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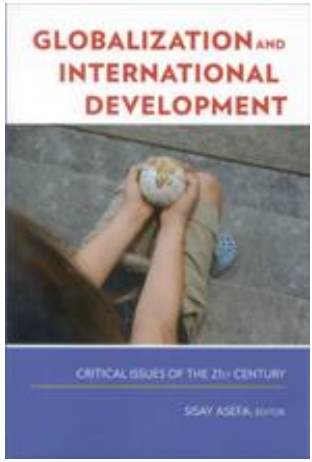

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6
Are Developing Countries Converging on Intellectual Property Rights?

Evidence from Plant Patents, 1977–2007

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For decades, researchers have attempted to develop better, more efficient sources of biofuels. On one hand, this development could represent a significant boon for developing countries. For example, sorghum in the Philippines has been found to have higher sugar content in its root than sugar cane, which is one of the best sources for efficient production of cellulosic biofuels. Economists have long advised developing countries, among others, to become less dependent on fossil fuels, whether in consumption or production. In addition, some types of biofuels may increase opportunities in production, employment, and research in the home country.

On the other hand, this could be problematic for developing countries. Provisions of the agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) to increase protection of intellectual property rights in developing countries and emerging markets have been expensive to implement. Finger (2004) estimates that the annual cost to the least developed countries would be $60 billion. Nogués (1993) finds that Argentine pharmaceutical consumers transfer $425 million yearly to foreign patent holders. With little home-country capacity or legal framework to issue patents and protect ideas, foreign (and domestic) residents may seek greater protection abroad. Such a move could increase the price of both R&D and the use of plant varieties, reducing gains to output, employment, and R&D. Despite widespread ratification of the U.N. Convention on Biological Diversity (CBD), some develop-

ing countries argue that royalties are still underpaid due to biopiracy and bioprospecting.

How have developing countries responded to the opportunity and challenge of greater intellectual property protection? Have foreign patent offices become complements or substitutes for domestic patent offices? This chapter examines the empirical record of this response.

Using data on intellectual property related to plants, I find that there is increased activity in protecting intellectual property in and by developing countries after laws related to intellectual property are introduced. In Brazil, India, and Mexico, there is a noticeable TRIPS effect. Protected inventions increased at home and abroad after TRIPS passage in 1997. This finding implies that foreign patent offices are complements in most countries.

The chapter proceeds in four sections. The first section briefly describes the methods available to protect ideas related to plants, and the second section describes the data on intellectual property. The third section presents the evidence, and the last section describes opportunities for future research.

PROTECTION OF PLANTS

The TRIPS agreement states that "Members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof." There are four main means by which plant-related innovations may be protected: 1) patents, 2) plant breeders' rights (PBR), 3) trade secrets, and 4) trademarks.

Among patents, there are two types that are relevant for plants: utility and plant. Utility patents are granted to plant-related inventions that meet the standards of novelty, usefulness, and nonobviousness. These can either be process, such as a method of using a plant or plant part in a breeding process that includes a step of sexual hybridization, or product, such as plant, seedling, plant seed, or plant part, per se, patents.[1] According to the U.S. Patent and Trademark Office, plant patents are for products only and are granted to inventors who have "invented or discovered and asexually reproduced a distinct and new variety of plant."[2] An additional requirement is that the plant must be stable.

Among developed countries, only the United States, Japan, and Australia recognize plant patents, and no developing country recognizes them (World Bank 2006, p. 25).

The criteria for plant variety protection (PVP) are uniformity, stability, and distinctness. TRIPs compliance requires that countries offer some form of protection to breeders, and many countries selected this option. Plant variety protection is the principal means by which plants are protected in the EU and in many developing countries. The first plant variety act was enacted in 1973, and many of these countries have joined or are in the process of joining the International Union for the Protection of New Varieties of Plants (UPOV). Others, such as India, Taiwan, and Thailand, have adopted national PVP programs. While PVP certifications are considered less restrictive than patents, costs associated with application vary significantly and can be prohibitive. The application fee represents 3 percent of GDP per capita in China and Colombia and 16 percent in Kenya. The annual maintenance fee represents up to 13 percent of GDP per capita in China, 16 percent in Kenya, and 0 percent in the United States.[3]

Trade secrets are another way plants might be protected. That is, fines may be imposed if nonpublic information about plant varieties is made public. This type of protection is often sought when replication is difficult, such as with hybrids.

