcomes. At various points, the literature alludes to policies that complement improved protection of IPRs. Examples include policies that influence the environment for doing business, investment in R & D, development of human capital and entrepreneurial education (e.g. with respect to the economic potential of intellectual property). The following sections present our attempt to peer more deeply into these issues.

## Presentation of the model

The present analysis is based on a stylised model of the interaction of IPR protection with other complementary policies and other factors, all seen in relation to economic indicators of particular interest for development. The modelling approach employs a system of equations owing to the endogenous nature of several of the explanatory variables. The examination of feedback mechanisms requires provision in the model for pathways for feedback relationships and various interrelated adjustments (e.g. R & D investment is influenced by IPR protection, but R & D investment also influences the evolution of knowledge capital).

The system of equations is as follows:

$$FDI = f(\text{IPR protection, GDP measures, macro-environment variables})$$

$$R \ \& \ D = f(\text{resources (human and physical capital), IPR protection, legal environment})$$

$$KC = f(\text{FDI, R\&D, IPR protection, legal environment})$$

$$\text{IPR protection} = f(\text{FDI, R \ \& \ D, WTO legal environment, other international institutional factors, domestic factors such as competition policy})$$

Whereby:

- *FDI* represents inflows of foreign direct investment;

markets whereby infringing exports from a producer in a country with weak IPR protection may be rejected by the market or subject to sanction. In addition, there is the basic cost of imitation (depending on the product this could be as high as two-thirds of the original producer’s costs, though probably much less for some items such as intangible digital products).

<sup>19</sup> E.g. J. Reichman and K.E. Maskus (eds), *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime* (Cambridge: Cambridge University Press, 2005); D. Encaoua, D. Guellec and C. Martínez, “The Economics of Patents: from Natural Rights to Policy Instruments”, *Cahiers de la maison des sciences économiques*, CNRS, Série verte no.2003.124 (Paris: October 2003).

<sup>20</sup> M. Kyle and A. McGahan, “Investments in Pharmaceuticals before and after TRIPS”, NBER Working Papers 15468, National Bureau of Economic Research, Inc (2009).

<sup>21</sup> Correa, “How Intellectual Property Rights Can Obstruct Progress”, SciDev.Net, April 4, 2005.

- *IPR protection* represents a measure for intellectual property rights protection (in the context of the present analysis this refers to patent, copyright and trade mark protection);
- *GDP measures* represent one or more measures of income (e.g. GDP per capita);
- *Macro-environment variables* represent policy variables that have to do with institutions, the effectiveness of government, taxes and how easy it is to do business in the country;
- *R & D* represents the investment in research and development;
- *WTO* represents one or more variables stating whether the country is a member of the World Trade Organization and the de facto obligation to assure availability of protection for intellectual property;
- *Legal environment* represents country regulations related to enforcement of the law (perceptions of corruption);
- *Resources (human and physical capital)* represent the inputs of production for both labour and capital;
- *KC* represents knowledge capital, a measure for the accumulation of assets related to the creation of knowledge.

### *Implementation of the model*

We implemented the model using a macro approach based on national-level data, with estimation via three-stage least squares. In addition to the core macro assessment, a further exercise was run at the macro-level to consider policy interactions (Box 1). Drawing on insights from the model, we conducted a supplementary, preliminary micro analysis using firm level data and simple regression analysis in order to explore whether there was confirming evidence of policy relationships identified at the macro level.

For the macro approach, we employed a three-stage least squares estimator because several variables of interest influence each other simultaneously. The simultaneous determination of the variables within and across equations caused the moment conditions of the ordinary least squares estimator to break down, requiring the use of instrumental variables and an estimate of the variance-covariance matrix of the disturbances to identify the parameters of interest. In simple terms, three-stage least squares is an application of the two-stage least squares estimator plus the additional step of jointly obtaining a consistent estimate of the variance-covariance matrix of the cross-equation disturbances to obtain the parameters associated with the variables of interest. In this application we assumed all explanatory variables as exogenous except when dependent variables appeared on the right-hand side as explanatory variables.<sup>22</sup>

The data for these exercises came from a variety of sources (see Annex). The basic indicators for IPR protection by type of IPR (i.e. patents, copyright and trade marks) were drawn from the set of indices developed by Park et al. and described by Park (2008) and by Park and Lippoldt.<sup>23</sup> As a next step, we took the policy and economic dataset underlying the work by Park and Lippoldt and augmented this with policy-related indicators drawn from the datasets used by La Porta, Lopez de Silanes, Djankov, Johnson and Shleifer in several of their papers; and Norris in one of her books.<sup>24</sup> The expansion of the dataset

<sup>22</sup> When running the first stage to obtain predicted values for each endogenous variable all the exogenous right hand side variables are used as instruments whether they were included in the relevant equation or not. In addition two extra variables (a dummy variable for OECD membership and an indicator for property rights) were included as instruments to identify the system. All the estimations were done in STATA 10.

<sup>23</sup> Walter G. Park, "International Patent Protection: 1960-2005" May 2008 37(4) *Research Policy* 761-766; Park and Lippoldt, "Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries", 2008.

<sup>24</sup> See R. La Porta, F. López-de-Silanes and A. Shleifer, "The Economic Consequences of Legal Origins" (2008) 46(2) *Journal of Economic Literature* 285; R. La Porta, F. López-de-Silanes, A. Shleifer and J. Botero, "The Regulation of Labor" (2004) 119(4) *Quarterly Journal of Economics* 1339; R. La Porta, E. Glaser, F. López-de-Silanes and A. Shleifer, "Do Institutions Cause Growth?" (2004) 9(3) *Journal of Economic Growth* 271; R. La Porta, F. López-de-Silanes, C. Pop-Eleches and A. Shleifer, "Judicial Checks and Balances" (2004) 112(2) *Journal of Political Economy* 445; R. La Porta, S. Djankov, F. López-de-Silanes and A. Shleifer, "Courts: The Lex Mundi Project" (2003) 117(4) *Quarterly Journal of Economics* 1193; P. Norris, *Driving Democracy: Do Power-sharing Institutions Work?* (New York/Cambridge: Cambridge University Press, 2008). Also, the reader may wish to note that these authors have kindly made available the datasets and working papers at <http://mba.tuck.dartmouth.edu/pages/faculty/rafael.laporta/publications.html> and <http://www.pippanorris.com/> [Both accessed October 13, 2010].

enabled us to look more extensively at the economic, political and social environments, including measures for infrastructure, human capital and R & D capacity, among others. This expansion was critical to us in exploring the potential effects of policies complementary to IPR protection that foster innovation or diffusion of innovation.

In addition, the micro-level analysis drew on supplementary firm-level data from the ORBIS database. The ORBIS database includes financial statement information on approximately 44,707,294 companies from all over the world from 1999 to 2008.<sup>25</sup> The combination of macro- and micro-level datasets enabled us to obtain proxies for the availability of inputs of production such as capital and labour, labour regulations, and other institutions and historical accidents related to development and relevant to firm-level incentives.<sup>26</sup>

### *Macro approach*

In light of the conclusions from the literature review and the framework provided by our preliminary model, the macro analysis is structured to identify policies that accompany and complement the strengthened protection of IPRs, helping to incentivise innovation and increase trade and trade-related investment. Here, the focus is on economy-wide policies. The macro approach tested the relationship of the following policies to the dependent variables in the model,<sup>27</sup> where they were included in a context of strengthened IPR protection:

- **Macroeconomic stability (especially in relation to inflation).**

In principle, countries that have a consistent monetary policy of controlling inflation may preserve the value of assets and therefore provide an appropriate climate for any type of investment including research and development.<sup>28</sup>

- **Quality of governance and quality of government.**

Responsible governments may be rewarded with relatively higher inflows of foreign direct investment to the extent that they create an economic environment with less risk than would otherwise be the case. Basically, a “responsible” government is perceived as non-corrupt, transparent, non-discriminatory, open and stable.<sup>29</sup> This may encourage greater innovative activity as well.

- **Enforcement or the rule of the law.**

Countries that are perceived as having a clear, simple, effective and expeditious judicial system could display higher levels of investment. Firms may also conduct more R & D in these countries, for example, as this factor may facilitate their ability to appropriate the benefits of their innovative activity.<sup>30</sup>

<sup>25</sup> The Orbis database as of 2008 covers the 30 OECD countries (i.e. this was prior to the recent accessions of Chile, Israel and Slovenia to the OECD) and the following emerging economies: Argentina, Brazil, Chile, China, Hong Kong (China), India, Indonesia, Malaysia, Morocco, Russian Federation, Singapore, South Africa, Chinese Taipei, Thailand and Tunisia.

<sup>26</sup> P. Krugman and M. Obstfeld, *International Economics: Theory and Policy*, 8th edn (Boston, MA: Pearson-Addison Wesley, 2009) considers an historical accident to be any occurrence providing a country, industry or firm with a head start relative to other competitors.

<sup>27</sup> These hypotheses describe the basic relationships stemming from previous research and are now presented under a unified model. There are other hypotheses which could potentially be tested within this framework. We leave the inclusion of additional variables into the model as future extensions of this work.

<sup>28</sup> K. Rogoff, “The Optimal Degree of Commitment to an Intermediate Monetary Target” (1985) 100(4) *Quarterly Journal of Economics* 1169; R. Barro, “Determinants of Economic Growth: A Cross-Country Empirical Study”, NBER Working Paper (August 1996).

<sup>29</sup> Barro, “Determinants of Economic Growth”, 1996; La Porta et al., “Courts: The Lex Mundi Project” (2002) 117(4) *Quarterly Journal of Economics* 1193; La Porta et al., “The Economic Consequences of Legal Origins” (2008) 46(2) *Journal of Economic Literature* 285.

<sup>30</sup> Barro, “Determinants of Economic Growth”, 1996; S. Djankov, R. La Porta, F. López-de-Silanes and A. Shleifer, “Courts: The Lex Mundi Project”, CEPR Discussion Papers 3344 (2002); E.L. Glaeser, R. La Porta, F. López-de-Silanes and A. Shleifer, “Do Institutions Cause Growth?”, NBER Working Papers 10568 (National Bureau of Economic Research, 2004); La Porta et al., “The Economic Consequences of Legal Origins” (2008) 46(2) *Journal of Economic Literature* 285.

- **The presence of bureaucratic obstacles to business practices and business establishment.**

These bureaucratic obstacles proxy for transaction costs; their reduction may foster increases in the number of firms in domestic markets and, on occasion, the creation of new markets.<sup>31</sup>

- **The quality of the labour force.**

Countries that possess a relatively more educated labour force may be more attractive to foreign investors—for example, by reducing the extent of necessary training expenditures and increasing the quality of inputs from local labour resources including potential innovation.<sup>32</sup>

- **The productivity of the labour force.**

Innovative firms looking to do research and development may locate in countries where labour productivity is high compared to other countries. As the concentration of such activity increases, it is likely that unit labour costs will decrease.<sup>33</sup>

- **The quality of the infrastructure of the country.**

The quality of the roads, telecommunications networks and ports, among other types of infrastructure, can reduce the cost of doing business.<sup>34</sup> In conjunction with adequate IPR protection, good infrastructure may be conducive to heightened levels of some types of economic activity (e.g. just-in-time manufacturing of IP-intensive components as inputs in global production chains).

### *Micro approach*

The micro-level analysis provided insights into these developments from the perspective of the firm. The broad objective of the micro approach was to explore the different motivations leading firms to innovate and how productive units utilise innovations. Unlike the macro-level assessment, the micro approach relied on simple regression analysis, using a single equation to consider one dependent variable at a time rather than the system of equations described above.<sup>35</sup> In specifying possible relationships to test, we drew on insights from the stylised model described above and on the macro-level results. Thus the micro-regression considered the significance of relationships between, on the one hand, the economic performance of firms, and on the other hand, IPR protection and complementary factors. The objective was simply to explore in a preliminary fashion whether significant relationships for these factors could also be found using firm-level data.

Use of a simplified econometric framework went hand in hand with three further simplifying assumptions.<sup>36</sup> In particular, we assume that firms choose to use their intellectual property, even though we cannot observe the actual outcome of this assumption. It is possible that firms choose not to disclose

<sup>31</sup> Barro, “Determinants of Economic Growth”, 1996; Djankov et al., “Courts: The Lex Mundi Project”, 2002; La Porta et al., “Courts: The Lex Mundi Project” (2002) 117(4) *Quarterly Journal of Economics* 1193.

<sup>32</sup> Barro, “Determinants of Economic Growth”, 1996; Glaeser et al., “Do Institutions Cause Growth?”, 2004.

<sup>33</sup> Barro, “Determinants of Economic Growth”, 1996; Glaeser et al., “Do Institutions Cause Growth?”, 2004.

<sup>34</sup> Barro, “Determinants of Economic Growth”, 1996; Glaeser et al., “Do Institutions Cause Growth?”, 2004.

<sup>35</sup> This was done in view of the complexity of interpretation, whereby use of a single equation approach facilitated identification of possible relationships between particular variables.

<sup>36</sup> In a future stage of the research, the following relationships could be examined in order to highlight important firm level factors including IPRs and their policy complements: (1) *Firm size*: Firm size may affect the likelihood of a firm innovating and increasing exports once IPRs are protected and regulation enforced. Public policy already influences firm size. For example, this can include policies with provisions that vary by firm size such as employment protection legislation or accounting and tax policies (with provisions that influence assets, employment, number of subsidiaries, and profits, among other aspects). Therefore, if firm size matters for increased innovation, reform of public policy may have a role in this regard. See A.B. Bernard and J. Bradford Jensen, “Exceptional Exporter Performance: Cause, Effect, or Both?” (1999) 47 *Journal of International Economics* 1; A.B.

their latest technological advancement immediately after it is developed, but only some time afterwards. However, if the firm's goal is to maximise profits or maximise market share then it follows the firm would choose to employ all resources available to it, including the intellectual property resources. Secondly, the point in the production process where the use of the intellectual property is potentially most important is also unknown and unobservable. Owing to data limitations, we must assume this lack of information is not critical to the results of the present assessment. Finally, most of the indicators we have for IPR protection, in particular the patent, copyright and trade mark indices developed by Park et al. represent a country's efforts to protect IPRs in terms of laws on the books. This presents an aggregation problem since firms operate in different sectors subjected to varying degrees of technological change and there is little variation within the Park et al. indices according to the conditions in each sector. Given these caveats, we treat the micro-level results as preliminary and point out the more illustrative cases of a positive influence of the intellectual property resources.

