Echoes of Bayh-Dole? A Survey of IP and Technology Transfer Policies in Emerging and Developing Economies

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ABSTRACT

Seeking to drive economic growth within the knowledge economy, governments have increasingly sought to commercialize the results of publicly funded research. The ability to use intellectual property (IP) as a tool to encourage and facilitate commercialization hinges on three fundamental policy concerns: protection, ownership, and management capacity. This chapter surveys the policies and practices across an array of emerging and developing economies, including Argentina, Brazil, Chile, China, Ethiopia, India, Indonesia, Jordan, Kenya, Malaysia, Mexico, the Philippines, Poland, Russia, South Africa, Tanzania, Uganda, and Vietnam. In regard to the availability of intellectual property protections, the survey finds that countries can logically be sorted into three tiers. The first tier contains the most innovative countries, those with an active intellectual property system used vigorously by domestic patentees. The second tier consists of countries actively seeking to become more innovative, with intellectual property systems that are only beginning to be used by domestic patentees. The third-tier countries are those with limited or nascent intellectual property systems and virtually no domestic patentees. Almost all first tier innovative countries, about half of second-tier countries, and no third-tier countries have formally addressed the question of intellectual property ownership through national policy. Among those that have, however, the survey finds a wide range of policy approaches used to address the question of intellectual property ownership, including patent law, labor law, government procurement or contract law, and laws governing national R&D or innovation systems, as well as rulings by ministries of science and technology or ministries of higher education. With regard to institutional intellectual property management capacity, the survey finds a very broad range of sophistication and expertise, both across and within countries of all three tiers. Higher capacities for institutional intellectual property management appear to be more closely associated with levels of R&D expenditure than with the existence or absence of national policies that allow or encourage institutional ownership. The implication is that intellectual property management at the institutional level grows in tandem with strong R&D and the capacity for the local economy to commercialize the technology.

1. INTRODUCTION

As governments in countries with emerging and developing economies confront the issues of globalization and technological advance, many have focused on how domestic universities and research institutes can promote economic growth by supporting and seeding innovation in the private sector. Such institutions have traditionally served two core missions: to educate the elites of the workforce and to conduct applied or adaptive research to address domestic economic and social needs. Institutions in developing countries are also often concerned with carving out a place for the country within the global scientific community.

Increasingly, government officials in developing countries are under pressure to democratize higher education and fund a broader range of research and development priorities. At the

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same time, commercializing innovation is being emphasized as a core mission of publicly funded research. To advance this mission, the tools of patenting, technology transfer, and venture creation are increasingly deployed. Indeed, in countries like China and India, student numbers are swelling, rates of publication in prestigious international journals are climbing, academic patents are growing, and the number of start-up companies is increasing. Like other areas of development policy, academic innovation may be an area in which developing countries can leapfrog directly to the standards and practices of the knowledge economy.

National systems of innovation are not made overnight; they evolve over generations. Those economies that are today actively seeking to expand the private economic impact of their publicly funded R&D are building upon the legacies of past investment in their institutions and in the human capital that is the very source of innovation. Today's challenge is to adapt the policy environment to improve the social rate of return on those investments. This can be achieved by increasing the flow of technologies into the private sector. It is therefore important to understand how technology transfer from universities and public research institutions is affected by national policies. The three fundamental policy questions that any country must answer are:

1. To what extent are intellectual property (IP) protections available?
2. To whom can/should the ownership of those property rights be assigned? (To the government or third-party sponsor of the research? To the institution where the work was conducted, or to the individual inventor?)
3. What capacity, in the form of dedicated infrastructure, programs, or other resources, will be provided to identify, protect, and commercialize new technologies and to support industrial development and technology-based entrepreneurship activities?

IP is just one part of an economy's system of innovation. The research base, the legal IP regime, and the institutional infrastructure all co-evolve in a synergistic process with each part supporting, and supported by, the others, just as the different parts of an ecosystem co-evolve. This chapter provides brief sketches of the national policies governing university and public sector technology transfer by means of intellectual property, looking at how the three basic policy questions have been addressed around the world. From these observations, we can distill general trends in legislative, regulatory, and institutional reforms from around the world.