Trademarks and geographic designations are words or symbols used to identify novel or geographic characteristics of plant varieties to consumers—for example, Michigan cherries, Egyptian cotton, and Ethiopian coffee.

While all aforementioned forms of protection are simultaneously possible, the focus of the analysis here will be patents and PVP certifications.

DATA

Patents for innovations related to plants are prohibited in most countries in our sample. Therefore, all patent data used in this analysis are patents issued to residents of developing countries and emerging markets by the U.S. Patent and Trademark Office (USPTO). For plant

patents, application data are only available from 2002. Rejection rates are calculated as the ratio of patent grants to patent applications in a given year. The rejection rate is intended to capture the quality of plant patents being issued by the United States.

Data on PVP certifications have been obtained from UPOV and the World Intellectual Property Organization (WIPO). Data on laws related to laws and agreements have been collected from the CBD, Farmers' Rights, the Food and Agriculture Organization of the U.N., WIPO, and the WTO.

Additional data, such as patents per resident and R&D expenditure as a fraction of GDP, have been gleaned from various sources to present the broader context in which decisions about plant-related intellectual property protection are being made.

EVIDENCE

Table 6.1 provides background data on the 14 developing countries and emerging markets in the sample. There is significant heterogeneity among countries for all measures: income per capita, share of agriculture in GDP, patents granted to residents per million, R&D expenditure as a fraction of GDP, and number of R&D researchers per million.

Since 1975, the quantity of plant-related innovations receiving intellectual-property rights protection has been rising in emerging markets and developing countries both at home and abroad. Figure 6.1 reports data on plant patents obtained in the United States, utility patents related to plants obtained in the United States, and PVP certifications issued in the home country. The patterns observed in the data suggest that innovations with weaker protection, PVP certifications, began to increase earlier than those seeking stronger protection through patents issued in the United States. While plant and utility patents began to rise significantly in the mid-1990s, PVP certifications began climbing significantly in the mid-1980s. Interestingly, the PVP data correspond more closely to plant and total patenting patterns in the United States, and the patent data in this sample follow plant and total plant patenting patterns in the United States with a lag of approximately 10 years.

Figure 6.2 gives data on applications for, grants of, and rejection rates for plant patents. Although patent protection of plant innovations is increasing, it is unclear whether the quality of these innovations is increasing. While the rejection rate as calculated is an imperfect measure of quality of innovations, it should give an indication of whether simply more plant-related ideas are seeking protection rather than better ideas. The high degree of variation between 2002 and 2006, the only years for which there are data, makes inference difficult. Rejection rates for all U.S. utility patents are available for a longer period and are recorded in Figure 6.3. Rejection rates were largely stable at around 60 percent in the 1990s but climbed to 70 percent by the mid-2000s.[4]

Developing countries and emerging markets have received plant-related utility patents in all subcategories. However, shares attributed to developing countries and emerging markets are relatively low in most subcategories and are largest in mushrooms, pepper, and conifers. These data appear in Figure 6.4.

For each country, we are interested in answering the following questions: Are there significant differences in intellectual-property protection sought at home and abroad? Do inventors respond to measures adopted to increase protection of plant-related ideas? Are these patterns different across countries? Figures 6.5–6.10 present data for each country in the sample and include dates of implementation of the UPOV, TRIPS, CBD, and national PVP certifications.

For Argentina and Brazil, most of the activity in IP protection of plants is in PVP certifications. In both countries, plant-related utility patents rose after 1999. Among the countries in the sample, Argentina and Israel are the earliest users of plant protection in the home country. In India and Taiwan, all the activity related to protection of plant innovations is in protection sought abroad. For Brazil, India, and Mexico, nearly all plant IP activity is concentrated in the post-TRIPS era. Following membership in UPOV, PVP certificates in Israel rose above nonzero levels consistently for more than 20 years. Of course, a formal multivariate econometric test would be warranted to ascribe causality, but the country-specific graphical analysis is suggestive.