### Presentation of results: Macro and micro

The development process for most developing countries is linked to FDI and trade with developed countries. FDI has been considered an important channel for technology transfer. In addition to outright acquisition of new technologies, other mechanisms such as knowledge spillovers, labour turnover and inter-firm supplier linkages further promote diffusion of technology within the economy. Currently, most of world trade has shifted to intermediate inputs; it has been argued that countries with higher growth rates and higher levels of R & D as a proportion of GDP produce intermediate goods of higher quality, which aids in producing more efficient capital goods and better final consumption goods.<sup>37</sup> This process allows developing countries to gradually close the gap between their current technology and the technological frontier, which increases the country's income and well-being.

The econometric model specified in this article tries to address the aforementioned pattern and shed light into the development process. However, the analysis of IPR reform is not as straightforward as for certain other types of policies because of the interrelated nature of IPR policy and other types of institutional changes. The revision of IPR legislation may interact with other institutional changes and the effects may appear gradually through various channels. Moreover, the growth process associated with R & D for new technologies can only be fully appreciated over the long run. Adding to the difficulties, acquiring technology usually involves making complementary investments. Keller, for example, finds that international trade enables domestic firms to raise their productivity by importing specialised foreign intermediate goods.<sup>38</sup> Complementary investments have to take place for this process to trigger domestic innovation. Identifying the characteristics of the environment that allow more R & D to occur is fundamental to ensuring an appropriate policy framework for development. If the current environment is not conducive for a country to engage in R & D on its own, then certain additional measures may need to be taken to modify these conditions.

Bernard and J. Bradford Jensen, "Why some firms export" (2004) 86(2) *Review of Economics and Statistics* 561; A.B. Bernard, J. Eaton, J. Bradford Jensen and Samuel Kortum, "Plants and Productivity in International Trade" (2003) 93(4) *American Economic Review* 1268. (2) *Firm location*: Do firms in the same industry cluster together and therefore increase their innovation, generate greater profits and boost exports when IPRs are protected? This could involve investigating potential economies of scale due to clustering and knowledge spillovers related to location. See Bernard and Jensen, "Exceptional Exporter Performance" (1999) 47 *Journal of International Economics* 1; Bernard and Jensen, "Why some firms export" (2004) 86(2) *Review of Economics and Statistics* 561; Bernard et al., "Plants and Productivity in International Trade" (2003) 93(4) *American Economic Review* 1268; Krugman and Obstfeld, *International Economics*, 2009.

<sup>37</sup> E.g. W. Keller, "Transfer of Technology" in L. Blume and S. Durlauf (eds), *The New Palgrave Dictionary of Economics*, 2nd edn (2008) discusses some of these issues.

<sup>38</sup> W. Keller, "Are International R&D Spillovers Trade-Related? Analyzing Spillovers among Randomly Matched Trade Partners", NBER Working Paper 6065 (National Bureau of Economic Research, Inc, 1997).



The model has four equations addressing areas related to country and firm performance through the economic environment. Each of the model's equations attempts to capture the behaviour of fundamental components related to the intellectual property environment for technology research and transfer, and growth. For example, FDI captures the effects of technology transfer across countries; the level of R & D for new products captures investments made in developing new technologies coupled with foreign ones brought from outside; service imports and licensing fees capture part of the confidence in the country's business environment; and finally, the IPR protection level captures a specific measure related to the reputation of the country's institutions that enable the environment to become conducive for growth. The key is to consider these variables jointly since policies intended to affect one of them directly may also affect the others indirectly.

A base specification for the model was estimated and then modified to test various policies affecting different areas of the IPR environment. Particular attention was paid to the evolution of inflows of FDI, the level of IPR protection (measured by the "Park" indices), the level of R & D in a country, and finally the amount of services imports per country. For example, one would not expect an education policy to affect the inflow of FDI directly, but through R & D, which is affected by the IPR environment, which is affected by FDI.

### *Macro-level base models for patents, copyright and trade marks*

The results for the base model for patents (Table 1) suggest a positive and statistically significant relationship between the level of IPR protection and FDI (equation 1); the level of FDI and the level of IPR protection (equation 2); the level of IPR protection and the level of domestic R & D (equation 3); and the amount of service imports corresponding to licence fees. We observe a feedback mechanism whereby a country that increased its protection of IPRs tended to be rewarded by an increase in FDI and, in turn, strengthened its IPRs. In this case, a 1 per cent increase in the protection of IPRs measured by the Patent Rights Index was associated with a 2.8 per cent increase in the inflow of FDI. Similarly, a 1 per cent increase in the inflow of FDI implied on average an increase in IPR protection by 0.3 per cent. We also capture the positive influence of IPRs on the level of R & D in a country, as shown by the sign and statistical significance of the parameter estimate of the Patent Rights Index in equation 3. For a 1 per cent increase in the level of protection of IPRs there was on average a 0.7 per cent increase in the domestic level of R & D. These positive results are compounded by the last equation where a 1 per cent increase in the level of IPR protection was associated with an increase in service imports of 2 per cent.

The results for the base model for copyrights follow a pattern similar to that of patents (Table 2). We observe a positive relationship between the Copyright Index and FDI. For a 1 per cent increase in copyright protection there was a 6.8 per cent increase in FDI. Likewise for a 1 per cent increase in FDI, there was on average a 0.075 per cent increase in copyright protection by the host country. When countries experienced a marginal increase in IPR protection, this drew a more than proportional amount of FDI. As they further increased protection within the time period of this study, they experienced further inflow of FDI. This positive relationship is again seen with respect to R & D, where a 1 per cent increase in copyright protection was associated with a 3.3 per cent increase in domestic R & D. In this case, we do not observe an increase in service imports in the form of licensing fees, as the parameter estimate was not statistically significant.

The base model for trade marks displays relationships similar to those in the two preceding base models (Table 3). On average, a country increasing its trade mark protection level by 1 per cent recorded an increase of 3.8 per cent in FDI. The feedback mechanism is present again, whereby a 1 per cent increase in FDI was associated with an increase in the domestic level of trade mark protection of 0.16 per cent. Similarly, when trade mark protection increased by 1 per cent it was associated with an R & D increase

of 1.4 per cent. Unlike the situation for copyrights, a 1 per cent increase in trade mark protection was associated with a statistically significant (2.9 per cent) increase in service imports in the form of licensing fees and payments.

Thus the base models for these three forms of intellectual property present broadly similar patterns. The statistical results suggest that for the period under study, increases in the protection of the IPRs tended to be associated with economic benefits: higher inflows of FDI, increases in the levels of domestically conducted R & D, and increases in the level of service imports as measured by licensing fees. A feedback mechanism is observed whereby the inflows of FDI create incentives for countries to keep elevating their levels of IPR protection to continue receiving the benefits of even more FDI inflows (within the ranges of IPR protection and timeframe of the study). In the base specification, attention should also be paid to the significance of the legal institutions variable and its relationship to R & D. Certainly, without protection, an economic agent could spend significant resources developing a novel idea that could be easily appropriated by others. Such a situation may leave the economic agent without profits, or even a loss, and thus inhibit future innovation.

### *Results for the macro-level assessment of complementary policies*

Within the macro-level assessment, a further detailed examination of policy complements was conducted. The analysis looks into the characteristics of the IPR environment through four sets of variables related, respectively, to the macro, resource, legal and institutional, and fiscal conditions:

- **Macro:**

The macro set relates to the government's performance in running the macro-economy and includes: corruption, the number of state-owned enterprises in the economy, the average level of inflation, the number of bureaucratic delays, the risk of contract repudiation (another proxy for legal institutions), the government's effectiveness, the size of the unofficial economy, and labour informality.

- **Resource:**

The resource set relates to domestic capacity-building endowments and captures quality differences in the inputs required to manufacture higher-value intermediate or final consumption goods. The set includes: the size of the population, secondary school enrolment, literacy rates, infant mortality rates, physical infrastructure (index), unemployment protection laws and social security guarantees.

- **Legal and institutional:**

This set relates to the enforceability of contracts, corruption within the country, the quality of the bureaucracy, citizen's perceptions of the judicial branch of government, and certain administrative impediments to start a business.<sup>39</sup> (We also tested the level of competition within a country with a proxy capturing the number of price controls in the economy.)

- **Fiscal:**

This set concerns the tax burden imposed by countries on firms located within their borders.<sup>40</sup>

<sup>39</sup> In the base specifications, we already attempted to capture the countries' legal institutions. We modified the base models to test other variables attempting to capture in alternative ways the legal and institutional dimension of the environment. This procedure avoided situations where explanatory variables in the same regression model suffered from high correlation coefficients because they measure similar, but not identical, dimensions of the countries' institutions.

<sup>40</sup> Previous empirical studies document a negative relationship between FDI and host country tax rates.

The regression analysis was repeated with a set of core variables from the base model included across the various iterations and the various other potential complements, each tested one at a time. Owing to space considerations, we only present one representative table with results for the four most significant complementary policy variables, shown in conjunction with just one type of IPR protection in each case. However, as discussed below, in a number of cases the coefficients for these four most significant complementary policies were statistically significant for the other intellectual property types as well.<sup>41</sup> The results point, in particular, to significant complementarity for IPR protection and policies affecting the size of the unofficial economy, infrastructure quality, corruption and taxation. These are each discussed in turn below.

The variable measuring the size of the unofficial economy provided interesting results for copyrights (Table 4) and trade marks. A larger unofficial economy was associated with constrained inflows of FDI. In particular, a 1 per cent increase in the size of the unofficial economy was associated with -0.03 per cent and -0.01 per cent decreases in FDI inflows in the case of copyrights and trade marks, respectively. (The parameter estimates of these variables with respect to patents fall in the same direction, but are not statistically significant.) In this context, reducing the size of the unofficial economy tended to be associated with increased inflows of FDI, while having a positive effect on the level of R & D. These effects, through a feedback mechanism, were likely to be eventually reflected in higher future levels of IPR protection.

The infrastructure quality index provided robust and statistically significant results for patents and trade marks. For patents (Table 5), a 1 per cent increase in the infrastructure's quality was associated with a 0.15 per cent increase in R & D, which would then influence the level of IPR protection and affect FDI inflows. Recall that R & D spending is a main cause for technical change. Countries with positive and high levels of R & D will tend to converge to parallel growth paths with similar positive growth rates while other countries may risk stagnation. Similarly, for trade marks a 1 per cent increase in the infrastructure's quality was associated with a 0.06 per cent increase in R & D. One explanation for the parameter's smaller magnitude, relative to patents, may be that patents require more physical inputs than trade marks. (The infrastructure index's parameter estimate was positive but not statistically significant for the case of copyrights.)

The sign of the variable measuring corruption was in line with expectations. The impact of this variable is greater for patents (Table 6) than for copyrights or trade marks, whereby a 1 per cent decrease in the country's corruption implies an increase of 0.15 per cent in R & D and a 0.03 per cent increase in patent protection. For copyrights, a 1 per cent decrease in corruption was associated with a 0.04 per cent increase in copyright protection. For trade marks, a 1 per cent decrease in corruption implies a 0.1 per cent increase in R & D. (Given the difficulties surrounding the measurement of institutions and the legal system, the other variables tested did not perform according to expectations. Obtaining a more accurate measure for these variables could be a topic for future investigation.)

With regard to taxes, the parameter estimates obtained confirmed empirical research from previous studies. The results from the tax level variable showed a negative relationship to both inflows of FDI and service imports. In particular, for trademarks (Table 7), a 1 per cent increase in the tax level implies lower FDI inflows (-3.6 per cent) and lower service imports (-3.2 per cent). There is a similar relationship for copyrights, with such a tax increase being associated with lower FDI inflows (-3.4 per cent) and service imports (-4 per cent). For patents the effect is similar, however, only statistically significant for FDI inflows. A 1 per cent increase in the tax level implies lower FDI inflows (-3.5 per cent). The results for these variables underscore that they have a more than proportional association with FDI inflows and service imports.

<sup>41</sup> The interested reader can refer to our OECD Trade Working Paper for the complete set of results: Cavazos Cepeda, Lippoldt and Senft, "Policy Complements to the Strengthening of IPRs in Developing Countries", 2010.

A key finding from the econometric exercise is the degree of interrelatedness between FDI and domestic variables. FDI has the potential to offer two major sources of welfare gains: (1) it can lower prices by shifting production to lower cost locations; and (2) it has the potential to encourage industrial development by introducing new technologies. (This is similar to results in the literature for trade, highlighting that countries which have adopted relatively open trade regimes have often grown substantially faster than more protectionist ones.) The present findings fit with similar conclusions by Branstetter and Saggi, where they find a positive relationship between the degree of IPR enforcement in developing countries and investment by US firms.<sup>42</sup>

### *Summing up the macro-level assessment*

The results of the macro-level assessment presented above provide an indication of the interrelationships between the variables for the protection of IPRs and those representing key dimensions of economic performance. The statistical significance of the results across the system of equations points to a virtuous circle, whereby improvements in the IPR environment are associated with improved economic performance—in particular with respect to FDI—and, in turn, further improvements in the IPR environment. Important policy complements are identified in the course of this assessment, notably with respect to variables that affect the ability to conduct business. These complements can be grouped under four headings: those affecting the macro-environment, resources, legal and institutional, and fiscal conditions. The association of these complements with desired economic outcomes varied somewhat across the groups and by type of IPR.

#### Box 1. IPR Policy Interactions

In addition to the results obtained from the system of equations, we tested the relationship at the macro-level between several policy dimensions jointly with the Patent Rights Index. We ran single equation regression models including interaction terms combining the indicator for the strength of patent rights with other economic parameters to determine which interactions were important for maximizing merchandise imports and FDI. The econometric specification followed Park and Lippoldt (2008) since the authors identified several institutions affecting the functioning of the country overall. This supplementary exercise yielded only a limited number of cases where the interaction terms had statistical significance. The significance of particular indicators was more apparent when countries were disaggregated by income levels.

For middle income countries, a 1 per cent increase in the interaction term representing the combination of economic openness and patent protection was associated with a 3 per cent increase in FDI. Similarly, conditional on being a least developed country (LDC), having a better business environment with relatively high levels of patent protection implied a discrete change in FDI of approximately 24 per cent. Looking at merchandise imports, the results show the importance of the legal system. For high income economies, a 1 per cent increase in the indicator for the interaction of the functioning of legal systems and patent protection was associated with an 8 per cent increase in merchandise imports. Additionally, conditional on the economy being a LDC, having a 1 per cent better score for the functioning of the legal system and patent protection combined implied a 4 per cent increase in merchandise imports. For LDCs, a 1 per cent increase in the indicator for the property rights regime interacted with patent rights yielded a larger implied increase in merchandise imports of approximately 17 per cent. The remaining results were not conclusive in a statistical sense and thus we do not discuss them here.