2. PRIMARY AREAS OF POLICY AFFECTING TECHNOLOGY TRANSFER

2.1 *Availability of IP protection*

The first policy question is whether private-property rights can be claimed over the intangible results of research. This issue is governed by a country's intellectual or industrial property laws. Some degree of global standardization has been achieved through multilateral agreements. The Paris Convention of 1883 ensures that foreign inventors from signatory countries are treated as nationals. The Patent Cooperation Treaty (PCT) of 1970 provides a common patent application clearinghouse for inventors wishing to file for patents in multiple countries. The Agreement on Trade-Related Aspects of Intellectual Property (TRIPS) of the WTO, adopted in 1994 and entered into force in 1995, stipulates minimum IP standards for members of the WTO. In addition, provisions or conditions for IP protection are often the subject of bilateral trade agreements. Influential centers of trade such as the United States and the European Union exert a harmonizing influence on the national policies of trade partners with whom they have concluded bilateral trade agreements. These trade leaders often set standards for IP protection that are even higher than the conditions set forth in TRIPS. In the specific area of newly bred plant varieties, the Union for the Protection of New Plant Varieties (UPOV) Convention, adopted in 1961 and revised in 1972, 1978, and 1991, has established international standards for plant variety protection (PVP). Each revision of the

treaty outlined increasing levels of protection that countries can decide to adopt.

Even if domestic IP rights are not available for a newly invented technology, the inventor does have the option of filing in other countries where IP rights may be granted. It is common for inventors around the world to minimally file in the major triad of the United States, Europe, and Japan.

2.2 *Ownership of intellectual property*

The second policy question concerns the locus of ownership of intellectual property that results from work done at publicly funded organizations. Legislative reforms have been introduced in many countries seeking to systematize and promote the commercialization of technologies. Many of these efforts have taken inspiration from the experience of the United States under the Bayh-Dole Act of 1980, which harmonized the variety of U.S. government agency IP ownership policies. The Bayh-Dole Act specifically focused on the rules concerning the disposition of IP rights over inventions that result from federally funded research. It effectively limited the government's role in ownership, vesting ownership rights to the organization where the invention is made, along with responsibilities and conditions for how the intellectual property is to be managed. It is possible, however, for other areas of law, including patent law and labor law, to shape how universities manage intellectual property.[1]

2.2.1 *IP, industrial property, or patent laws and regulations*

IP or patent law often provides conditions for the disposition of patent rights between the individual inventor, the institution that employs him or her, and a designated assignee of the rights, which can be either the employing institution or a third party.

2.2.2 *Labor or employment laws and regulations*

Employment laws and regulations can stipulate the privileges, rights, and responsibilities of employees, including the disposition of rights to inventions made during the course of employment. These commonly specify that inventions made in the natural course of employment are to become the property of the employer, although conditions may be put in place, such as requiring additional compensation for the employee-inventor. In some countries, particularly in continental Europe and Scandinavia, an exemption to labor law has been historically granted to university faculty, dubbed the "professor's exemption." This exemption gives faculty the right to take ownership over any intellectual property resulting from the research they conduct at the university.

2.2.3 *Laws of funded or contracted research*

Government funds or contracts, including those granted for the conduct of research, often carry requirements for the recipients of those funds or for the parties to that contract. In some (increasingly rare) cases, a government may explicitly require that the results of research funded by the government be made freely available to the public, thus prohibiting any private IP claims. In other cases, a government may itself take ownership of IP rights over the results of research. Alternatively, a government may choose to devolve the rights of ownership, either to the institution that hosted the research or to the individual inventor. The primary justification of the latter two policies is that putting the IP rights into the hands of the host institution or the inventor properly aligns private economic incentives to encourage inventions and entrepreneurial activity. The premise is that economic activity governed by the market will better serve the economy and consumers—while at the same time generating rewards and incentives for institutions and researchers based on the actual market impact of their contribution.

2.2.4 *Laws and regulations of the national R&D system*

Governments in many countries are taking specific steps to develop national innovation or R&D systems supported by an integrated set of policies covering the creation of new research institutions, increased research funding, management of human resources, and the provision of grants and subsidies. These policies might include tax incentives for industry R&D and institutions along

with funds to support venture investment and entrepreneurship. As part of the integrated policy, there may be rules for the provenance of intellectual property created within the national system.