The findings in this study are broadly consistent with the recent literature on plant-related intellectual property rights, such as Helfer (2002) and World Bank (2006). Particularly on the issue of patents,

Table 6.1 Country Data, Developing Countries, and Emerging Markets

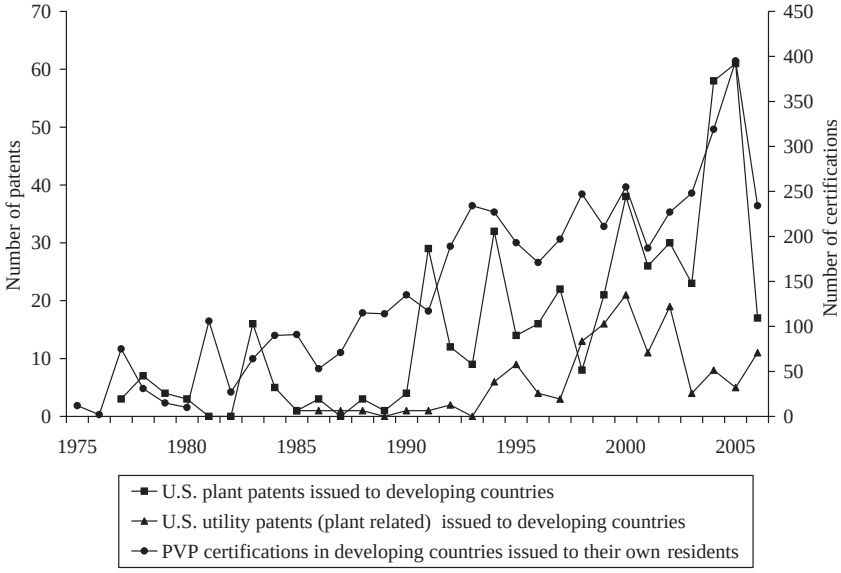
	GDP per capita, PPP[a] $US 2005	Agriculture % GDP 2005	Patents granted to residents per million population 2005	R&D expenditure % GDP 2000–2005	Researchers in R&D per million population 1990–2005
All developing countries	1,939	11.1	—	1.02	—
East Asia and the Pacific	2,119	6.4[b,c]	—	1.61	722
Latin America and the Caribbean	4,480	8.7[d]	—	0.56	256
High income	34,759	1.7[b]	286	2.45	3,781
Middle income	2,808	9.6	—	0.85	725
Low income	610	21.4	—	0.73	—
Israel	17,828	3.0	48	4.46	—
Argentina	4,728	9.4	—	0.41	720
Chile	7,073	5.5	1	0.61	444
Costa Rica	4,627	8.7	—	0.39	—
Mexico	7,454	3.8	1	0.40	268
Brazil	4,271	8.1	1	0.98	344
Colombia	2,682	12.5	—	0.17	109
Thailand	2,750	9.9	1	0.26	287
Ecuador	2,758	6.5	—	0.07	50
Indonesia	1,302	13.4	—	0.05	207
Honduras	1,151	13.9	—	0.05	—
South Africa	5,109	2.5	—	0.76	307

India	736	18.3	1	0.85	119
Taiwan	16,067	1.7	1,865	2.26	3,972[e]

[a] Purchasing power parity.
[b] 2004 data.
[c] Asia (excluding Middle East).
[d] Only Latin America.
[e] 1998–2005 data.

SOURCE: Columns 1, 2, 4, and 5: World Bank (2007); aggregates calculated from UNDP (2008). Column 3: UNDP (2008). Data on Taiwan are from Food and Fertilizer Technology Center for the Asian and Pacific Region (2008) and Taiwan Intellectual Property Office (2007). Data on population are from United Nations (2007).

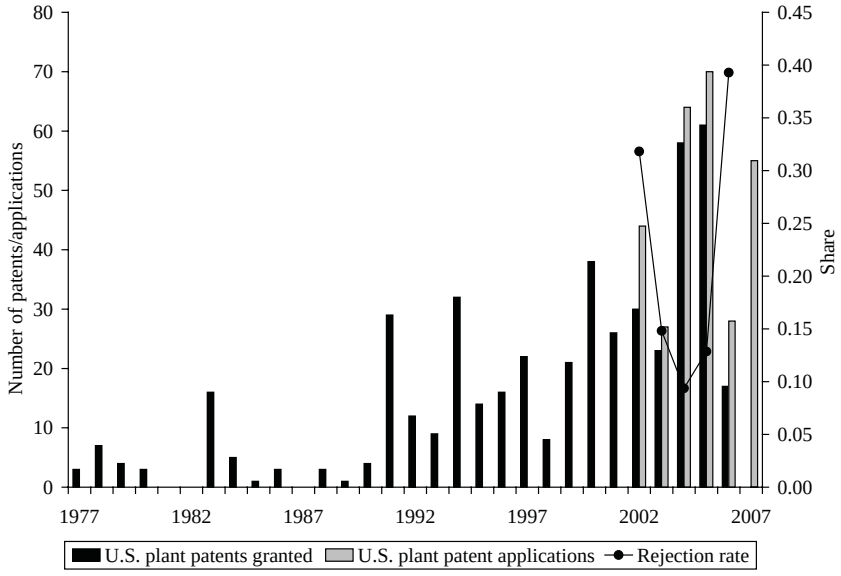
Figure 6.1 Intellectual Property Related to Plants, Developing Countries and Emerging Markets, by Application Year, 1975–2006