In sum, the most statistically significant results are consistently related to the factors having the highest impact on the business environment, such as the legal system and the protection and preservation of property rights, in conjunction with protection of patent rights. The incentive to innovate depends not on the rents of a successful innovator per se, but rather on the difference in rents between the successful innovator and the unsuccessful one. Thus, it appears that the operation of patent rights in conjunction with the broader legal institutions in the country permits the successful innovator to protect these incremental rents.

<sup>42</sup> L. Branstetter and K. Saggi, “*Intellectual Property Rights, Foreign Direct Investment, and Industrial Development*,” NBER Working Papers 15393 (National Bureau of Economic Research, 2009).

### *Results of the micro-level assessment*

As noted above, given difficulties in availability and interpretation of micro-level data with respect to intellectual property, we employed a simplified approach in order to obtain a first glimpse of the inner workings of the firm with respect to the IPR environment and economic performance. We developed single equation regression models focusing on three different dependent variables, each individually and in turn: firm total sales, firm total assets, and firm total intangible fixed assets. These were selected in view of the potential effect of intellectual property on their performance. We analyse these separately for the cases of patents, copyrights and trade marks. The results are presented in Table 8, indicating where significant relationships were found; the objective is to provide an indication of relationships to be explored in further research.

The selection of independent and control variables for inclusion in this exercise proceeded based on insights from the literature. Among the variables included in the simple regression models were: inward FDI, IPR protection (the Park et al. indices for patent rights, copyright or trade mark rights), the level of GDP per capita, an indicator for openness, a measure for the business environment, a measure for the legal institutions within the country, a measure for property rights, and a measure for government effectiveness. We included these variables in each model because they cover relevant dimensions of the business environment. We then included other variables to identify certain complementary policy dimensions that could also exert influence on the outcome variables in question. These additional variables included: a measure of co-operation between university research and industry, a measure for innovative capacity, a measure for the rule of law, a measure for regulatory quality, and a measure for political stability.

The results of the micro-level assessment were positive in certain cases, but less straightforward compared with the macro-level outcomes. First, the indicators for all three types of IPR protection were significant for each type of firm-level economic performance, with the exception of intangible assets (where the coefficients for copyright and trade mark protection were not significant). Secondly, the preliminary results point to the significance of most of the complementary policy indicators for intangible assets; in the case of copyright and trade marks, the results also pointed to at least one complementary policy being significant for sales and total assets. In other words, there is some evidence that firms do capitalise on improved IPR protection taking place in conjunction with complementary factors such as opportunities for industry-university collaboration.<sup>43</sup>

### **Conclusion**

This article considers the wave of IPR reform that has rolled out globally over the past two decades. The analytical approach laid out in the article employs complementary macro and micro levels of analysis in order to examine the economic implications of this IPR reform and variation in associated economic performance. In considering this variation, the analysis looks at the policy complements that have been associated with positive economic outcomes or that may have influenced further IPR reform.

Under each approach, the analysis has found a tendency for IPR reform to deliver positive economic results. Reforms concerning patent protection have tended to deliver the most substantial results, but the results for copyright reform and trade mark reform were also positive and significant. Overall, the policy complements that were found to be most important in facilitating positive results were those related to inputs for innovative and productive processes and to the ability to conduct business. These include policies that influence the macro-environment for firms as well as the available resources, legal and institutional conditions, and fiscal incentives.

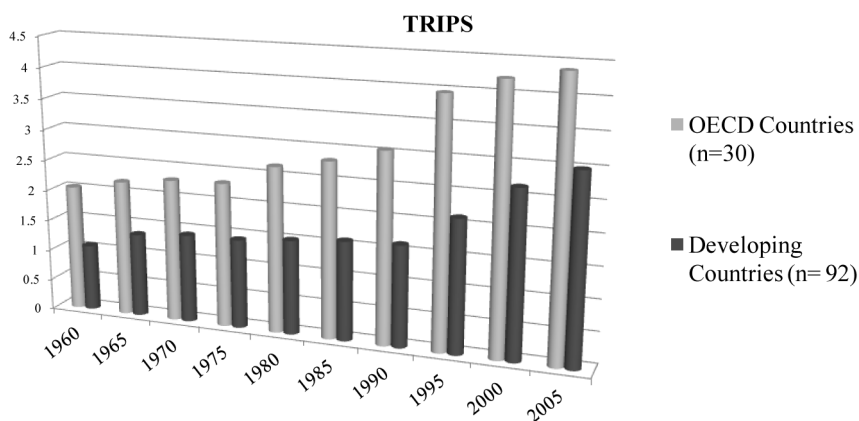
<sup>43</sup> Future research to expand the analysis based on a more disaggregated approach may yield stronger results. In addition, further research could usefully explore the importance of variation at the country level.

The importance of specific complements varies depending on a country's level of development and other dimensions. However, an implied cross-cutting theme is the importance of human capital. The knowledge and skills that people are able to put into action constitute a factor that fuels innovation and business, enabling countries to develop and capitalise on intellectual property. For all countries, investment in people appears to be one important factor in reaping the optimal benefits of IPR reform.

## Appendix: Figures and tables

Figure 1. Index of patent rights based on laws on the books (0 = weak, 5 = Strong)

*Note:* The chart presents the average score for the Patent Rights Index for OECD and developing countries. Using objective criteria, the Patent Rights Index scores the strength of patent rights based on laws on the books. Scores can range from 0 to 5.



Source: Park and Lippoldt, "Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries", 2008.

Table 1. Base model for patents<sup>44</sup>

VARIABLES	Log of FDI	Log patent index	Log research and development	Log knowledge capital
Log patent index	2.819***		0.751*	2.046**
	(0.764)		(0.435)	(0.793)
Log per capita GDP	0.0757			
	(0.103)			
Log of free trade	-0.320			
	(0.596)			
Log WEF IPR	0.210			
	(0.430)			
Log legal institutions	-0.0785		1.355***	-1.810**

<sup>44</sup> Source: Authors' calculations.

VARIABLES	Log of FDI	Log patent index	Log research and development	Log knowledge capital
	(0.487)		(0.370)	(0.913)
Government effectiveness (dummy)	0.318	-0.0118		
	(0.247)	(0.0430)		
Log doing business	-0.00506			
	(0.0863)			
Log research and development		8.88e-05		1.474***
		(0.0434)		(0.279)
Log of FDI		0.301***		
		(0.0337)		
Log of research quality		-0.601***	0.0735	
		(0.226)	(0.869)	
Log university		0.229	1.899**	
		(0.183)	(0.812)	
Percent of secondary enrolment			0.00289	
			(0.00412)	
Log of population			-0.0518	
			(0.0778)	
Constant	6.135***	-1.213***	-6.365***	6.876***
	(1.249)	(0.262)	(0.712)	(2.163)
Observations	113	113	113	113
R-squared	0.433	-0.213	0.764	0.493
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 2. Base model for copyright<sup>45</sup>

VARIABLES	Log of FDI	Log copyright index	Log research and development	Log knowledge capital
Log copyright index	6.826*		3.312***	1.966
	(3.939)		(0.596)	(1.882)
Log per capita GDP	0.143			
	(0.442)			
Log of free trade	1.758			
	(1.615)			
Log WEF IPR	0.264			
	(0.864)			
Log legal institutions	-1.834*		1.088***	-3.066***

<sup>45</sup> Source: Authors' calculations.

VARIABLES	Log of FDI	Log copyright index	Log research and development	Log knowledge capital
	(0.954)		(0.314)	(1.074)
Government effectiveness (dummy)	0.429	-0.0547**		
	(0.410)	(0.0260)		
Log doing business	-0.0461			
	(0.247)			
Log research and development		0.127***		2.052***
		(0.0279)		(0.334)
Log of FDI		0.0727***		
		(0.0179)		
Log of research quality		0.0145	-0.374	
		(0.149)	(0.709)	
Log university		-0.279**	2.162***	
		(0.135)	(0.635)	
Percent of secondary enrolment			0.000845	
			(0.00228)	
Log of population			-0.0301	
			(0.0586)	
Constant	11.26	-0.757***	-3.071***	12.88***
	(8.518)	(0.161)	(0.639)	(2.179)
Observations	108	108	108	108
R-squared	-0.476	-0.054	0.522	0.375
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 3. Base model for trade marks<sup>46</sup>

VARIABLES	Log of FDI	Log trade mark index	Log research and development	Log knowledge capital
Log trade mark index	3.784***		1.436***	2.973***
	(0.720)		(0.270)	(0.949)
Log per capita GDP	0.0276			
	(0.142)			
Log of free trade	0.635			
	(0.952)			
Log WEF IPR	-0.0659			
	(0.845)			
Log legal institutions	-1.726**		1.378***	-1.367

<sup>46</sup> Source: Authors' calculations.



VARIABLES	Log of FDI	Log trade mark index	Log research and development	Log knowledge capital
	(0.677)		(0.297)	(1.038)
Government effectiveness (dummy)	0.911***	-0.185***		
	(0.250)	(0.0440)		
Log doing business	-0.155			
	(0.155)			
Log research and development		0.271***		1.381***
		(0.0558)		(0.313)
Log of FDI		0.165***		
		(0.0278)		
Log of research quality		0.0209	-0.532	
		(0.311)	(0.739)	
Log university		-0.666**	2.632***	
		(0.307)	(0.666)	
Percent of secondary enrolment			-0.00113	
			(0.00223)	
Log of population			0.00422	
			(0.0470)	
Constant	13.62***	-1.143***	-4.587***	10.05***
	(2.750)	(0.308)	(0.481)	(1.969)
Observations	92	92	92	92
R-squared	0.152	-0.654	0.801	0.362
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 4. The unofficial economy and the copyright index<sup>47</sup>

VARIABLES	Log of FDI	Log copyright index	Log research and development	Log knowledge capital
Log copyright index	-0.652		2.647***	2.336
	(2.288)		(0.681)	(1.625)
Log per capita GDP	0.332			
	(0.298)			
Log of free trade	0.835			
	(1.107)			
<i>Unofficial economy</i>	-0.0322***			
	(0.00999)			
Log legal institutions	-0.960		0.791**	-1.481

<sup>47</sup> Source: Authors' calculations.

VARIABLES	Log of FDI	Log copyright index	Log research and development	Log knowledge capital
	(0.734)		(0.336)	(1.029)
Government effectiveness (dummy)	0.713**	-0.0339		
	(0.309)	(0.0356)		
Log doing business	0.236			
	(0.188)			
Log research and development		0.169***		1.584***
		(0.0415)		(0.336)
Log of FDI		0.0746**		
		(0.0297)		
Log of research quality		-0.440	0.628	
		(0.286)	(0.928)	
Log university		-0.0863	1.515*	
		(0.274)	(0.817)	
Percent of secondary enrolment			0.000403	
			(0.00251)	
Log of population			-0.116	
			(0.0854)	
Constant	6.652	-0.399	-2.964***	10.15***
	(5.213)	(0.344)	(0.680)	(2.030)
Observations	99	99	99	99
R-squared	0.489	0.025	0.599	0.410
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 5. Infrastructure quality index and the patent rights index<sup>48</sup>

VARIABLES	Log of FDI	Log patent index	Log research and development	Log knowledge capital
Log patent index	2.589***		0.376	2.160***
	(0.884)		(0.434)	(0.624)
Log per capita GDP	-0.0541			
	(0.174)			
Log of free trade	-0.465			
	(0.939)			
Log legal institutions	0.000921		0.794**	-0.689
	(0.574)		(0.341)	(0.796)
Government effectiveness (dummy)	0.410*	-0.0662		

<sup>48</sup> Source: Authors' calculations.

VARIABLES	Log of FDI	Log patent index	Log research and development	Log knowledge capital
	(0.238)	(0.0491)		
Log doing business	-0.0254			
	(0.110)			
Log research and development		0.102*		1.077***
		(0.0560)		(0.249)
Log of FDI		0.308***		
		(0.0370)		
Log of research quality		-1.177***	2.371***	
		(0.333)	(0.809)	
Log university		0.699**	-0.602	
		(0.277)	(0.688)	
Percent of secondary enrolment			-0.000268	
			(0.00323)	
Log of population			-0.177***	
			(0.0630)	
<i>Infrastructure quality index</i>			0.151***	
			(0.0573)	
Constant	8.336***	-1.084***	-4.914***	4.942***
	(2.115)	(0.399)	(0.720)	(1.738)
Observations	88	88	88	88
R-squared	0.348	-0.066	0.797	0.368
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 6. The corruption index and the patent index<sup>49</sup>

VARIABLES	Log of FDI	Log patent index	Log research and development	Log knowledge capital
Log research and development		0.0165		1.023***
		(0.0563)		(0.258)
Log FDI		0.260***		
		(0.0370)		
Log research quality		-1.011***	2.072*	
		(0.265)	(1.088)	
Log university research		0.436*	0.0504	
		(0.255)	(1.059)	
Government effectiveness	0.554***	-0.0164		

<sup>49</sup> Source: Authors' calculations.

VARIABLES	Log of FDI	Log patent index	Log research and development	Log knowledge capital
	(0.199)	(0.0579)		
<i>Corruption index</i>		0.0339*	0.154**	0.00760
		(0.0203)	(0.0636)	(0.126)
Frequency of price controls		0.000542		
		(0.0118)		
Log patent index	2.097***		1.082*	2.229***
	(0.740)		(0.582)	(0.777)
Log GDP per capita	0.0463			
	(0.144)			
Log free trade	-0.219			
	(0.773)			
Log doing business	-0.00557			
	(0.109)			
Log secondary school enrolment			-5.49e-05	
			(0.00482)	
Log population			-0.0973	
			(0.0816)	
Constant	7.139***	-0.722	-5.336***	3.184***
	(1.602)	(0.441)	(0.818)	(1.206)
Observations	106	106	106	106
R-squared	0.495	0.250	0.749	0.568
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 7. Tax levels and the trade mark index<sup>50</sup>

VARIABLES	Log of FDI	Log trade mark index	Log research and development	Log knowledge capital
Log trade mark index	2.539***		1.407***	-0.949
	(0.573)		(0.202)	(0.766)
Log per capita GDP	-0.376**			
	(0.167)			
Log of free trade	0.394			
	(1.141)			
Log legal institutions	0.0559		1.097***	-1.282
	(0.765)		(0.296)	(1.263)
Government effectiveness (dummy)	0.797***	-0.177**		

<sup>50</sup> Source: Authors' calculations.