2.2.5 *Ownership questions in the absence of domestic policies*

In cases when IP rights are not available in an inventor's home country, the question of ownership may still arise, in particular the ownership of available foreign IP rights, whether it be by the individual inventor, their government, their employing institution, or a third-party assignee.

Importantly, in the absence of laws specifically enabling or restricting ownership of intellectual property, universities and public research institutions are free to establish their own policies and practices. This is the situation in many countries, including developed countries such as the U.K. Such openness can allow a research institution greater IP management flexibility. On the other hand, the lack of a specific national policy on IP ownership often indicates a lack of coordination or transparency.

2.3 *IP management capacities*

The third fundamental policy question concerns the provision for IP management and technology commercialization. Merely providing for the existence of private-property rights over intellectual assets is not enough. Public institutions need more than rights to own intellectual assets; they need to develop the infrastructure and expertise required to manage these intellectual assets and engage in productive commercial relationships with private companies and investors. Even in high-income countries such as the United States, institutional developments took a decade or more to spread through universities. While universities were left to create infrastructure and expertise on their own in the United States, many other countries have pursued policies that range from providing subsidies to universities to set up technology transfer offices (TTOs)—Denmark is a good example—to establishing national networks or central offices to coordinate and assist universities in developing their technology transfer operations (such as Chile).[2]

While national laws and regulations provide a legal framework within which universities and public research institutes operate, these are ultimately implemented by the staff dedicated to the management of technology commercialization. Institutional policies can be slow to take shape, and dedicating resources, establishing offices, and deploying staff takes time and commitment. However, while universities develop or adapt formal policies, rules, and regulations, the informal norms and practices within the academic culture are equally crucial. Once policies and capacity are established at the institutional level, an effective IP management program can take up to ten years to develop and mature into a self-sustaining enterprise that is supported by the academic community. These capacity developments are often most visible in the creation of offices or units for IP management, technology transfer, or commercialization, and in the volume of patents, licensing deals, or spinouts coming from the public sector.

3. CURRENT POLICIES IN EMERGING ECONOMIES

3.1 *Argentina*

IP protection. Argentina's current patent law, the Law on Patents and Utility Models No. 24.481 was adopted in 1995, amended by Law No. 24.572 in 1995, and harmonized in 1996 by Executive Decree No. 260.96. Argentina joined the WTO and became signatory to TRIPS in 1995, which entered into force in Argentina on 1 January 2000.[3, 4] Under Article 100 of the new Law on Patents, pharmaceutical products became patentable as of 2000 (with patent applications accepted as of 1995). Article 6 of the new Law on Patents, however, clearly stipulates that plants, animals, and indeed "*all classes of living materials and substances existing in nature*" cannot be patented. Article 7 reinforces this, excluding from patentability "*the totality of biological and genetic material existing in nature…*"[5] Patents are administered by the Instituto Nacional de la Propiedad Industrial (INPI).[6]

Plant varieties are protected in Argentina under the 1973 Law No. 20.247 on Seed and

Phytogenetical Creation (the Plant Varieties Law). Argentina joined UPOV in 1994, as enacted by Law No. 24.376 on the Protection New Varieties of Plants.[7, 8]

In 2004, the National Agency of Scientific and Technologic Promotion announced an initiative to help researchers, both in industry and government laboratories, to pay for foreign patent filings, in an effort to boost the rate of domestic patenting (in many jurisdictions, domestic filing is a prerequisite for foreign filing). In 2000, 145 patents issued by Argentina went to residents of Argentina, while 1,442 went to foreign residents.[9]

Ownership. The 1990 Law on the Promotion of Technological Innovation No. 23.877 and the 1995 Law on Higher Education No. 24.521 provided certain conditions for institutional ownership and transfer of intellectual property resulting from the work of researchers.[10] The 1990 law allows national research institutions to establish or outsource TTOs, but leaves the question of internal distribution of income up to institutional policy. It allows for researchers to receive income beyond their government salaries from technology commercialization activities. The law also provides for government funding of TTOs for collaborations with (preferably small) businesses and establishes a fund for this purpose. In the 1995 law, Article 59 establishes the financial autonomy of national universities and their right to seek additional sources of revenue from the provision of services, products, contributions, fees charged, and any other resources, including technology transfer and commercialization. The law also allows national universities to form or own corporations.[11]