NOTE: Developing countries and emerging markets for U.S. utility and plant patents data are Israel, Costa Rica, India, South Africa, Brazil, Colombia, Argentina, Indonesia, Chile, Honduras, Mexico, Taiwan, Thailand, and Ecuador. Developing countries and emerging markets for PVP certification data are Argentina, Brazil, Chile, Colombia, Ecuador, Israel, Mexico, and South Africa. Patent origin is determined by the residence of the first-named inventor in case of U.S. plant patent and by the residence of any inventor in case of U.S. utility patent (plant related). PVP certifications are presented by grant year.

SOURCE: U.S. Plant patents, 1994–present: UPOV (2009); before 1994: Patent Technology Monitoring Team. PVP certifications, 2002–2006: UPOV (2009); 1975–2001: WIPO (n.d.). U.S. utility patents related to plants: Data retrieved by the author from the USPTO Web site: http://www.uspto.gov.

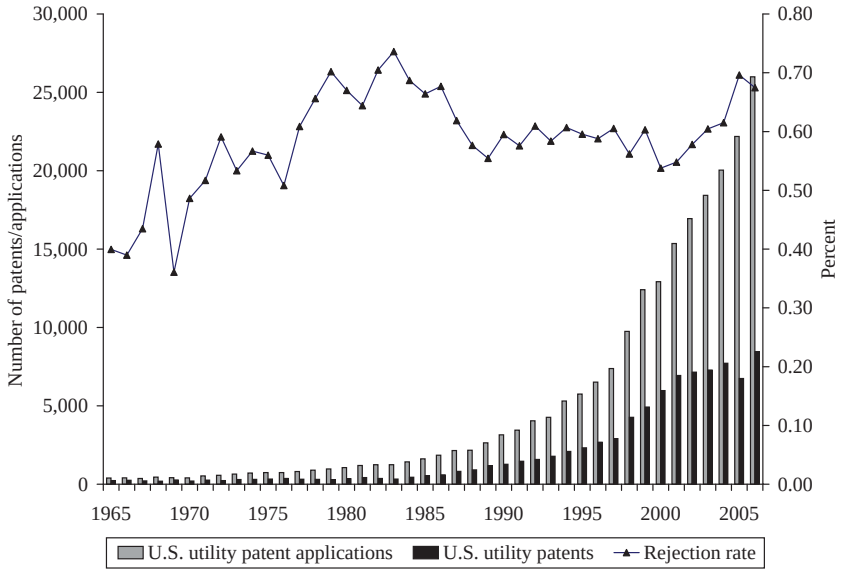
Figure 6.2 U.S. Plant Patents, Grants and Applications, Developing Countries and Emerging Markets, by Application Year, 1977–2007



NOTE: Developing countries and emerging markets are Israel, Costa Rica, India, South Africa, Brazil, Colombia, Argentina, Indonesia, Chile, Honduras, Mexico, Taiwan, Thailand, and Ecuador.

SOURCE: Data prior to 1994: Patent Technology Monitoring Team; 1994–present: USPTO (2008a).