VARIABLES	Log of FDI	Log trade mark index	Log research and development	Log knowledge capital
	(0.238)	(0.0691)		
Log doing business	-0.401***			
	(0.137)			
<i>Tax level</i>	-3.687***	0.265	0.0603	-3.208**
	(1.073)	(0.379)	(0.412)	(1.262)
Log research and development		0.391***		1.827***
		(0.0749)		(0.349)
Log of FDI		0.138***		
		(0.0491)		
Log of research quality		-0.194	0.132	
		(0.469)	(0.530)	
Log university		-0.968**	2.100***	
		(0.433)	(0.497)	
Percent of secondary enrolment			-0.000990	
			(0.00185)	
Log of population			-0.135***	
			(0.0469)	
Constant	17.06***	-0.339	-3.811***	10.24***
	(3.245)	(0.618)	(0.444)	(2.176)
Observations	75	75	75	75
R-squared	0.410	-0.393	0.833	0.625
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

 Table 8. IPR protection, complementary policies and firm performance<sup>51</sup>

	Sales	Total assets	Intangible assets
<i>Patents and ...</i>			
Patents	√***	√**	√***
FDI			√*
Free trade			√*
University-Industry co-operation			√*
Business innovation capacity			√**
<i>Copyright and ...</i>			
Copyright		√**	√**

<sup>51</sup> This table presents three indicators of firm economic performance and the policy variables that demonstrated significant relationships to this performance, based on a preliminary regression exercise. The check marks indicate areas where the econometrics point to a significant relationship and the asterisks indicate the highest degree of significance from the various iterations conducted (\*\*\* p<0.01, \*\* p<0.05, \* p<0.1).

Source: Authors' calculations.

	Sales	Total assets	Intangible assets
FDI			√**
Legal institutions			√*
Government effectiveness		√*	
<i>Trade marks and ...</i>			
Trade marks	√***	√***	
Business innovative capacity			√**

## Annex. Variables and data sources

### A. Dependent variables

1. Inward Foreign Direct Investment (FDI) Stock. Source: United Nations Conference on Trade and Development (UNCTAD) Foreign Direct Investment Database (FDI-online), at <http://stats.unctad.org/fdi> [Accessed October 13, 2010].
2. Research and development (R & D). Sources:
  - (a) United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics, Data Center, Custom Tables, Science and Technology, at [http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=136&IF\\_Language=eng&BR\\_Topic=0](http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=136&IF_Language=eng&BR_Topic=0) [Accessed December 6, 2010].
  - (b) Organization for Economic Cooperation and Development, Source: OECD, Science and Technology Database, *Main Science and Technology Indicators*, Vol. 2006, Rel. 02, at <http://www.sourceoecd.org> [Accessed October 13, 2010].
3. Patent Rights Index. Source: J.C. Ginarte and W. G. Park, "Intellectual Property Rights and Economic Growth" (1997) 15(3) *Contemporary Economic Policy* 51; and W.G. Park and A. Wagh, "Index of Patent Rights" in *Economic Freedom of the World: 2002 Annual Report* (2002).
4. Copyrights and Trademark Rights Indexes: Taylor W. Reynolds, "Quantifying the Evolution of Copyright and Trademark Law", 2003, American University, doctoral dissertation and Walter G. Park, "Do Intellectual Property Rights Stimulate R&D and Productivity Growth? Evidence from Cross-national and Manufacturing Industries Data" in Jonathan Putnam (ed.), *Intellectual Property and Innovation in the Knowledge-Based Economy*, (Ottawa: Industry Canada, 2005) pp.9:1–9:51. See [http://strategis.ic.gc.ca/epic/site/ippd-dppi.nsf/vwapj/09-EN%20Park.pdf/\\$file/09-EN%20Park.pdf](http://strategis.ic.gc.ca/epic/site/ippd-dppi.nsf/vwapj/09-EN%20Park.pdf/$file/09-EN%20Park.pdf) [Accessed October 13, 2010].
5. International Trade in Services (proxy for Knowledge Capital). Source: UNCTAD *Handbook of Statistics On-line*, Report Folder V, Table 5.1, at <http://stats.unctad.org/handbook> [Accessed October 13, 2010].

### B. Explanatory variables

*Real GDP per capita* (in real 2000 US dollars). Source: World Bank, *World Development Indicators (WDI)* 2007, CD-ROM.

*Physical property rights.* Source: World Economic Forum, *Global Competitiveness Reports 2000* (Table 3.11), 2004–5 (Table 6.03), 2005–6 (Table 6.03), and 2006–7 (Table 1.01), Oxford University Press. This variable measures Business Executive opinions on how well private property is protected, including financial assets (1 = are poorly defined and not protected by law ... 7 = are clearly defined and well-protected by law).

*Innovative capacity.* Source: World Economic Forum, *Global Competitiveness Reports 2000* (Table 7.01), 2004–5 (Table 9.04), 2005–6 (Table 8.03), and 2006–7 (Table 9.08), Oxford University Press. This variable measures Business Executive opinions on companies' capacity for innovation (1 = obtains technology by imitation of foreign technology or licensing ... 7 = obtains technology by conducting formal research and pioneering their own new products and processes).

*Quality of research institutions.* Source: World Economic Forum, *Global Competitiveness Reports 2000* (Table 7.04), 2004–5 (Table 3.05), 2005–6 (Table 3.05), and 2006–7 (Table 9.01), Oxford University Press. This variable measures Business Executive opinions on the quality of scientific research institutions (1 = non-existent ... 7 = the best in their fields internationally).

*University-industry research collaboration.* Source: World Economic Forum, *Global Competitiveness Reports 2000* (Table 7.06), 2004–5 (Table 3.08), 2005–6 (Table 3.07), and 2006–7 (Table 9.03), Oxford University Press. This variable measures Business Executive opinions on the extent to which businesses collaborate with local universities to engage in R&D (1 = minimal or non-existent ... 7 = intensive and ongoing).

*Index of legal effectiveness.* This variable is a composite score of judicial independence, impartial courts, security of property rights (tangible and intellectual), and integrity of the legal system. Source: Economic Freedom Network (EFN), 2006 Dataset: <http://www.freetheworld.com/release.html> [Accessed October 13, 2010].

*Index of freedom to trade internationally.* This variable is a composite score of minimal taxes or interference with trade (including tariffs and non-tariff barriers to trade), minimal capital controls and foreign ownership restrictions. Source: Economic Freedom Network (EFN), 2006 Dataset: <http://www.freetheworld.com/release.html> [Accessed October 13, 2010].

*IPR survey.* Source: World Economic Forum, *Global Competitiveness Reports 2000* (Table 7.09), 2004–5 (Table 6.04), 2005–6 (Table 6.04), and 2006–7 (Table 9.07), Oxford University Press. This variable measures Business Executive opinions on the stringency of intellectual property protection (1 = is weak or non-existent ... 7 = is equal to the world's most stringent).

*Doing Business Rank.* This variable measures the ease of doing business (for example, the number of procedures required in starting a business, dealing with licenses, employing workers, registering property, getting credit, protecting investors, enforcing contracts, paying taxes, trading across borders, and closing down a business). Countries are ranked in ascending order (1 = easiest place to do business, 2 = next easiest, etc.) Source: World Bank Group at <http://www.doingbusiness.org/CustomQuery> [Accessed October 13, 2010].

*Governance.* Source: World Bank at <http://info.worldbank.org/governance/wgi2007> [Accessed January 25, 2008].

There are six dimensions of governance: voice and accountability (VA), political stability (PS), government effectiveness (GE), regulatory quality (RQ), rule of law (RL), and control of corruption (CC). For purposes of this study, the six measures are averaged: Governance Index = (VA + PS + GE + RQ + RL + CC)/6.

*US price index (GDP deflator).* Source: Economic Report of the President, <http://www.gpoaccess.gov/eop/download.html> [Accessed October 13, 2010].

*Size of the unofficial economy.* Source: Taken from the dataset used in Juan Botero, Simeon Djankov, Rafael La Porta, Florencio Lopez de Silanes and Andrei Shleifer “The Regulation of Labor” (2004) 119 *Quarterly Journal of Economics* 1339.

*Infrastructure quality index.* Source: Taken from Rafael La Porta, Florencio Lopez de Silanes, Andrei Shleifer, and Robert Vishny, “The Quality of Government” (1999) 15 *Journal of Law, Economics, and Organization* 222.

*Corruption.* Source: Taken from Simeon Djankov, Rafael, La Porta, Florencio Lopez de Silanes, and Andrei Shleifer, “Courts: The Lex Mundi Project” (2003) 118 *Quarterly Journal of Economics* 453.

*Tax level.* Source: *OECD Centre for Tax Policy Administration.*

*Percent of secondary enrolment.* Source: Pippa Norris, Democracy Timeseries Data Release 3.0 (January 2009), available at <http://www.pippanorris.com/> [Accessed October 13, 2010].

*Population.* Source: Pippa Norris, Democracy Timeseries Data Release 3.0 (January 2009), available at <http://www.pippanorris.com/> [Accessed October 13, 2010].

*Firm level data:* ORBIS dataset proprietary data from Bureau van Dijk Electronic Publishing.



# The Curious Economics of Parallel Imports

**Keith E. Maskus**

*Professor of Economics, University of Colorado at Boulder*

☞ Economics and law; Exhaustion of rights; Intellectual property; Parallel imports

## Introduction

In this article I review the recent economics literature on the determinants and effects of parallel imports (PI), which are goods brought legally into a market without the authorisation of the local intellectual property rights (IPR) owner.<sup>1</sup> Among the most important limitations on the scope of IPR is the exhaustion doctrine, which states that at some point the original producer of the good loses its distribution rights. For example, once a firm sells a commodity with a registered trade mark or recognised patent within the United States it cannot limit further distribution because first sale within the country exhausts the original ownership rights. Similarly, distribution rights are exhausted upon first sale anywhere within the European Union (EU). However, both the United States and the EU prohibit imports of such goods from outside their territories.

Once rights are exhausted, it becomes legal for anyone to sell the goods he has purchased within the region of application. Because such transactions occur outside the distribution system of the original IPR owner, they are called “gray market activities” (in the United States) or “parallel imports” (in the EU and most of the world). The existence of PI raises a number of interesting policy and strategic questions that have attracted attention by economists. For example, parallel trade is essentially arbitrage of IPR-protected merchandise within policy-integrated markets. These goods are likely to have different prices across countries. Here I review two types of price differences that support such arbitrage. First is consumer-price differences that generate simple retail-level PI in horizontal markets. Second is the deeper, and more strategic, issue of vertical pricing in circumstances where an original manufacturer sells its goods through wholesale distributors in different markets. This situation offers the original IPR-owning firm a menu of strategic choices and challenges in dealing with the competitive threat of PI.

Another important issue is how the legality of PI might alter the incentives of innovative firms to invest in research and development (R & D). For example, the global research-based pharmaceutical firms oppose permitting PI of patented or trade marked medicines into the United States, arguing that the likely reduction in profits would reduce their ability to innovate. This question is closely related to national price controls for medicines, which establish different prices and can give rise to PI.

## Basic economic and legal concepts

Virtually all legally produced goods are distributed with the benefit of some form of IPR. Fashion goods and cosmetics are marketed in different countries with trade marks and brand names. Digital products, such as music recordings and software, are sold or licensed under copyrights, as are films and television broadcasts. Pharmaceutical products rely on patent protection, while new machinery embodies technologies that may also be patented. Indeed, most goods incorporate a complex mix of numerous IPRs to support

<sup>1</sup> This article draws on the analysis in Mattias Ganslandt and Keith E. Maskus, “Intellectual Property Rights, Parallel Imports and Strategic Behavior” in Keith E. Maskus (ed.), *Intellectual Property, Growth and Trade* (Amsterdam: Elsevier 2008), pp.263–288.

their global distribution. IPRs are generally justified as policy interventions needed to encourage invention and creation of new technologies and products and to support their commercialisation. These objectives are achieved through exclusive production and distribution rights, which help firms garner economic returns on their R & D investments. An important factor is that innovators have a strong incentive to sell their IPR-protected goods at different prices to different types of consumers. There are always “impatient” buyers who are willing to pay higher prices for quicker delivery or product versions with higher quality and there are always “patient” consumers who would prefer to save money by waiting or accepting less quality. Countries, or various groups within countries, also display different demand characteristics. Given these differences, firms prefer to differentiate their prices, terms, or access to raise their aggregate returns to investment. An excellent example is that studios release new films at different times in varying locations and also stagger the release dates for recorded videos for purchase and rental markets.<sup>2</sup> Similarly, if a drug manufacturer can sell medicines at a lower price in poor countries than in rich countries, it would prefer to do so as long as those lower prices cover marginal costs.

As mentioned earlier, the legal principle governing whether firms can segment markets to support price discrimination across countries in goods protected by IPR is the exhaustion doctrine. This regulation is a fundamental component of each country’s policy regime. With strong rights to exclude PI, firms can separate markets and differentiate prices and access terms. Obviously exhaustion of rights matters for marketing strategy, the vertical organisation of distribution, and investments in future R & D.

### *International differences in the exhaustion doctrine*

Before discussing the economics of PI, I briefly describe variations in their legal treatment across countries.<sup>3</sup> Policy in the European Union is regional exhaustion in all fields of intellectual property, thereby permitting PI among Member States. However, the EU excludes such trade coming from countries outside the Community. The European Court of Justice (ECJ) consistently has upheld the view that free circulation of goods has legal precedence over IPR. This principle extends to goods that may vary in price across countries owing to differing price controls, including pharmaceutical products, despite the obvious conflict between trade policy and public health policy. One important exception is that products placed on the market under a compulsory licensing order may not be parallel traded.

The United States follows a mixture of policies. Trade mark law sets out a “common-control exception”, under which trade mark owners may bar PI except where both the foreign and domestic firms are in a parent-subsidiary relationship.<sup>4</sup> Further, to exclude PI a trade mark holder must show that the imported goods are not identical in quality to the original products and could cause confusion among consumers.

The situation is different for patents and copyrights. US patent owners are protected against PI by an explicit right of importation. Similarly, under the Copyright Act of 1976, PI in copyrighted goods may be excluded. This difference in treatment reflects the legal principles of the underlying IPR mechanisms. Patents and copyrights provide monopoly rights to permit recovery of investment costs. The ban on PI simply extends the exclusivity of those rights. Trade marks, however, are a guarantee to consumers that the firms using the marks are the ultimate origin of goods sold or their licensees. Parallel imports are legitimate goods originally sold under the trade mark. If no consumer confusion would result then PI amount simply to another distribution channel for authentic commodities.

<sup>2</sup> Philip McCalman, “Foreign Direct Investment and Intellectual Property Rights: Evidence from Hollywood’s Global Distribution of Movies and Videos” (2004) 62 *Journal of International Economics* 107.

<sup>3</sup> This discussion summarises the extensive treatments in Keith E. Maskus, “Parallel Imports” (2000) 23 *The World Economy* 1269; and Carsten Fink, “Entering the Jungle of Intellectual Property Rights Exhaustion and Parallel Imports” in Carsten Fink and Keith E. Maskus (eds), *Intellectual Property Rights and Development: Lessons from Recent Economic Research* (Oxford: Oxford University Press, 2004).