However, the 1995 Law on Patents and Utility Models (24.481, modified by 24.572) established that the ownership of inventions made by employees in the course of their jobs goes to the employer, in most cases. But the law also requires the distribution of a share of the income to the inventor, and for researchers at national universities, it, in effect, gives joint ownership to the university and the centralized agency CONICET (Consejo Nacional de Investigaciones Cientificas y Tecnicas), which manages employment and pays salaries for most university-based scientists in the country. TTOs of individual institutions may establish individual agreements with CONICET for the assignment and management of particular inventions. CONICET does not, however, have a general policy on handling joint inventions.[12]

Institutional capacities. As a result of ownership laws, there is both some IP management and coordination capacity at the government level. TTOs exist at some universities, and IP management is also contracted out to third-party management companies or centers. Among the most developed programs are:[13]

- University of Quilmes
- University of Cordoba
- University of Litoral
- Inis Biotech (the TTO for Instituto Leloir)
- Some capacity for IP management is centralized at CONICET, within its Directive for Science and Technology Links (Dirección de Vinculación Científico Tecnológica). This lists on its Web site more than 60 patents registered in Argentina, 12 registered in other Latin American countries, and four registered in the European Union, the United States, and Canada[14]
- The Constituyentes Technology Pole (Polo Tecnológico Constituyentes) was created in 1997 to facilitate technology transfer for several research institutions, including the National University of General San Martín (UNSAM), the Atomic Energy Commission, (Cómision Nacional de Energia Atómica - CNEA), and the National Institute of Industrial Technology (Instituto Nacional de Tecnología Industrial - INTI)

The Secretary of University Policies, which is part of the Ministry of Education, has established a Technology Network (Red de Vinculacion Tecnologica) that holds meetings and provides general information. Its main mission is to maintain professional networks.

3.2 *Brazil*

IP protection. Brazil has a long history of IP rights, having first introduced a system of protection in

1809. Brazil was also an original signatory to the Paris Convention in 1884. Beginning in the 1950s, Brazil pursued an aggressive science and technology policy designed in part to engender economic development under an import-substitution development policy. The previous Industrial Property Code (Law No. 5.772), dating from 1971, supported this policy by excluding patent protection for certain areas of technology, such as pharmaceuticals and chemicals. Following political and economic reforms, IP laws changed significantly in the 1990s. Brazil became a founding member of WTO and thus a signatory to the TRIPS Agreement in January 1995. The Law on Industrial Property No. 9.279 of 1996 entered into force in May 1997 to implement TRIPS. It has since been amended several times. Patents are administered in Brazil by the National Institute of Industrial Property (Instituto Nacional da Propriedade Industrial - INPI).[15] Article 10 of the Law on Industrial Property excludes from patentability materials existing in nature: "all or part of natural living beings and biological materials found in nature, even if isolated therefrom, including the genome or germplasm of any natural living being, and natural biological processes."[16, 17]

Plant varieties are protected under Law No. 9.456, adopted in April 1997, and implemented by Decree No. 2.366, in November 1997. They are also protected by the Ordinances of the Ministry of Agriculture No. 503, in December 1997, and No. 8, in June 1999. Brazil has been a member of UPOV since May 1999.[18]

In 2002, Brazil issued 666 patents to residents of Brazil and 1,366 to foreign residents.[19]

Ownership. For purposes of invention ownership, researchers at universities and public research institutes are not considered, under Brazilian law, to be different from other kinds of employees. The Law on Industrial Property gives inventors the right to apply for a patent, but gives employers the right to ownership of an invention by an employee that is "hired to invent," according to the terms of their employment contract. The law thus differentiates between inventions made in the course of employed work, inventions made separately from employed work (free inventions), and inventions that combine both (mixed inventions). Universities thus need to establish the type of inventions on a case-by-case basis and can take title to those made in the course of employed work. According to Article 93 of the Law on Industrial Property and spelled out in Presidential Decree No. 2.553, of April 1998, inventors who are employees in public institutions are to receive remuneration from the income created by the patent, as an incentive or bonus for inventing. The exact share to be distributed is left to institutional policy, but is not to exceed one-third of the value of the invention. Terms of IP ownership and revenue sharing are further spelled out in implementing orders of the Ministry of Science and Technology, No. 88, of 1998, and the Ministry of Education and Sport (No. 322 of April 1998).[20]