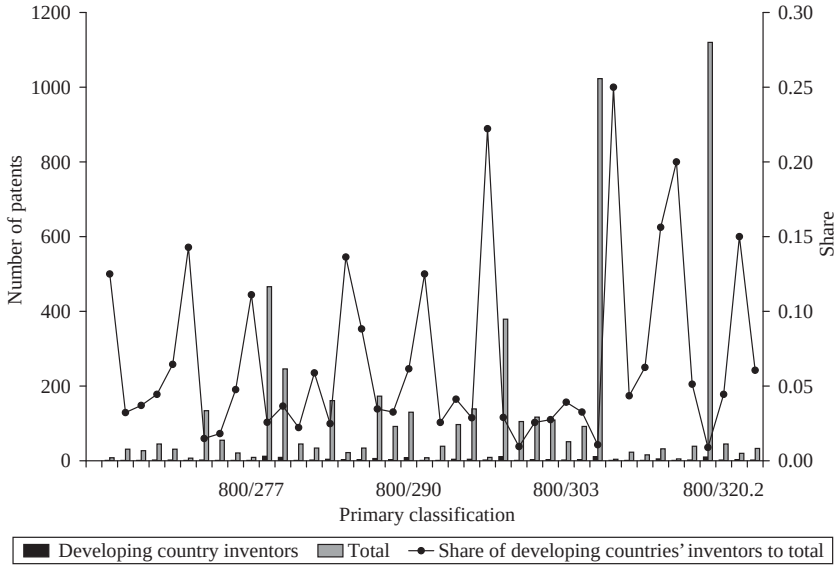
Figure 6.3 U.S. Utility Patents, Grants and Applications, Developing Countries and Emerging Markets, by Grant Year, 1965–2006



NOTE: Developing countries and emerging markets are Israel, Costa Rica, India, South Africa, Brazil, Colombia, Argentina, Indonesia, Chile, Honduras, Mexico, Taiwan, Thailand, and Ecuador.

SOURCE: U.S. utility patent data: USPTO (2008b). U.S. utility patent application data: USPTO (2008c).

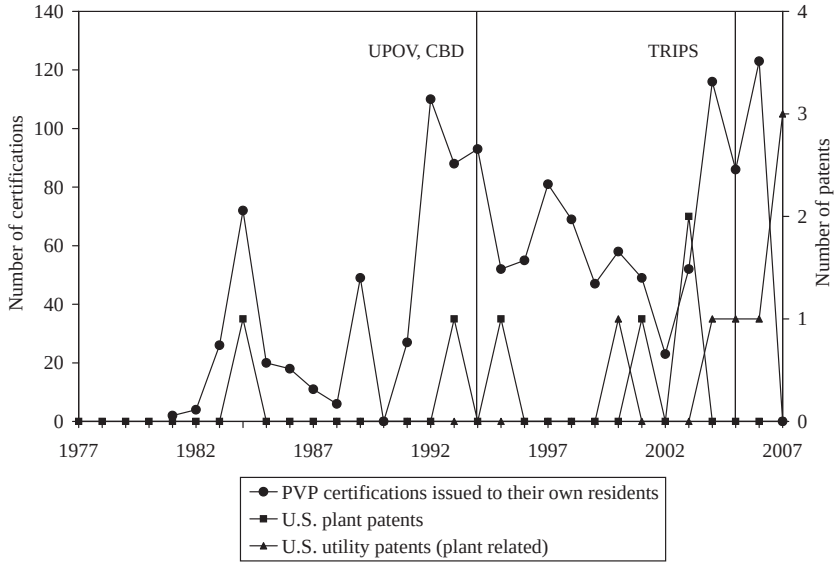
Figure 6.4 U.S. Utility Patents Issued to Developing Countries and Emerging Markets, by Plant Category, 1985–2006



NOTE: Developing countries and emerging markets are Israel, Costa Rica, India, South Africa, Brazil, Colombia, Argentina, Indonesia, Chile, Honduras, Mexico, Taiwan, Thailand, and Ecuador. Patent origin is determined by the residence of at least one inventor. Classification codes are as follows: 800/277 = Method of producing a plant or plant part using somatic cell fusion (e.g., protoplast fusion, etc.). 800/290 = The polynucleotide alters plant part growth (e.g., stem or tuber length, etc.). 800/303 = Male-sterile. 800/320.2 = Rice.

SOURCE: USPTO (2008b).