<sup>4</sup> A.P. Palia and C.F. Keown, “Combating Parallel Importing: Views of U.S. Exporters to the Asia-Pacific Region” (1991) 8 *International Marketing Review* 4; National Economic Research Associates, *The Economic Consequences of the Choice of Regime of Exhaustion in the Area of Trademarks* (London: NERA, 1999).

Under Japan's case law it is more open to PI than the United States or EU.<sup>5</sup> Japan allows PI in patented and trade marked goods unless they were explicitly barred from parallel channels by contract provisions or unless they were marketed under a foreign price regulation. In copyrights Japan has an open PI regime except for studio films, reflecting the economic interests of its domestic movie industry.

Australia permits patent owners to block PI but such trade is generally allowed in trademarked goods. Australia is open to PI in copyrighted music and video recordings. Finally, India pursues international exhaustion in trade marked and patented goods, but largely blocks PI in copyrighted products. Again, this situation reflects the strength of the local film and software industries, which prefer not to see their goods re-imported without their control. In general, developing nations are more open to PI in all fields of IPR protection than are developed economies.<sup>6</sup> This reflects stricter limitations on the exercise of IPR and the belief that the competition from PI can benefit low-income consumers.<sup>7</sup>

These differences in perceived commercial and consumer interests make it difficult to achieve international agreements on exhaustion. Indeed, it proved impossible in the negotiations leading to the TRIPS Agreement at the World Trade Organization to reach a global consensus. As a result, art.6 of TRIPS permits each country to establish its own rules on exhaustion, so long as the policy meets basic non-discrimination principles.

It is not surprising that a global rule on PI could not be reached. Indeed, this is the point of the multi-country bargaining model in Richardson.<sup>8</sup> He demonstrated that neither a regime of full international exhaustion (a uniform global price) nor a regime of full national exhaustion (segmented markets), could be negotiated.

Some agreements have been reached in preferential trading arrangements (PTAs). The EU has a region-wide exhaustion policy, which is particularly significant with the recent accession of lower-income transition economies in Eastern and Central Europe. In contrast, the North American Free Trade Agreement contains no explicit reference to exhaustion, suggesting that the policy is left up to individual members. However, in its PTAs with Central American nations, Jordan, Morocco and Vietnam, the United States has made it a priority that its trading partners restrict parallel imports in pharmaceuticals.<sup>9</sup> This provision, one of the so-called "TRIPS-plus" features of PTAs, is controversial.

### *Preliminary matters on the economics of PI*

Parallel imports are unauthorised trade across borders of goods protected by intellectual property rights in the destination nation. Thus PI exploit either a retail price differential between two markets or a mark-up between the wholesale price in one country and the retail price in another sufficient to cover the costs of procuring and shipping goods. Parallel imports can arise from either temporary or persistent factors. Economic shocks, such as exchange-rate fluctuations and temporary demand shifts, permit temporary arbitrage opportunities across countries. The effects of this arbitrage are normally short-term, however, and I do not consider them here.

<sup>5</sup> F. Abbott, "First Report (Final) to the Committee on International Trade Law of the International Law Association on the Subject of Parallel Importation" (1998) 1 *Journal of International Economic Law* 607.

<sup>6</sup> Maskus, "Parallel Imports" (2000) 23 *The World Economy* 1269.

<sup>7</sup> However, a number of countries, particularly in the Middle East and Latin America, have rigorous single-distributor laws in IPR-protected goods, which they justify as a means of encouraging licensing. It is likely that such laws are anti-competitive. See Keith E. Maskus and Mohamed Lahouel, "Competition Policy and Intellectual Property Rights in Developing Countries" (2000) 23 *The World Economy* 595. General issues regarding the linkages between PI and competition policy are discussed in Matthias Ganslandt and Keith E. Maskus, "Wholesale Price Discrimination and Parallel Imports", CESifo Working Paper (2007).

<sup>8</sup> Martin Richardson, "An Elementary Proposition Concerning Parallel Imports" (2002) 56 *Journal of International Economics* 233.

<sup>9</sup> Keith E. Maskus, "Intellectual Property Rights in the U.S.-Colombia Free Trade Agreement" in Jeffrey J. Schott (ed.), *The Free Trade Agreement between Colombia and the United States* (Washington DC: Institute for International Economics, 2006) pp.145-165.

Rather, the economic literature has focused on longer-term impacts that arise in structural equilibrium outcomes. Theorists have considered two basic settings in which PI can affect profits of a firm that manufactures a good protected by IPR and uses independent firms to market and distribute the product. First, parallel trade is viewed as simple arbitrage that limits the scope for international price discrimination.<sup>10</sup> A firm with market power wishes to set prices across markets that reflect differences in willingness to pay for its good but the differences cannot exceed the cost of PI. Secondly, parallel trade may be a response to differences between retail and wholesale prices in a setting of vertical price control.<sup>11</sup> A firm using independent distributors that have market power in national markets must consider several conflicting problems in managing PI, which generate a pro-competitive effect in the import market. Parallel imports also make distribution of goods inefficient since costly trade replaces more cost-efficient local distribution. The following sections summarise the literature in each case.<sup>12</sup>

### Price discrimination and retail arbitrage

In models of retail (or consumer) arbitrage, originator firms set optimal prices at the retail level, as though they sold directly to purchasers. To maximise profits, firms would like to set separate prices that capture the economic valuation of specific consumers or groups of purchasers. Such discrimination requires a number of factors to hold, most notably that the scope for arbitrage among groups is limited. Unlimited and costless trade among consumers would eliminate any price differential and force the firm to set uniform prices.

The standard analysis involves third-degree price discrimination. Here, prices differ across groups of consumers, with each group distinguished by a common elasticity of demand (or willingness to pay).<sup>13</sup> This possibility most closely corresponds to internationally segmented retail markets, with perhaps a single price in each country. Parallel trade sharply limits the scope for international price discrimination to the extent that it does not involve large transactions costs. Indeed, if PI are legal the price variations between geographical markets cannot exceed the costs of trade, including trade barriers, between them. In turn, no PI flows actually take place, since the competition impacts are all in prices. The main point is that the scope for international price discrimination is far greater in the context of national exhaustion than in a regime of international exhaustion.

It is evident that, except in unusual circumstances, profits of original firms are higher, the greater the ability to engage in price discrimination across countries.<sup>14</sup> However, profits are only one component of economic well-being and the overall welfare impacts on society are typically theoretically ambiguous. By extension, the welfare effects of PI are also ambiguous. In technical terms, price discrimination can

<sup>10</sup> David A. Malueg and Marius Schwartz, "Parallel Imports, Demand Dispersion, and International Price Discrimination" (1994) 37 *Journal of International Economics* 187.

<sup>11</sup> Yongmin Chen and Keith E. Maskus, "Vertical Pricing and Parallel Imports" (2005) 14 *Journal of International Trade and Economic Development* 1; Mattias Ganslandt and Keith E. Maskus, "Vertical Distribution, Parallel Trade and Price Divergence in Integrated Markets" (2007) 51 *European Economic Review* 943.

<sup>12</sup> A third issue is that PI may undermine incentives of original firms to provide pre-sales and post-sales services, such as advertising, test drives, quality assurances and warranties; see J.S. Chard and C.J. Mellor, "Intellectual Property Rights and Parallel Imports" (1989) 12 *The World Economy* 69; G.F. Mathewson and R.A. Winter, "An Economic Theory of Vertical Restraints" (1984) 15 *Rand Journal of Economics* 27; and Claude E. Barfield and Mark A. Groombridge, "The Economic Case for Copyright Owner Control over Parallel Imports" (1998) 1 *Journal of World Intellectual Property* 9. These are costly activities that may require exclusivity to recoup. At the same time, there are circumstances involving network effects across consumers where PI can actually increase profits of firms through complementary services: see Po-Lu Chen, "Three Essays on International Trade with a Focus on Intellectual Property Rights" (Unpublished dissertation, University of Colorado at Boulder, 2010). I do not consider these cases further.

<sup>13</sup> First-degree price discrimination involves setting a separate price for each individual, which is rarely feasible. Second-degree price discrimination refers to firms setting separate prices for differentiated groups within a regional market, such as high-income versus low-income consumers. In fact, there are cases in which PI under the latter possibility can raise profits of the originator firm (see Simon P. Anderson and Victor A. Ginsburg, "International Pricing with Costly Consumer Arbitrage" (1999) 7 *Review of International Economics* 126) and in situations with demand uncertainty across markets (see Horst Raff and Nicolas Schmitt, "Endogenous Vertical Restraints in International Trade" (2005) 49 *European Economic Review* 1877).

<sup>14</sup> Paul R. Krugman, "Pricing to Market when the Exchange Rate Changes", National Bureau of Economic Research Working Paper No. W1926 (1986).

reduce welfare by causing a divergence between countries of the marginal valuation of consumption. This is inefficient because people in higher-valuation locations could, via PI, purchase from regions with lower valuations, raising overall well-being. At the same time, price discrimination can expand global consumption because lower prices make goods affordable to consumers in more price-sensitive markets. Thus the essential trade-off is whether the marginal efficiency losses from the valuation distortion are larger or smaller than the infra-marginal gains in consumer surplus in the lower-priced region.

A necessary and sufficient condition for third-degree price discrimination to diminish total “Marshallian” welfare is that total consumption is at least as large under a uniform price. That is, price discrimination can only increase total welfare in the world if total consumption of a good increases. Schmalensee<sup>15</sup> proves this hypothesis in cases where the good may be produced at constant marginal costs.<sup>16</sup> It should be noted that this result is static only and depends on prices being equalized by zero-cost arbitrage. If parallel trade involves costly transactions it may alter the welfare balance in favour of segmentation. Thus the key question is whether total global consumption can be larger under price discrimination. The literature has shown that this possibility exists for several reasons. These are particularly relevant in the context of IPRs, where goods have large development costs and very low marginal production and distribution costs, generating significant economies of scale.

For example, suppose that price discrimination permits the original firm to open new markets in countries with low marginal valuations. In this way, consumers in poor countries are more likely to find the products on their markets than otherwise. This strategy would likely not be worthwhile if the firm were forced to charge a uniform price. Thus market segmentation and price differentiation may generate greater welfare gains than is available under a uniform price, because as additional markets are established both consumer surplus and producer surplus rise.

These basic trade-offs clearly exist in a world of many countries, where some may go underserved under a uniform pricing constraint. Thus Malueg and Schwartz present a model with many countries and compare the gains and losses from price discrimination, a uniform price and a mixed regime with uniform prices in subsets of similar markets and price differences among groups of markets.<sup>17</sup> In their model, demand elasticities in countries must be significantly different for price discrimination to increase welfare compared to a uniform price. Interestingly, however, they find that a mixed regime with uniform prices within groups of markets, and price discrimination across such groups, offers the highest welfare possibilities. This result suggests that it could be globally optimal to encourage regional IPR exhaustion within groups of countries with similar demand characteristics and low transport costs (e.g. the European Union or developing countries in a regional PTA), while sustaining price differentiation across groups, as long as significant international differences in income persist. This observation has obvious implications for PI policy as regards the supply of essential medicines in the developing world.<sup>18</sup>

<sup>15</sup> Richard Schmalensee, “Output and Welfare Implications of Monopolistic Third-Degree Price Discrimination” (1981) 71 *American Economic Review* 242.

<sup>16</sup> See Hal R. Varian, “Price Discrimination and Social Welfare” (1985) 75 *American Economic Review* 870; and Marius Schwartz, “Third-Degree Price Discrimination and Output: Generalizing a Welfare Result” (1990) 80 *American Economic Review* 1259–1262 for more complicated cases.

<sup>17</sup> Malueg and Schwartz, “Parallel Imports, Demand Dispersion, and International Price Discrimination” (1994) 37 *Journal of International Economics* 187.

<sup>18</sup> Keith E. Maskus, “Ensuring Access to Essential Medicines: Some Economic Considerations” (2002) 20 *Wisconsin International Law Journal* 563.

## Vertical price control models and parallel imports

While it is natural to conceive of PI as consumer arbitrage against retail price differences, survey evidence suggests that the bulk of such trade happens at the wholesale level.<sup>19</sup> This is true of both consumer goods, such as wearing apparel, cosmetics, pharmaceuticals, automobiles and recorded music, and intermediate goods, including machinery, chemicals and bulk ingredients. In fact, wholesale-level trade is conducted both by independent but licensed distributors and specialised parallel trading companies.

Ganslandt and Maskus<sup>20</sup> discussed three primary reasons why retail-level arbitrage is small. First, there are significant costs associated with finding reliable PI supplies and getting goods across borders. If fixed costs of such activity are even modest we would not expect consumer arbitrage. Secondly, there may be complementary services that are sold with the physical goods, such as calling plans for mobile phones, reducing the attractiveness of goods available abroad. Thirdly, consumer-level PI may be illegal for public-health reasons. This is the case for pharmaceuticals in the EU, for example, and for alcoholic beverages in the United States. Regarding medicines, firms engaged in parallel trade must gain approval from health authorities, requiring substantial certification costs. Thus the simple idea that manufacturers exercise retail price discrimination and individuals buy and sell goods across markets is misleading. Instead, firms sell to wholesale distributors, which become the primary sources of PI.

Efficient distribution often requires permitting the IPR holder a significant degree of vertical control over its licensees. Multinational enterprises build markets through establishing exclusive dealership rights in various territories. Exclusivity makes it easier for original firms to monitor marketing efforts and enforce product quality. However, it may be difficult in foreign markets to enforce private contractual provisions prohibiting sales outside the authorised distribution chain. In this context, restrictions against PI are required to support exclusive territorial rights.<sup>21</sup>

Maskus and Chen<sup>22</sup> and Chen and Maskus<sup>23</sup> first developed a model of vertical price control (VPC) and its impacts on PI and welfare. In their approach, a manufacturer has one independent distributor in each of two locations, home and foreign, and is protected by IPRs in both. The firm sets its wholesale prices and licensing fees within two-part contracts in order to induce profit-maximising retail prices, which vary according to demand elasticity. Where PI exist, or there is a threat of PI, the two distributors compete in the home market.

There are a number of trade-offs to consider in this model. First, PI generate a pro-competitive effect in the home market, reducing manufacturer profits. Secondly, the decision to limit or deter PI changes the wholesale price in the export market, causing an inefficient distribution problem there. Finally, if PI actually exist they incur real resource costs, also reducing profits. In basic economic jargon, the IPR owner has two instruments, the market-specific wholesale prices, to deal with three problems, leading to costly distribution inefficiencies.