Institutional capacities. As early as 1982, under the former military regime, a central office for technological innovation was established at the National Council for Scientific and Technological Development to promote innovation at universities and encourage technology transfer to Brazilian industry. Thereafter, 12 Technological Innovation Centers were established at Brazilian universities to protect intellectual property and facilitate the university–industry interface. Today, more than 30 universities and research institutes operate TTOs.[21] Among the largest and most experienced are:

- the Agency for Innovation at Unicamp (Inova Unicamp)[22] at the State University of Campinas (Unicamp)[23]
- the USP Agency for Innovation (Agência USP de Inovação)[24] at the University of Sao Paolo
- the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária - EMBRAPA),[25] which adopted an institutional IP policy in 1996 and opened its IP Secretariat in 1998 to handle intellectual property and technology transfer[26]
- the Technology Development Support Center (Centro de Apoio ao Desenvolvimento Tecnológico - CDT), created in 1989 at the University of Brasília, and among the

earliest university centers for technology transfer [27, 28]
- the Secretariat for Technology Development (Secretaria de Desenvolvimento Tecnológico - Sedetec) at the Federal University of Rio Grande do Sul, formed by merging the operations of a TTO and an incubator network in 2000[29]

Patenting by Brazilian public sector institutions has grown dramatically. In 2003, the top seven universities plus EMBRAPA received 153 patents in just one year.[30] In contrast, over the 15 years between 1980 and 1995, all Brazilian universities and EMBRAPA received just 264 patents combined.[31]

3.3 *Chile*

IP protection. IP protection over technological inventions in Chile is based upon the Industrial Property Law (No. 19.039) of 1991. A 2005 modification (No. 19.996) brings Chilean law into line with the minimum requirements in TRIPS and the IP requirements in the bilateral free-trade agreements concluded with the United States and the European Union. Chile has been a member of the WTO and a signatory to TRIPS since 1995. However, Chile is not a member of the PCT. In Chile, patents are administered by the Department of Industrial Property. [32, 33, 34] Plant varieties are protected in Chile under the Rights of Breeders of New Varieties of Plants (No 19.342) of April 1997. Chile joined UPOV in 1996.

In 2000, Chile granted 32 patents to residents of Chile and 569 to foreign residents.

Ownership. The Industrial Property Law (No. 19.039) regulates the ownership of intellectual property resulting from work conducted under contract or employment. A section specifically on universities stipulates that IP rights derived from the work of university employees belong to the university or its designee, since that inventive or creative work is understood to be part of the job obligation. However, certain limitations on the assignment of IP ownership are set by workers' rights provisions in Chilean labor law, namely that universities cannot ask employees to completely waive the portion of IP rights due to them as inventors. Major Chilean research funding sources (such as FONDEF and CONICYT) now require IP protection of results by those organizations receiving funding, including universities.[35]

Institutional capacities. Among leading Chilean organizations with an organizational capacity for IP management are:
- University of Concepción, with its Center for Industrial Property (Unidad de Propriedad Industrial)[36]
- In 2003, the University of Chile formed the Central Commission for Industrial Property (Comisión Central de Propiedad Industrial)[37]
- Fundación Chile, which coordinates innovation and entrepreneurship projects based upon Chilean R&D, provides expertise and resources for IP management[38]
- NEOS, a consulting company located in Santiago, provides professional IP services for universities in Chile[39]

3.4 *China*

IP protection. IP law is widely viewed in China as a western import, with a first patent law adopted relatively recently in 1984 and a copyright law adopted in 1990. While protection and enforcement under these has been of ongoing concern for outsiders, the internal political climate has been shaped by the desire to join WTO and the growing prowess of Chinese companies in science and technology. It is largely these internal forces that led to the strengthening of the patent law in 1992 and in 2001.