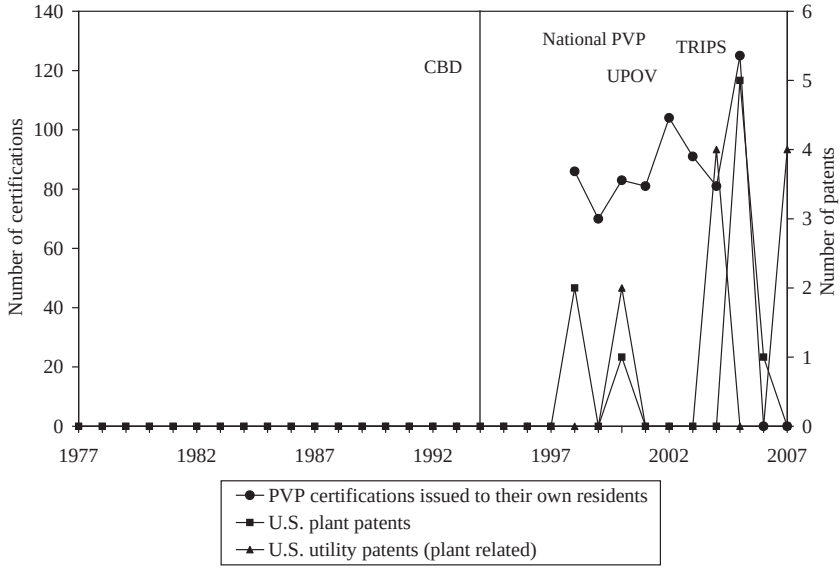
Figure 6.5 Argentina, Intellectual Property, Plants, 1977–2007



NOTE: Patent origin is determined by the residence of the first-named inventor. CBD, TRIPS, and UPOV represent the year that the country ratifies the CBD, joins the World Trade Organization, and joins UPOV. The first national Plant Variety Protection law was enacted in 1973.

SOURCE: U.S. Plant patents, 1994–present: UPOV (2009); before 1994: Patent Technology Monitoring Team. PVP certifications, 2002–2006: UPOV (2009); 1975–2001: WIPO (n.d.). U.S. utility patents related to plants: Data retrieved by the author from the USPTO Web site, http://www.uspto.gov. Law data: Summary from WIPO (2007), CBD (2009), and Farmers' Rights (2009).

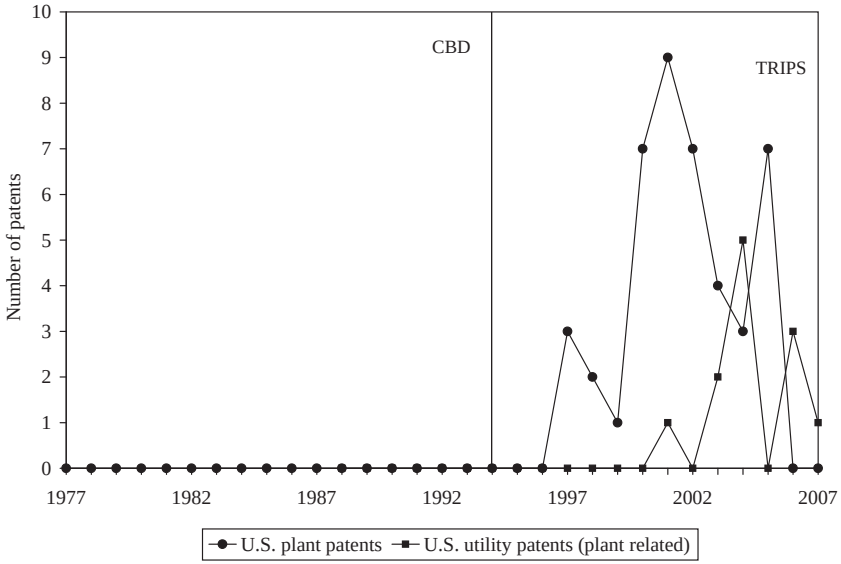
Figure 6.6 Brazil, Intellectual Property, Plants, 1977–2007



NOTE: Patent origin is determined by the residence of the first-named inventor. CBD, TRIPS, and UPOV represent the year that the country ratifies the CBD, joins the World Trade Organization, and joins UPOV. The first national Plant Variety Protection law was enacted in 1973.

SOURCE: U.S. Plant patents, 1994–present: UPOV (2009); before 1994: Patent Technology Monitoring Team. PVP certifications, 2002–2006: UPOV (2009); 1975–2001: WIPO (n.d.). U.S. utility patents related to plants: Data retrieved by the author from the USPTO Web site, http://www.uspto.gov. Law data: Summary from WIPO (2007), CBD (2009), and Farmers' Rights (2009).