Their conclusions can be summarised as follows. Starting from a situation of very low trade costs, an increase in those charges reduces PI. The manufacturer also raises its wholesale price in the export market and, at some point, that price becomes high enough to eliminate PI completely. As trade costs rise even higher, to the level that segments markets, the manufacturer can then cut its wholesale price toward the efficient vertical level. The authors show that the manufacturer's profits initially go down with a rise in trade cost. However, as PI are deterred, profits start to rise until they achieve their maximum at full segmentation. As for welfare, which is the sum of profits and joint (two-country) consumer surplus, it

<sup>19</sup> National Economic Research Associates, *The Economic Consequences of the Choice of Regime of Exhaustion in the Area of Trademarks*, 1999.

<sup>20</sup> Ganslandt and Maskus, "Vertical Distribution, Parallel Trade and Price Divergence in Integrated Markets", (2007) 51 *European Economic Review* 943.

<sup>21</sup> Chard and Mellor, "Intellectual Property Rights and Parallel Imports" (1989) 12 *The World Economy* 69.

<sup>22</sup> Keith E. Maskus and Yongmin Chen, "Parallel Imports in a Model of Vertical Distribution: Theory, Evidence, and Policy" (2002) 7 *Pacific Economic Review* 319; Keith E. Maskus and Yongmin Chen, "Vertical Price Control and Parallel Imports: Theory and Evidence" (2004) 12 *Review of International Economics* 551.

<sup>23</sup> Chen and Maskus, "Vertical Pricing and Parallel Imports" (2005) 14 *Journal of International Trade and Economic Development* 1.

also exhibits this non-monotonic shape. Considering consumer benefits in the two countries together, they are highest where there are no trade costs and a maximum PI volume, which causes retail prices to converge. However, there is a distribution effect, with those in the import market enjoying lower retail prices and those in the export market suffering increases, as in standard arbitrage models. The fact that overall welfare is U-shaped suggests that PI are likely to be beneficial when trade costs are low but harmful when trade costs are intermediate or high. Thus, permitting PI may enhance well-being within regional trade agreements, especially those that work to reduce transactions costs on intra-region trade.

This analysis has been extended in a pair of papers by Ganslandt and Maskus.<sup>24</sup> The first paper notes that the Chen-Maskus models failed to account fully for the strategic effects of imperfect competition at the distributor level as trade costs go down. In their extended work they demonstrate the curious outcome that, as unit trade costs fall toward zero and PI volume increases, the manufacturer in fact would raise the wholesale price in the import market even as it reduces the wholesale price in the export market. The reason is that, in an increasingly integrated market, it pays to push one of the distributors out of the market, leaving the joint region open for the remaining distributor. The implication is that an open regime of PI, coupled with declining trade costs, could foster more concentration of the distributor market while inducing price divergence rather than convergence. As the authors discuss, this may be one reason for the observed failure of retail prices within the EU to move together as much as authorities had anticipated. A further implication is that the combined welfare of two countries may be maximised at a modest level of trade costs, arguing for leaving some “sand in the gears” if PI are legal.

In their second contribution, Ganslandt and Maskus comment on the sense of an EU competition policy rule stating that, ordinarily, manufacturers cannot discriminate among their distributors by setting different wholesale prices. In essence, this rule reduces the number of control instruments to one without removing the underlying market problems. In their analysis it turns out that, while a uniform price can be beneficial in welfare terms for low trade costs, at higher trade costs the policy forces the original firm to set higher retail prices in both markets than would exist with wholesale price discrimination. Under reasonable circumstances, then, an apparently consumer-oriented competition regime of open PI and non-discrimination among wholesalers can have negative welfare consequences—a curious outcome, indeed.

Much remains to be done in the analysis of VPC models with parallel trade. For example, there are no systematic models of price competition or product differentiation in the literature. More fundamentally, there is no analysis yet of multiple markets or the implications of differential PI regimes within preferential trading arrangements. Finally, more analysis is needed of the likely strategic responses of IPR owners to international exhaustion policies. For example, in countries that are potential sources of PI international firms owning IPR could choose to acquire their distributors or build their own distribution markets, rather than work with independent wholesalers.<sup>25</sup>

## Parallel imports and investments in R & D

PI ordinarily should reduce the profits made by an original manufacturer owning intellectual property, which would induce inventive firms to take the legal treatment of PI into account in determining their R & D investments. Thus one of the major arguments against legalising PI is that it would diminish investments in new technologies. This claim is prominent in the US debate over whether to permit re-imports of pharmaceuticals from Canada and western Europe. Research-based pharmaceutical firms lobby

<sup>24</sup> Ganslandt and Maskus, “Vertical Distribution, Parallel Trade and Price Divergence in Integrated Markets”, (2007) 51 *European Economic Review* 943; Ganslandt and Maskus, “Wholesale Price Discrimination and Parallel Imports,” CESifo Working Paper, 2007.

<sup>25</sup> In a different context, Raff and Schmitt, “Endogenous Vertical Restraints in International Trade” (2005) 49 *European Economic Review* 1877 showed that trade liberalisation would encourage multinational firms to establish exclusive national territories.

strenuously to forestall implementation of such legislation. More generally, research-oriented firms in any IPR-based industry would oppose removing restrictions on PI.<sup>26</sup> For example, major music publishers were strongly opposed to the 1998 relaxation of import barriers against sound recordings in Australia.<sup>27</sup>

Despite such claims, there is relatively little economics literature on this point. I discuss some papers on this subject in the first subsection. After that I describe evidence regarding the strong linkages among price regulations, R & D and parallel trade, especially in pharmaceutical products.

### *Basic models of R & D and parallel trade*

The first study to combine PI competition with incentives for R & D in a theoretical model is by Li and Maskus.<sup>28</sup> They use the VPC model and add an R & D stage prior to competition between distributors. The manufacturer must initially decide how much to invest in a technology that will reduce its production costs with some probability of success. The firm next chooses its vertical price structure with its distributors, either on the basis of a high cost or a low cost, depending on its R & D outcome. Importantly, the difference in these costs and prices determines the volume and impacts of PI. Their essential conclusion is that legalised PI would reduce final-stage profits of the manufacturer, causing it to invest less at the outset in comparison with an environment of no PI. However, the amount by which R & D falls depends on market parameters, including PI transport costs. With modest trade costs legalising PI may actually raise economic well-being, even as it diminishes R & D. At larger transport costs, however, the combination of resources wasted in shipping PI across borders and lower R & D tends to reduce welfare. Li and Robles<sup>29</sup> find similar results in the case of product innovation.

In a different competitive approach, Valletti<sup>30</sup> shows that a policy of global exhaustion, which would essentially require a uniform price across countries, can increase welfare even if it reduces up-front investment in R & D. Put more simply, the uniform price raises static welfare but reduces R & D relative to the case with market-segmented price differentials. In a related paper, Valletti and Szymanski<sup>31</sup> build on the Malueg-Schwartz framework<sup>32</sup> and find that international exhaustion can raise static welfare but reduce investments in product quality.

### *Price controls, parallel imports and R & D*

Government price controls in different countries clearly can generate parallel imports. In markets for pharmaceutical products, national governments often choose quite different policies.<sup>33</sup> Some countries adopt strict price ceilings that are substantially lower than prevailing prices in other countries. Where they are legal, PI respond to these price differentials, causing medicines to flow from countries with lower regulated prices to markets without price regulations or with higher price limits. In fact, this process can be highly elastic within the EU, as shown by Ganslandt and Maskus in 2004, using data for Sweden.<sup>34</sup>

<sup>26</sup> Barfield and Groombridge, "The Economic Case for Copyright Owner Control over Parallel Imports" (1998) 1 *Journal of World Intellectual Property* 9.

<sup>27</sup> Maskus, "Parallel Imports" (2000) 23 *The World Economy* 1269.

<sup>28</sup> Changying Li and Keith E. Maskus, "The Impact of Parallel Imports on Investments in Cost-Reducing Research and Development" (2006) 68 *Journal of International Economics* 455.

<sup>29</sup> Changying Li and John Robles, "Product Innovation with Parallel Imports", Victoria University of Wellington, Working Paper (2005).

<sup>30</sup> Tomasso M. Valletti, "Differential Pricing, Parallel Trade, and the Incentive to Invest" (2006) 70 *Journal of International Economics* 314.

<sup>31</sup> Tomasso M. Valletti and Stefan Szymanski, "Parallel Trade, International Exhaustion and Intellectual Property Rights: A Welfare Analysis" (2006) 54 *Journal of Industrial Economics* 499.

<sup>32</sup> See Malueg and Schwartz, "Parallel Imports, Demand Dispersion, and International Price Discrimination" (1994) 37 *Journal of International Economics* 187.

<sup>33</sup> See Patricia M. Danzon, *Pharmaceutical Price Regulation* (Washington, D.C.: The American Enterprise Institute Press, 1997).

<sup>34</sup> Matthias Ganslandt and Keith E. Maskus, "The Price Impact of Parallel Imports in Pharmaceuticals: Evidence from the European Union" (2004) 23 *Journal of Health Economics* 1035.



Parallel imports have two novel effects in a situation with price regulations. First, it changes the incentives for research-based firms to undertake R & D. Secondly, it could put pressure on the price regulations of different countries, pushing them toward policy harmonisation. Thus PI in markets subject to price regulations have rather different effects than arbitrage in situations in which the manufacturing firm can adjust prices without considering binding price caps.

In this context, Rey sets out a model in which price controls are taken as given and shows that PI cause retail prices in unregulated markets to fall, diminishing the incentives to invest in R & D.<sup>35</sup> Danzon goes further by claiming that international price discrimination, even where associated with price controls, largely reflects international differences in elasticity of demand.<sup>36</sup> Segmented markets can support an efficient allocation of R & D costs across different locations to the extent that the variable prices reflect so-called Ramsey pricing. Price discrimination in this view is therefore globally and dynamically optimal in social terms. In contrast, PI can reduce economic well-being by undermining efficient price differentials.

It should be noted that there is little evidence that actual price controls around the world reflect underlying consumer demands in this context. Rather, governments regulate prices for a variety of public health and political-economic reasons, including to free ride on the R & D performed in higher-price locations. Importantly, such price caps are generally set in consultation with the pharmaceutical companies. In an insightful paper, Grossman and Lai introduce negotiated price controls and show that PI can fundamentally change the policy equilibrium.<sup>37</sup> Because parallel trade moves from low-price jurisdictions to high-price locations it weakens the ability of health authorities to impose aggressive price controls, which is possible in the absence of arbitrage. Furthermore, parallel trade ensures that a low price cap in any one country reduces incentives for R & D investment worldwide. Thus arbitrage through PI makes government health policies interdependent and forces each government to consider the effects of its price regulation on global incentives to invest in new drugs. In fact, these two effects—diminished bargaining power and the need to consider global R & D impacts—can be so powerful that, in their model, legalisation of PI actually would increase global incentives for investment in innovation.

As in the case of vertical price control models, the literature on this kind of regulation-induced PI and dynamic innovation incentives is still new and needs much more analysis. Considerably more research would flesh out relevant market characteristics that can affect the returns to R & D under parallel trade. The results of such models could add greatly to our understanding of the relationships among IPR, competition regulation, public health management, and innovation policies.

## Concluding remarks

In this article I reviewed essential legal and economic issues surrounding parallel imports, also called grey-market trade. This is a significant form of competition within the European Union and across regional territories in the United States. It remains a controversial international policy question. For example, the US Government continues to flirt with the idea of opening the country's borders to PI of medicines from Canada and western Europe. The formal literature on PI is growing rapidly and considers such issues as horizontal (retail) arbitrage, vertical price control models, the role of price regulations, and impacts of legalised PI on R & D spending. At present these models rely on specific assumptions and may not readily generalise to practical situations. However, they do highlight a number of important insights about what drives PI and how such trade affects market competition. For example, it is potentially quite important

<sup>35</sup> Patrick Rey, "The Impact of Parallel Imports on Prescription Medicines" (University of Toulouse, unpublished manuscript, 2003).

<sup>36</sup> Patricia M. Danzon, "The Economics of Parallel Trade" (1998) 13 *Pharmacoeconomics* 293.

<sup>37</sup> Gene M. Grossman and Edwin L.-C. Lai, "Parallel Imports and Price Controls", Center for Economic Policy Research Discussion Paper 5779 (2006). See also Paul Pecorino, "Should the U.S. Allow Prescription Drug Re-imports from Canada?" (2002) 21 *Journal of Health Economics* 699.

that, as noted in the VPC models, combining PI with other forms of competition policy, such as a requirement for non-discriminatory distributor prices, can actually have perverse impacts on market integration and consumer welfare.

Also important is novel thinking about the ambiguous roles PI play in the R & D area. If prices are otherwise uncontrolled, a free regime of parallel trade reduces firm profitability and therefore reduces investments in innovation, though we have little evidence as to the size of that effect. However, where PI interact with national differences in price controls, the process changes the bargaining dynamics between firms and governments. It is possible that a mix of price caps and PI can increase global R & D incentives, which may be significant in the international debate over free riding on the geographically concentrated R & D expenditures in medicines. However, to date none of these predictions have been faced with careful and systematic empirical investigation, the task to which economists need to turn quickly.

One policy issue of vital importance is whether restraints on parallel trade should be a central component of attempts to distribute essential medicines to poor countries in a sustainable fashion without destroying incentives to create such drugs. As noted in Ganslandt et al.,<sup>38</sup> there are major dynamic and static market and social externalities in this area and it is important to separate distribution needs from innovation incentives. Assuming that sufficient financial and technical resources are found to develop important new drugs for diseases of poor countries, it is important to ensure that those medicines, targeted for specific markets, are not shipped to higher-income locales.<sup>39</sup> Here, truly, is an area in which global and national policies regulating parallel trade require thorough thought and careful implementation.

<sup>38</sup> Mattias Ganslandt, Keith E. Maskus and Eina V. Wong, "Developing and Distributing Essential Drugs to Poor Countries: The DEFEND Proposal" (2001) 24 *The World Economy* 779.

<sup>39</sup> See Drusilla K. Brown and George Norman, "Optimal Intellectual Property Rights and Humanitarian Assistance During a National Health Emergency", Tufts University Working Paper (2003).