New plant varieties are protected under the Regulation on the Protection of New Plant Varieties, implemented in 1997. China joined UPOV in 1999.[40]

In 2004, China granted 18,241 patents to residents of China and 31,119 patents to foreign residents.[41]

Ownership. As early as 1985, just five years after Bayh-Dole passed in the United States, provisional regulations issued by the State Council on Technology Transfer gave Chinese universities the right to manage and use the inventions

of university researchers, even though ownership formally remained with the State.[42] The government, however, has only recently encouraged universities to assert such rights. China adopted its Act for Promotion of Technology Transfer in 1996, later reinforced by the Decision on Reinforcing Technological Innovation and Realizing Industrialization of the State Council in 1999 and by the Opinion on Exerting the Role of Universities in Science and Technological Innovation issued jointly by the Ministry of Education and the Ministry of Science and Technology in 2002.[43] The latter is often called the "Chinese Bayh-Dole Act." In 2003, the Ministry of Education again clarified the rights of IP ownership by institutions undertaking research sponsored by the government in its Key Points on Promoting Science and Technology of Universities.[44]

Institutional capacities. Internal organizational capacity for IP management is most readily found at leading universities, such as:

- Tsinghua University, with probably the most well-developed university TTO in China[45]
- Beijing University

The number of patent applications from across the full range of Chinese universities is significant. It quadrupled in the four years from 1999 (with 988 applications) to 2002 (with 4,282 applications).[46] For comparison, U.S. universities reported total patent applications increasing less than two fold between 1999 (with 8,457 applications) and 2002 (with 12,222 applications).[47] However, some caution should be taken in interpreting these figures, since the practice of patenting by Chinese academics appears to have been adopted as something of a proxy for published research. In fact, inventorship on patents is widely admitted as a criterion for academic promotion. Significantly, far fewer Chinese university patents are being licensed or commercialized. Still, Tsinghua University reports having spun off more than 38 companies, generating annual sales of US$1.8 billion and actively incubating more than 200 companies at the Tsinghua Science Park during 2003 alone.[48]

3.5 *Ethiopia*

IP protection. Ethiopia is an example of a country still largely outside of the global IP system. Ethiopia has a basic patent code, created in 1995 by Proclamation No. 123 Concerning Inventions, Minor Inventions, and Industrial Designs, and instituted in 1997 by Regulation No. 12. The stated purpose is to encourage local innovation (mostly minor adaptations of existing technologies) and transfer in foreign technologies. The proclamation precludes the patenting of plants, animals, and essentially biological processes.[49] The country is an observer but not a signatory to WTO, and is thus not bound to compliance with TRIPS. Ethiopia protects copyright under its civil code.[50]

PVP was introduced in February 2006 by Proclamation No. 481, Plant Breeder's Rights.[51]

In 2000, the Ethiopian Intellectual Property Office received just seven patent applications and granted just one, to a foreign resident. In the same year it granted 19 industrial designs, 12 to residents of Ethiopia and seven to foreign residents.[52]

Ownership. There is no national framework and an apparent lack of clarity or transparency about the terms and conditions under which public research institution or individual inventors might be owners of any IP rights.

Institutional capacities. The largest research organizations in the life sciences are Addis Ababa University, Alemaya University, the Ethiopian Health and Nutrition Research Center, the Ethiopian Agricultural Research Organization, the National Veterinary Institute, and the International Livestock Research Institute (ILRI), all producing locally or regionally marketable research results. Only the Ethiopian Agricultural Research Organization has an IP unit in formation. The rest have no IP management units, and their scientists and staff have a very low level of awareness and knowledge about IP rights. The Ethiopian Intellectual Property Office has received only a handful of patent applications from university researchers in Ethiopia, (primarily in agriculture, pharmaceuticals, and mechanics) and only one from the Ethiopian Agricultural Research Organization.[53]

3.6 *India*

IP protection. India's history with IP law is deeper than that of many developing countries. The first patent law was adopted in 1856, and by 1911 Indian patent law conformed to the standards of developed countries. Copyright, trade secrecy, and design laws have been in place equally as long. However, patent law was relaxed in 1970 under the import-substitution industrial policy, which encouraged economic development through the reverse engineering of western technologies. Since adopting market-oriented reforms and seeking WTO membership in the 1990s, reform in IP law has been rapid. India joined the WTO and became signatory to TRIPS in 1995. Patent law was strengthened in 1999 and again in 2002 to become compliant with TRIPS.[54] Legislation that passed in 2005 reinstated the patenting of pharmaceutical compounds, reversing legislation from 1970 that limited patenting to the processes for the manufacture of pharmaceuticals.[55] Today, an elite cadre of Indian pharmaceutical companies has emerged with the capacity to engage in globally competitive R&D, significantly influencing India's internal IP policy debate.