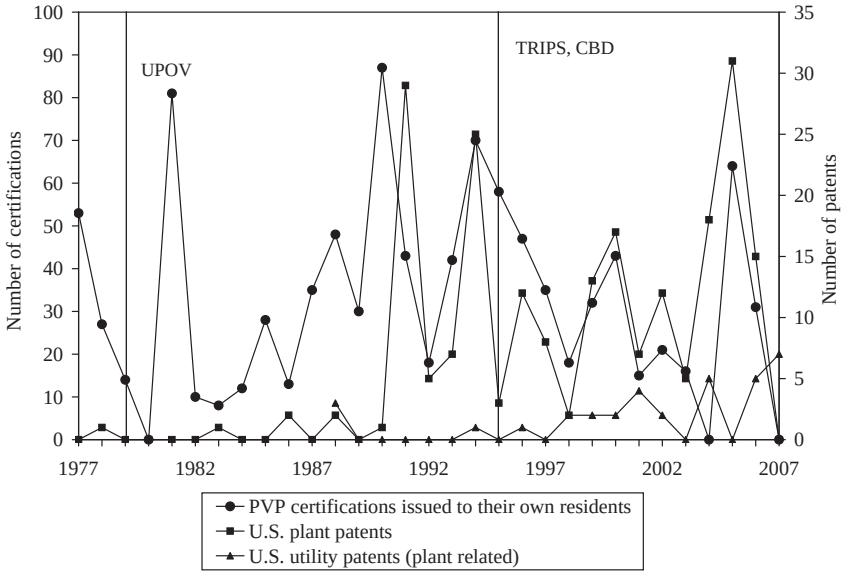
Figure 6.7 India, Intellectual Property, Plants, 1977–2007



NOTE: Patent origin is determined by the residence of the first-named inventor. CBD, TRIPS, and UPOV represent the year that the country ratifies the CBD, joins the World Trade Organization, and joins UPOV. The first national Plant Variety Protection law was enacted in 1973.

SOURCE: U.S. Plant patents, 1994–present: UPOV (2009); before 1994: Patent Technology Monitoring Team. PVP certifications, 2002–2006: UPOV (2009); 1975–2001: WIPO (n.d.). U.S. utility patents related to plants: Data retrieved by the author from the USPTO Web site, http://www.uspto.gov. Law data: Summary from WIPO (2007), CBD (2009), and Farmers' Rights (2009).

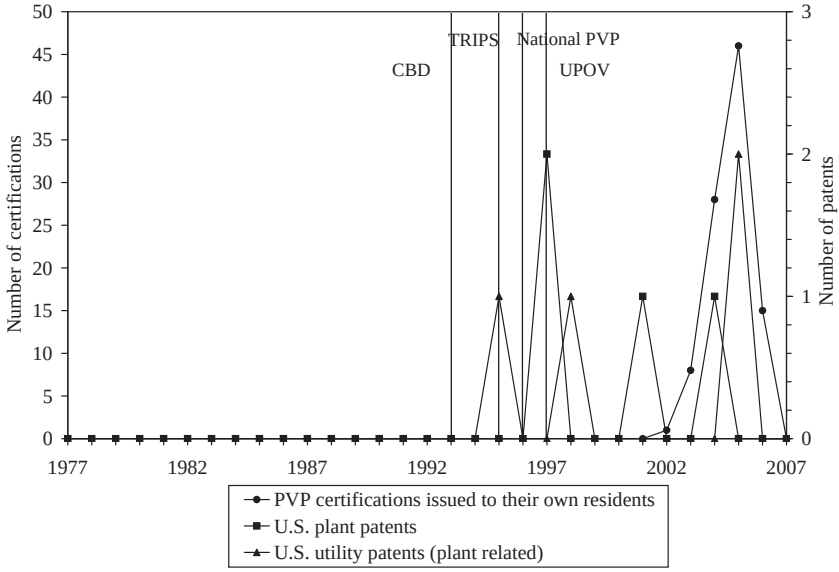
Figure 6.8 Israel, Intellectual Property, Plants, 1977–2007



NOTE: Patent origin is determined by the residence of the first-named inventor. CBD, TRIPS, and UPOV represent the year that the country ratifies the CBD, joins the World Trade Organization, and joins UPOV. The first national Plant Variety Protection law was enacted in 1973.

SOURCE: U.S. Plant patents, 1994–present: UPOV (2009); before 1994: Patent Technology Monitoring Team. PVP certifications, 2002–2006: UPOV (2009); 1975–2001: WIPO (n.d.). U.S. utility patents related to plants: Data retrieved by the author from the USPTO Web site, http://www.uspto.gov. Law data: Summary from WIPO (2007), CBD (2009), and Farmers' Rights (2009).