# The Role of Intellectual Property Rights in Addressing Climate Change: The Case of Agriculture

**Russell Thomson**

*Melbourne Institute of Applied Economic and Social Research, and Intellectual Property Research Institute of Australia, University of Melbourne*

**Elizabeth Webster\***

*Melbourne Institute of Applied Economic and Social Research, and Intellectual Property Research Institute of Australia, University of Melbourne*

☞ Climate change; Economics and law; Farming; Greenhouse gas emissions; Patents

## Introduction

Debate regarding the contribution of intellectual property (IP) rights to lessening climate change is intensifying. On one side, IP optimists emphasise their function in encouraging investment in research and development (R & D) and commercialisation. Accordingly, in 2009 the United States Patent and Trademark Office (USPTO) began a programme of fast-tracking examination of green technology patents as a means to “accelerate the development and deployment of green technology” (USPTO 2009).<sup>1</sup> The alternative view, principally associated with developing countries, sees the monopoly rights embodied in IP as a barrier to technology adoption and international transfer. Proponents of the latter view have suggested modifying IP policy, for example, through compulsory licence provisions.<sup>2</sup> In this article, we consider the role that IP rights can play in delivering technological change to abate greenhouse gas emissions, focusing on the agricultural sector.<sup>3</sup> We ask: Are formal IP rights an effective means to promote the development and diffusion of abatement technologies? Or do they simply act as a barrier to the uptake of new technologies?

We begin by outlining an economic framework with which to examine these perspectives. We argue that, first and foremost, the long-term solution must include a policy that ameliorates (the negative) third-party effects of carbon emissions. This means some form of carbon price—either a tax on carbon generating activities (and subsidy for carbon mitigating activities), or an emission trading scheme. Once an appropriate carbon price has been established, there is no IP policy difference between technologies that abate greenhouse gas emissions and technologies that meet other needs.

\* The authors are grateful to Deli Chen, Chris Dent, Michael Nash and Paul Jensen.

<sup>1</sup> USPTO, “The U.S. Commerce Department’s Patent and Trademark Office (USPTO) Will Pilot a Program to Accelerate the Examination of Certain Green Technology Patent Applications”, media release (2009), at [http://www.uspto.gov/news/pr/2009/09\\_33.jsp](http://www.uspto.gov/news/pr/2009/09_33.jsp) [Accessed October 13, 2010].

<sup>2</sup> See UNFCCC, “Report of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention on its eighth session, held in Copenhagen from 7 to 15 December 2009”, FCCC/AWGLCA/2009/17 (2010); N. van den Broek, L. Feldman, C. Greenhalgh, M. Hilton, E. Derclaye and P. Leonard, *The economics of Intellectual Property rights and climate change*, (2009) Intellectual Property Institute, Copenhagen.

<sup>3</sup> We do not consider technologies that can contribute to adaptation to changed climatic conditions, such as drought management technologies. In general, adaptation behaviours do not impose costs or benefits on third parties (externalities). However, we recognise these may be considered important for equity or welfare reasons.

However, it has long been recognised that the potential role of IP rights varies between technological fields and between industries. In this article, we take a detailed look at abatement technologies in the agricultural sector. Agriculture is an important case study. It contributes between 11 and 12 per cent of total anthropogenic carbon dioxide equivalent (CO<sub>2</sub>e). Since agricultural abatement strategies are cost competitive, they are expected to play a notable role in the global response.<sup>4</sup> Furthermore, since the agricultural sector makes up a larger share of economic output and emissions in developing countries, it represents an important fault line between the two sides of this debate. Based, inter alia, on 15 semi-structured interviews with agricultural industry groups, private firms and scientists in the public and university sectors, we identify and describe current and prospective abatement technologies. We then discuss the role that IP might play in shaping the incentives to research, develop and use these technologies in the originating country and around the world.

## Policy framework

Excessive CO<sub>2</sub>e have accumulated in the atmosphere because decision-makers do not bear the full consequences of their actions. That is, people other than those who directly benefit from carbon emissions (the buyer and seller of products associated with emission) incur costs, in the form of adverse climatic conditions and rising sea levels. The efficient policy response is to ensure that the cost of each additional unit of CO<sub>2</sub>e abated is equal across all sectors, and is also equal to the marginal damage cost of emissions prevented. That is, we should pursue the lowest cost abatement options first and we should abate to the point that environmental benefit equals the cost to the market economy. The standard market based solution in these cases is to increase the relative cost of emissions via a carbon tax or cap and trade system.<sup>5</sup> A direct carbon price provides an incentive for abatement, including the adoption of abatement technology and changing output mix.<sup>6</sup>

Once a global carbon price or cap on emissions has been imposed there is nothing special about the provision of climate change related technology.<sup>7</sup> However, investment in the creation and diffusion of new technology suffers from another, long recognised, form of market failure. Unfettered markets can undersupply new technology relative to the social optimum to the extent inventions can be copied without compensating the inventor. Two main policy solutions to this appropriability problem exist: public funding for R & D and legally enforceable IP rights. Each of these policy options has costs and benefits which depend on specific characteristics of the technological field. In the remainder of this section we discuss these costs and benefits and outline those characteristics which determine their relative magnitude and therefore the overall effectiveness of IP rights. Subsequently, in the third section we consider agricultural abatement technologies in some detail.

In principle, if the benefits from all potential R & D projects were known, and technology consumers could easily be taxed in a non-distortionary manner, then the best solution would be to publicly fund all research, development and commercialisation and eschew IP rights. Indeed, in some instances, government-funded R & D has been very successful, such as the green revolution in the mid-20th century.

<sup>4</sup> P. Smith, D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, O. Sirotenko, "Agriculture. In Climate Change 2007: Mitigation", Contribution of Working Group III to B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds), *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge and New York: Cambridge University, Press, 2007).

<sup>5</sup> Regulation can also reduce emissions, but government capacity to design regulation which will equate marginal abatement costs across all areas of the economy is limited.

<sup>6</sup> It is sometimes erroneously argued that the incentive to increase productivity provides a de facto incentive to abate emissions. Increases in productivity may or may not reduce emissions. Clearly, many (e.g. labour saving) productivity-enhancing innovations of the 20th century led to an increase in emissions per unit of output. Further, even new technology which increases output per unit of (e.g. fuel) input will not necessarily ensure lower total emissions, since this ultimately depends on how output adjusts (which depends, inter alia, on the price elasticity of demand).

<sup>7</sup> Note that undertaking any costly abatement represents foregone consumption, whether through reduced output of high emission products or investing in abating R & D. That is, the price of abatement is equal to the value of goods foregone. Welfare is diminished if any R & D project with a net positive social value is not undertaken, whether the technology is directed at carbon abatement, health care or consumer goods is immaterial.

In this vein, some commentators have advocated a “climate change Manhattan project”, i.e. a government-sponsored mission-oriented technology programme, although others, such as Mowery et al., warn that dependence on centrally planned R & D may not generate sufficient diversity for optimal outcomes and will not induce adoption of technologies.<sup>8</sup>

In practice of course, R & D is subject to considerable risk and uncertainty relating to technical feasibility and market acceptance. In the light of this, private businesses are often better positioned to identify and exploit R & D investment opportunities. Private businesses often have access to more information, particularly relating to market demand on which to base R & D investment decisions. IP rights, such as patents, plant breeders’ rights and copyright,<sup>9</sup> decentralise decision-making and harness market forces to allocate investment in R & D. They achieve this by enabling innovators to charge royalties or higher prices on goods and services embodying their technology, relative to a situation of unconditional copying. Note that IP rights only generate an incentive to invest in R & D where there is a positive willingness to pay for technology; their effectiveness in encouraging investment in climate change technology therefore rests on the existence of a carbon price or equivalent. Where there is demand for new technologies, IP rights enhance private investment in research as well as downstream development and commercialisation activities. Where unfettered imitation is a possibility, IP rights may also encourage research to adapt technology to different environments<sup>10</sup> and the transfer of early stage research from government laboratories or universities to private sector firms for subsequent development and commercialisation.

However, while the patent system creates an incentive to create and adapt technology, the higher price charged under the temporary monopoly of IP protection also prevents people from enjoying the benefits from something that has no cost to society (i.e. after technology is created). This means that, in static terms, IP rights result in a loss of social welfare. Because new technology commonly builds on (or extends) what has gone before, inhibiting “use” through higher prices can potentially reduce the rate of technological progress.<sup>11</sup> By providing legally sanctioned market power associated with IP rights, government effectively replaces one form of market failure with another. It is therefore incumbent upon the architects of the IP system to ensure it does more good than harm.

Neither direct government funding of R & D nor IP rights offer a perfect solution to the problem of generating and diffusing new technology. On the one hand, government provision is limited in its ability to identify valuable projects. On the other hand, encouraging investment from private innovators through the IP system results in deadweight loss. In the light of this, it is generally considered that optimal innovation policy should incorporate a mix of direct financing and IP rights.

The prospective role of IP depends on a number of industry- and technology-specific factors. IP rights are particularly important where technology is easily copied and where it is difficult or impossible to maintain trade secrets. For example, survey evidence suggests that patents are most important in industrial

<sup>8</sup> D. Mowery, R. Nelson and B. Martin, “Technology Policy and Global Warming: Why New Policy Models Are Needed (or Why Putting New Wine in Old Bottles Won’t Work)” (2010) 39 *Research Policy* 1011.

<sup>9</sup> Throughout this article, we focus primarily on patents and to lesser degree plant breeders’ rights and copyright. The reason is that these three types of legal rights facilitate excludability of technology assets. Trade marks have a subtly different economic function, first and foremost to carry information about “product” quality: see, for a discussion of the economics of trade marks, G.B. Ramello, “What’s in a Sign? Trademark Law and Economic Theory” [2006] *Journal of Economic Surveys* 547.

<sup>10</sup> This article does not aim to provide a comprehensive survey of the effect of IP in all mechanisms of international technology transfer; rather we aim to discuss their potential role in the entire innovation pathway including R & D, commercialisation as well as international transfer, focusing on the specific case of agricultural climate change technologies. For a more in depth discussion of IP and international transfer specifically, see K. Maskus, “Intellectual Property and the Transfer of Green Technologies: An Essay on Economic Perspectives” (2009) 1 *WIPO Journal* 133; and B. Hall and C. Helmers, “The Role of Patent Protection in (Clean/Green) Technology Transfer”, (2010) *NBER Working Papers* 16323, National Bureau of Economic Research, Inc..

<sup>11</sup> Several features of the patent system aim to minimise potential negative side effects. Patents require innovators to publicly disclose technical details of their inventions in exchange for a finite period. In principle, the disclosure requirement ensures that new knowledge is made available to other inventors. However, in contrast to this theory, recent evidence indicates that patent disclosures are less important sources of learning for firms than other mechanisms such as interaction with customers and suppliers: see W.M. Cohen, R.R. Nelson and J.P. Walsh, “Protecting their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)” NBER Working Paper 7552 (Cambridge MA: 2000); P.H. Jensen and E. Webster, “Knowledge Management: Does Capture Impede Creation?” (2009) 18(4) *Industrial and Corporate Change* 701.

sectors<sup>12</sup> where the technology is highly codified, such as pharmaceuticals and chemicals.<sup>13</sup> In contrast, IP rights are less important in inducing investment in technologies that are inherently excludable, either because the technology can be exploited while maintaining trade secrecy or because they are difficult or costly to imitate. Excludable complementary assets can facilitate appropriation of returns from otherwise non-excludable technology assets (as highlighted by Teece<sup>14</sup>). IP rights are also not important where they cannot be effectively used to protect technology from imitation, such as where monitoring is not feasible. In practical terms, some subject matter is not suitable for IP protection.

## Agricultural abatement technology

This section presents a more detailed discussion of current and prospective strategies for abating CO<sub>2</sub>e emissions in the agricultural sector. Agricultural innovation—the development and dissemination of new technologies and farming practices—is currently a cost competitive carbon-mitigation strategy and is therefore expected to play a notable role in the world’s response to climate change.<sup>15</sup> While the emphasis in this section is on the potential role of IP rights, some technical details are given in order to assess their potential contribution to abatement.

Globally, the main components of agricultural emissions are nitrous oxide (N<sub>2</sub>O) from soils, predominantly from fertilizer use (38 per cent), and methane from enteric fermentation (32 per cent) and wet rice cultivation (11 per cent).<sup>16</sup> N<sub>2</sub>O is a greenhouse gas nearly 300 times more potent than CO<sub>2</sub>. Urea-based fertilisers and animal urine are important sources of nitrogen that are ultimately the source for N<sub>2</sub>O. The overarching principle in abating N<sub>2</sub>O emissions relates to matching supply of nitrogen to the spatial and temporal needs of crops or pastures.<sup>17</sup> Approaches to reducing these emissions include optimising fertiliser application timing and additives to slow fertiliser breakdown.

Methane is produced as a by-product of enteric fermentation, the process whereby micro-organisms living in the rumen (a special stomach) of cattle and sheep break down coarse plant material. Methane emissions effectively represent a loss of energy, meaning there is some overlap between technologies and farm practices that reduce methane emissions with those that increase efficiency of feed use. The main factor determining emissions from enteric fermentation is the number of animals. However, strategies to reduce methane from enteric fermentation per animal have the potential for abatement of between 14 and 25 per cent.<sup>18</sup> Abatement strategies include feed (diet) management and supplements as well as technologies that act to alter the rumen microbial population and its activity. The microorganisms responsible for methane production in the rumen are called methanogens. Methanogens are also active in flooded rice paddies.

As discussed above, IP rights will only be useful when they relate to an idea that can be easily copied and the use or embodiment of which can be monitored. Current agricultural abatement research falls into both the ‘IP-relevant’ and ‘IP-irrelevant’ camps and we discuss each of these in turn. Before we turn to this discussion, we re-emphasise our earlier point: without some form of carbon price, pecuniary incentives

<sup>12</sup> R.C. Levin, A.K. Klevorick, R.R. Nelson and S.G. Winter, “Appropriating the Returns from Industrial-Research and Development” (1987) 3 *Brookings Papers on Economic Activity* 783; Cohen et al., “Protecting their Intellectual Assets”, 2000.

<sup>13</sup> N. Harabi, “Appropriability of Technical Innovations: An Empirical Analysis” (1995) 24(6) *Research Policy* 981.

<sup>14</sup> D. Teece, “Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy” (1986) 15 *Research Policy* 285.

<sup>15</sup> See Smith et al., “Agriculture” in *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, 2007; Vattenfall & McKinsey, “Global Mapping of Greenhouse Gas Abatement Opportunities up to 2030” (2007).

<sup>16</sup> Smith et al., “Agriculture” in *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, 2007. The remainder includes biomass burning and manure management.

<sup>17</sup> R. Dalal, W. Wang, P. Robertson and W. Parton, “Nitrous Oxide Emissions from Australian Agricultural Lands and Mitigation Options: A Review” (2003) 41 *Australian Journal of Soil Research* 165.

<sup>18</sup> R.J. Eckard, *Greenhouse Gas Emissions and the Australian Red Meat Industry*, Report to Meat and Livestock Australia (May 2006).

for farmers to adopt and abate will be largely absent. Without a carbon price, there will be only nominal private incentives to invest in these technologies, and the role of IP policy will therefore be largely academic.