Plant varieties are covered by the Protection of Plant Varieties and Farmers' Rights Act of 2001.[56] India has not joined UPOV.

In 2004, India granted 851 patents to residents of India and 1,466 to foreign residents.[57]

Ownership. In 2000, the Ministry of Science and Technology issued a ruling that gave title to intellectual property to those institutions that receive funding from the Ministry. While this is not a legislated policy, it signaled a milestone in an ongoing trend of shifting technology transfer activities away from the government to research institutions. This trend has been underway since at least 1995.[58]

Institutional capacities. The bulk of intellectual property and technology transfer expertise in the public sector remains located in government agencies, particularly in the Council for Scientific and Industrial Research (CSIR), the Department of Science and Technology (DST), and the Department of Biotechnology (DBT). The Ministry of Science and Technology, the Indian Council of Medical Research (ICMR), and the National Research and Development Council (NRDC) are also involved in technology transfer activities.[59]

Most academic intuitions still lack IP management capacity, with the exception of the leading Indian Institutes of Technology (IITs) and a few other universities. TTOs or centers are now found at:

- IIT New Delhi
- IIT Bombay
- IIT Kharagpur
- IIT Kanpur
- IIT Guwahati
- IIT Roorkee
- IIT Chennai
- Delhi University
- Govind Ballabh Pant University of Agriculture & Technology, Pant Nagar
- Bidhan Chandra Krishi Vishwavidyalaya
- Jadavpur University[60]

Only a small portion of the 277 Indian universities listed by the Association of Indian Universities have functioning TTOs.[61] In April 2005, a professional association for technology transfer was launched—the Society for Technology Management (STEM).[62] In April 2006, the Minister of Science and Technology announced plans to set up an Indian Institute for Intellectual Property Management.[63]

3.7 *Indonesia*

IP protection. Intellectual property is a relatively new concept in Indonesia. Indonesia signed the Paris Convention in 1950. It joined WIPO in 1979. Industrial Designs were introduced by Law No. 5, Concerning Industry, in 1984. Patents were introduced by Law No. 6, Patent Law, in 1989 and amended by Law No. 13 in 1997. Indonesia has been a member of WTO and a signatory to TRIPS since 1995.[64, 65]

In Indonesia, a plant variety can be protected by a patent if it fulfils the basic requirements for patentability. In addition, in 2001 the Indonesian parliament passed a Plant Variety Protection Act, based on the UPOV 1991 standards, to establish a PVP system.[66] Indonesia has, however, not joined UPOV.

In 1996, Indonesia granted 16 patents to residents of Indonesia and 615 to foreign residents.[67] In 2003, however, Indonesia granted 2,902 patents, including both residents and nonresidents.[68]

Ownership. The 2002 Law No. 18, titled National Systems for Research, Development, and Application of Technology, stipulates that institutions and universities in Indonesia should establish units for IP management and that they may use the income derived from the exploitation of intellectual property.[69]

Institutional capacities. There are now, at least nominally, over 90 IP management units at institutes and universities throughout Indonesia. Leading centers of public sector IP management include:

- more than 30 research institutes of the Agency for Agricultural Research and Development (AARD) have their technology transfer needs handled by Kekayaan Intellectual dan Alich Teknologi (KIAT), established in 1999
- Indonesian Institute of Science (LIPI)
- University of Indonesia
- Bandung Institute of Technology
- Bogor Agricultural University (IPB)[70]

3.8 *Jordan*

IP protection. Jordan joined the WTO in 1999, as the 136th member of the WTO. It became a member and signatory to TRIPS in April 2000. The Patents of Invention Law No. 32 was adopted in 1999. In 2001, Jordan signed the U.S.-Jordan Free Trade Agreement, which led to further IP reforms. Patents are issued by the Industrial Property Protection Directorate (IPPD) of the Ministry of Industry and Trade.[71, 72, 73]

Plant varieties are protected under the Plant Varieties Law No. 24 of 2000. Jordan acceded to UPOV in October 2004.