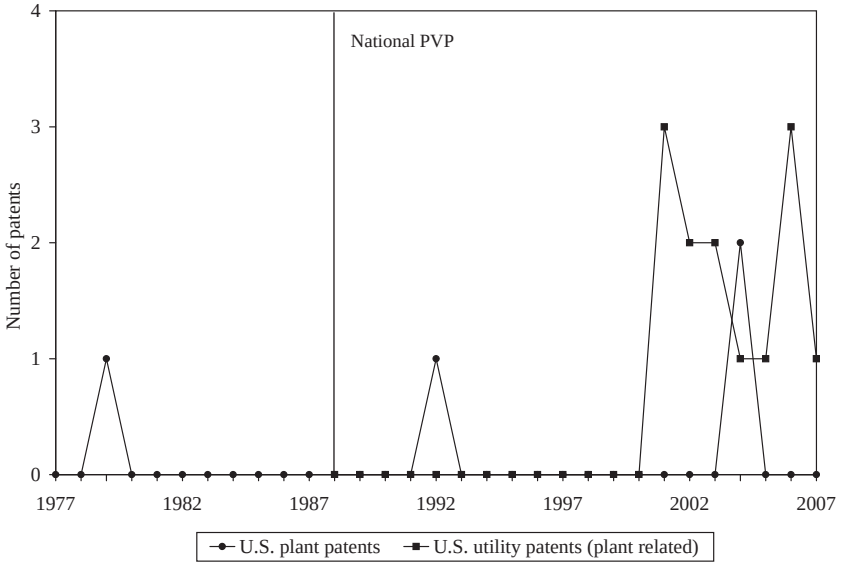
Figure 6.9 Mexico, Intellectual Property, Plants, 1977–2007



NOTE: Patent origin is determined by the residence of the first-named inventor. CBD, TRIPS, and UPOV represent the year that the country ratifies the CBD, joins the World Trade Organization, and joins UPOV. The first national Plant Variety Protection law was enacted in 1973.

SOURCE: U.S. Plant patents, 1994–present: UPOV (2009); before 1994: Patent Technology Monitoring Team. PVP certifications, 2002–2006: UPOV (2009); 1975–2001: WIPO (n.d.). U.S. utility patents related to plants: Data retrieved by the author from the USPTO Web site, http://www.uspto.gov. Law data: Summary from WIPO (2007), CBD (2009), and Farmers' Rights (2009).

Figure 6.10 Taiwan, Intellectual Property, Plants, 1977–2007



NOTE: Patent origin is determined by the residence of the first-named inventor. CBD, TRIPS, and UPOV represent the year that the country ratifies the CBD, joins the World Trade Organization, and joins UPOV. The first national Plant Variety Protection law was enacted in 1973.

SOURCE: U.S. Plant patents, 1994–present: UPOV (2009); before 1994: Patent Technology Monitoring Team. PVP certifications, 2002–2006: UPOV (2009); 1975–2001: WIPO (n.d.). U.S. utility patents related to plants: Data retrieved by the author from the USPTO Web site, http://www.uspto.gov. Law data: Summary from WIPO (2007), CBD (2009), and Farmers' Rights (2009).

the conventional wisdom is that developing countries prefer weaker IP rights and that these will spur innovation. This analysis suggests that a more nuanced and time-series investigation of the empirical record is in order and that the issue is not settled.

CONCLUSION

An examination of data on intellectual property related to plants finds that there is increased activity in protecting intellectual property in and by developing countries. This finding implies that foreign patent offices are complements in most countries. In Brazil, India, and Mexico, there is a noticeable TRIPS effect, and protected inventions increase at home and abroad after TRIPS passage in 1997. From the data it is difficult to glean implications for taking advantage of new biofuel opportunities, for example, beyond protection of ideas. Were these preexisting ideas or new ideas seeking protection? Did new knowledge arise as a result of new protection or in spite of it? What are the results with respect to commercialization? This is still an open research question and deserves further attention in future research.

Notes

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1. The scope of per se patents is not only the application identified but applications not yet identified.
2. USPTO definition, http://www.uspto.gov/web/offices/pac/plant/.
3. World Bank (2006), UNDP (2008), and author's calculations. GDP per capita data are for 2005.
4. One must be careful in interpreting the data on rejection rates, as applications and rejections arrive at irregular and different intervals.

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