### **Agricultural abatement technologies: IP relevant**

Most of the IP-relevant technologies are based on pharma-chemical or information technologies. Formal IP rights can be regarded as enabling carbon emission technologies as they give the original inventing business the confidence to invest in research, development and commercialisation. In this way, IP rights are dynamically efficient since they encourage the production of technologies that otherwise would not exist. However, they still involve a static inefficiency, since the new technologies, once created, are sold at prices above cost.

In most cases, the technologies described below need adaptation and calibration to local conditions and therefore cannot be transferred costlessly between regions. IP rights are important to support transfer activities of private firms. In these cases, the existence of IP rights encourages international transfer since possessing a monopoly right increases the returns to product development and adaptive investments. Alternatively, governments can fund adaptive investments directly.

#### *Land management and soil emissions*

Computer software decision support tools, based on biophysical models of the agronomic system, offer considerable scope to reduce N<sub>2</sub>O emissions from broad acre agriculture and emissions from wet rice cultivation. They can achieve this by optimising management of agricultural inputs such as fertilisers. For example, the International Rice Research Institute has developed an interactive computer based decision support tool called Nutrient Manager which calculates the optimal amounts of fertiliser to be applied using answers to about 10 simple questions.

Computer programs are inherently non-excludable in the absence of legally enforceable IP (copyright or software patents). However, there are a range of technological options for preventing unauthorised use of such models, such as remote hosting of data and the software. For example, the most widely employed decision support tool for broad acre agriculture in Australia is run from remote servers, which prevent unauthorised use without the need for legally enforced IP rights.

Transfer between different agronomic environments, including international transfer of these technologies faces a number of obstacles, most importantly the need for complementary investment. While the fundamental science behind computer based biophysical models is internationally transferable, the models require local data input which is expensive and time consuming to collect. In these cases IP protection can allow firms undertaking this additional work to charge a price sufficient to cover the costs.

#### *Enhanced efficiency fertilisers and soil emissions*

Enhanced efficiency fertilisers are chemical additives which improve the longevity of fertiliser nitrogen in the soil and thereby reduce N<sub>2</sub>O emissions. These compounds can also be employed in the management of animal manure (urine patches and feedlot effluent). As chemical entities, enhanced efficiency fertilisers are protectable by patents and as noted previously survey evidence suggests that patents are particularly important in the case of pharmaceuticals and chemicals.<sup>19</sup>

<sup>19</sup> Levin et al., "Appropriating the Returns from Industrial-Research and Development" (1987) 3 *Brookings Papers on Economic Activity* 783; Cohen et al., "Protecting their Intellectual Assets", 2000.

However, as in the case of computer-based biophysical models, adaptive research represents an important barrier to the utilisation and uptake of fertiliser technologies to reduce N<sub>2</sub>O emissions—particularly between different environments—required for international transfer. The issue is that achieving maximum effectiveness of enhanced efficiency fertilisers requires an understanding of the interaction of these chemicals with soil and environmental variables.<sup>20</sup> Therefore an important complementary area of research is focused on understanding how these compounds behave in different bio-physical contexts. Excludability of the primary technology (enhanced efficiency fertilisers) can, in principle, generate an incentive for private firms to invest in this complementary research to the extent that demonstrating effectiveness is important for encouraging uptake.

The value of enhanced efficiency fertilisers as an abatement tool is somewhat dependent on prevailing labour costs. The reason for this is that labour inputs can substitute for enhanced efficiency fertilisers, since adding small amounts of fertiliser many times over the growing period essentially achieves the same effect of maintaining the nitrogen in the soil and lowering emissions.

### *Pharmaceuticals and livestock emissions*

Abatement of methane emissions from livestock can potentially be achieved by manipulating the rumenal microbial population and its function. One approach is to develop pharmacological agents, like antibiotics and defaunation agents.<sup>21</sup> As was noted above, it is generally considered that formal IP rights are an important factor in encouraging private firms' investment in new chemical entities. It is hoped that ongoing research will produce new pharmacological agents—though at this stage, research is generally considered to be at a pre-commercial stage, and there appear to be few patented pharmaceuticals with a proven ability to reduce methane emissions.

It has been claimed that antibiotics already in use in the feedlot industry to control disease and increase feed-use efficiency, such as Monensin and Rumencin, may contribute to abatement.<sup>22</sup> However, more research is needed to better understand the function of these chemicals, the contexts in which they are effective, sustainability of effect, and trade-offs with other aspects of animal husbandry (such as feed use efficiency).

Another prospective technology is a methanogenic vaccine. Research into a methanogenic vaccine which promises very low (marginal) cost abatement strategy is ongoing. However at the time of this study this technological option is very much blue-sky (e.g. no proof of concept or commercialisation stages have yet been reached). Like pharmaceutical products, a methanogenic vaccine would have limited natural excludability. So, IP rights, such as patents, would be important to stimulate private funding.

### *Forage crops and livestock emissions*

Beneficial forage crops can reduce emissions from livestock in an extensive context. The goal of this research is to identify and develop plants which contain natural chemicals, such as tannins or alkaloids that can be sown into pastures for grazing and thereby reduce methane emissions from grazing livestock. At this stage, there are no such crops in use at a commercial level. Beneficial forage crops (e.g. tanniniferous crops) would theoretically be protectable by plant breeders' rights, or patents if genetically modified varieties are developed in the future. Our consultations suggested that research to this end, in Australia at least, is currently dominated by public research organisations, though the introduction of a carbon price could change this.

<sup>20</sup> D. Chen, H. Suter, A. Islam, R. Edis, J. Freney and C. Walker, "Prospects of Improving Efficiency of Fertilizer Nitrogen in Australian Agriculture: A Review of Enhanced Efficiency Fertilizers" (2008) 46 *Australian Journal of Soil Research* 289.

<sup>21</sup> Defaunation agents affect protozoa (another type of micro-organism) which support methanogens.

<sup>22</sup> Eckard, *Greenhouse Gas Emissions and the Australian Red Meat Industry*, 2006.



### *Emissions measurement technology*

As discussed, a carbon price is necessary to underpin an incentive for farmers to adopt new abating technologies.<sup>23</sup> To achieve this requires not only a price for carbon, but also CO<sub>2</sub>e accounting that records the actions of individual farmers. While farm-level monitoring is not commercially viable, experimental systems have been used to measure ammonia and methane from intensive animal production systems. Monitoring technology for livestock emissions includes two component technologies: physical instrumentation and bio-physical models. The latter use actual emissions to calibrate simulations of the emissions. Emissions measurement technologies are likely to be easily copied and suitable for patent or copyright protection. These technologies therefore are unlikely to flourish without proper IP protection.

### **Agricultural abatement technologies: IP irrelevant**

In this section we discuss a number of abatement technologies and management practices for which IP does not appear to play a role in ongoing research or technology transfer, mainly because either the knowledge relates to an idea that can be easily copied and the use or embodiment of which cannot be monitored, or because the new “technology” is completely embodied in tangible material. Consultations suggest these have considerable potential to contribute to abatement, though again, the lack of pecuniary incentive to adopt and abate means there is little private incentive to invest in these technologies. What research is being undertaken appears to be mostly publicly financed.

### *Land management practices*

Improved land management practices have considerable scope to contribute to abatement. Such agronomic practices are essentially know-how embodied in agronomists, farmers and other land custodians. They cannot be protected by formal IP. The main barrier to adoption is the cost of transferring tacit knowledge and demonstrating advantages in specific agricultural contexts. In the absence of private incentive to invest in demonstration and adoption, these appear to be a strong candidate for government funding.

Safe alternate wetting and drying is a management strategy which reduces methane emissions from wet rice cultivation. Safe alternate wetting and drying relates to the optimal timing of drying out and flooding of paddies including crop rotation—the word “safe” implies it is undertaken with no loss of productivity. Flooded rice paddies emit methane while, on the other hand, dry paddies emit N<sub>2</sub>O. Research into optimising the trade-off in different environments is ongoing. The International Rice Research Institute is a key proponent of this research which is funded by contributor governments and from corporate donations and therefore not reliant on IP rights to attract funding. Tangible or embodied technology requirements for safe alternate wetting and drying are virtually negligible. It therefore appears to be a cost effective means of achieving abatement. However, there are other important barriers to adoption. First, there is a lack of incentive for farmers to implement these management practices. Secondly, reliable water supplies are a prerequisite to the application of safe alternate wetting and drying methods, and these are not always present in developing countries with limited infrastructure.

Conservation tillage is another practice with potential to contribute to abatement and sequestration. Conservation tillage is the practice whereby crops are grown with minimal disturbance to the soil and with more crop residual maintained. Additionally, conservation tillage generally relies on the application of herbicides such as glyphosate (Roundup) for weed control. Reduced tillage practices are highly effective in soil water conservation and show the potential to increase soil carbon (i.e. sequestration). However, research suggests that the sequestration potential is dependent on other environmental considerations, most importantly sufficient rainfall. More research is needed to establish how and in what circumstances

<sup>23</sup> As highlighted for example by Mowery et al., “Technology Policy and Global Warming” (2010) 39 *Research Policy* 1011.

tillage practices can contribute to sequestration. IP rights do not appear to be a significant barrier to the international transfer and adoption of conservation tillage practices. According to industry groups, barriers to the adoption of conservation tillage include the need for investment in adapted tilling equipment on the farmer's behalf. A recent report found that barriers to the adoption of conservation tillage in China included the perceived potential for yield reductions and herbicide (glyphosate) requirements.<sup>24</sup> Glyphosate was protected by patents owned by the US multinational enterprise Monsanto, but the protection expired at the beginning of last decade. Since that time the price of glyphosate has decreased, and it is widely believed that availability of generic glyphosate produced in China has played a role in this.

### *Other options for abatement in livestock industries*

As mentioned above, methane emissions from livestock can be influenced through managing cattle diet and feed supplements. However, much of this knowledge is relatively 'low-tech', well-known and therefore unpatentable. For example, optimising carbohydrate to protein ratios and providing high quality pastures can increase efficiency and reduce emissions. In intensive contexts (feedlots), coconut oil and cottonseed oil are routinely added to feed to increase the productivity of feed use and therefore reduce emissions per quantity of meat produced. Other feed additives that can potentially reduce the methane production in the enteric fermentation process include organic acids, tannins, saponins and yeasts. Some manipulation of animal feed base is possible in an extensive context through the control of forage crops.

Further research in this area will continue to develop optimal strategies for abatement. Such management options essentially reflect know-how and commonly available materials and therefore probably not protectable by any IP rights. Again, this may be a good candidate for public funding, though a price on carbon would create an incentive for private investment in this field if it is possible to prevent imitation through secrecy.

Researchers in Australia have also undertaken research into heritability of animal's propensity to emit methane, suggesting a possibility to develop low-emission livestock breeds. At this time this approach is considered blue-sky. Genetic improvement can potentially be achieved via traditional breeding programmes, though in the future this may be achieved through transgenic technologies (i.e. genetically modified). Our consultations suggested that patents do not play an important role in new breeds because the assets associated with naturally bred animals are always embodied in tangible products (animals and semen) and are therefore excludable. IP rights may become more important if molecular genetic technologies are developed in this field.

## **Overview of technologies identified and the role of IP rights**

In the preceding section we have identified a range of innovations which can contribute to abatement in the agricultural sector that are not protectable by IP rights. These include know-how embodied in agricultural advisers and farmers, for example, relating to animal husbandry and land management practices like safe alternative wetting and drying. In some senses these reflect "low tech" options. However, there was consensus that more scientific research is required to better understand how these can best be applied to abate CO<sub>2</sub>e emissions. Further investment is also required to support demonstration and diffusion. Developing and transferring these technologies will largely need to be financed through public funds.

We have also identified a number of agricultural abatement technologies which IP rights can play an important role in preventing imitation which might otherwise undermine the commercial return to innovators. These include computer software decision support tools and chemicals used in enhanced

<sup>24</sup>D. Vere, "Research into Conservation Tillage for Dryland Cropping in Australia and China", Impact Assessment Series Report No.33 (April 2005).

efficiency fertilisers and to abate methane emissions from ruminant livestock. Most of these technologies require investment in complementary research to facilitate optimal deployment and technology transfer across regions.

In the case of enhanced efficiency fertilisers, a critical complementary area of research focuses on understanding how these fertilisers behave in specific local environments. Private investment in such research might be forthcoming but it will depend on their ability to charge royalties on fertiliser sales. Similarly while the basic science behind biophysical models is internationally applicable, it requires costly collection of data and calibration to local conditions. IP rights can enable organisations which collect and calibrate local data to re-coup their costs through higher prices or license fees. Given the large contribution to emissions made by livestock, blue-sky research into pharmaceutical and biologically active agents that can mitigate associated emissions may be the most important technology identified. Irrespective of whether the technology is IP-relevant or -irrelevant, without a carbon price, or the clear prospect of a carbon price, there is little incentive for private firms to invest in the research stage as there is little incentive that farmers will take up the new technology.

## Conclusion

Superficially, the broad and sizable third-party benefits associated with carbon-mitigating agricultural technologies might be thought to contraindicate the use of IP which tends to raise the price of technology and therefore inhibit adoption. However, this erroneous view mixes up two different and entirely independent externalities. Once an appropriate price on carbon has been established, the policy problem of ensuring optimal investment in abatement technology is essentially the same as any other technology. Governments currently employ an array of policies to address the market failure inherent in the process of innovating. The question we then ask is: what is the best mix of policies for agricultural abatement innovation?

First, a price on carbon, administered in such a way as to account for individual farmer actions is necessary to create pecuniary incentives to adopt carbon abating technologies. A corollary is that the potential positive contribution of IP rights largely depends on an appropriate price on emissions (or a credible commitment to introduce one). If an appropriate carbon mitigating regime is not forthcoming, the attractiveness of IP as a policy option is greatly diminished. In this case, IP rights are unlikely to induce private abatement R & D and the negative consequences associated with monopoly provision of technology and potential freedom-to-operate restrictions are likely to outweigh the benefits.

Secondly, we highlight the considerable potential of innovation in areas in which IP rights are unsuitable or not needed. These include abatement achievable through new and improved agronomic practices relating to land management and animal husbandry. Developing best practice demands ongoing research to understand both the basic science and location specific aspects of agronomic systems. The global IP system is unlikely to affect investment in, or international transfer of, these innovations. Alternatively, there appears to be a strong case for public funding of research and extension services to facilitate deployment in cases where IP rights are unsuitable.

Finally, we have identified a number of promising fields of technology in which IP rights are important in facilitating appropriation by innovators. However, we suggest caution in not overstating the relative magnitude of the barrier IP rights represent in terms of international technology transfer. In most cases, it appears that the need for adaptive research, demonstration or complementary assets represent a more immediate barrier. In the absence of alternative mechanisms for funding these adaptive activities, there is no strong rationale for weakening IP over these technologies.