In 2004, Jordan granted four patents to residents of Jordan and 56 patents to foreign residents.

Ownership. Jordanian law is flexible in its approach to commercializing technology developed in public sector institutions. Currently, a high-level comprehensive review is underway of all relevant legislation and supporting regulations to outline areas that could be improved by an explicit act promoting commercialization. This legal and regulatory review will lead to specific improvements in their technology transfer infrastructure.[74]

Institutional capacities. Few universities or research organizations have had time to adapt to the new IP legislation, and thus far only the Royal Scientific Society, the premier government research institution, reports having established its Technology Transfer Centre.[75]

3.9 *Kenya*

IP protection. The application of IP regimes is not deeply rooted in the history of Kenya or in other countries of eastern Africa, and the country has typically responded to colonial influence or international developments. Kenya first introduced its Patent Registration Ordinance in 1914, which was modeled and dependent upon the British system. However, the Industrial Property Act of 1989 established the first independent patent system in Kenya. Kenya joined the WTO and became signatory to TRIPS in 1995. The 1989 Act was superseded by the Industrial Property Act of 2001, which set up the Kenya Industrial Property Institute (KIPI)[76] as an autonomous office to administer patents, utility models, trademarks, and service marks. Section 26 of the Industrial Property Act includes standard TRIPS exemptions from patentability: methods for treatment of human or animal, diagnostic methods, any drugs or compounds necessary to combat threats to public health, and plant varieties.[77]

PVP was established in 1972 by the Seeds and Plant Varieties Act and implemented under the Seeds and Plant Varieties Regulations of 1994. Kenya acceded to UPOV in 1999 under the terms of the 1978 Act. PVP is administered by the Kenya Plant Health Inspectorate Service (KEPHIS), under the Ministry of Agriculture and Rural Development.[78]

In 2001, Kenya granted no patents to residents of Kenya and 33 patents to foreign residents. That year just two applications were received from residents of Kenya.[79]

Ownership. A national policy for IP ownership, beyond that stipulated in the employment and inventorship clauses of the *Industrial Property Act,* is largely irrelevant because public sector research institutions make up most of the R&D infrastructure in Kenya. Many were founded with a mandate for conducting innovation and product development, since R&D is almost nonexistent in the private sector. Thus, public institutions are neither prohibited nor mandated to take ownership; they are left to themselves to adopt institutional policies and capacities to assert ownership, as long as the institutions operate according to the basic requirements of national IP law.

Institutional capacities. The development of institutional IP management capacity has been motivated partly by reports that the University of Nairobi, the premier university in Kenya, has had to forego IP rights for some innovations due to a lack of clear policy and structures. These innovations included a fermented milk product, a beer product, a disease-resistant pea variety, a pesticide compound, a database of medicinal plants, and a potential AIDS vaccine.[80] The following research institutions are currently engaged in developing IP policies and creating IP offices:

- University of Nairobi has recently adopted an IP policy that establishes an internal TTO.[81]
- Moi University has established Moi University Holdings Ltd., a fully owned subsidiary with a TTO to manage the university's intellectual property.[82]
- Jomo Kenyatta University of Agriculture and Technology (JKUAT) has drafted an IP policy and employs one IP manager.
- At Kenya Agricultural Research Institute (KARI) a legal officer manages intellectual property.
- The International Livestock Research Institute (ILRI) adopted an IP policy in 1998 and has an IP office at its Nairobi center.[83, 84, 85]

3.10 *Malaysia*

IP protection. Malaysia instituted a range of IP laws in the 1980s, including the Patents Act of 1983 (Act No. 291). The Patents Act has been amended several times, both before and after Malaysia joined the WTO and signed TRIPS in 1995. The Patents Act excludes from patentability the same life-science subject matter excluded in TRIPS, including plant and animal varieties, essentially biological processes, and methods of medical diagnosis and treatment. Since the 1983 Act, Malaysia has allowed product patents on pharmaceutical and agricultural chemical compounds. The Intellectual Property Corporation of Malaysia Act of 2002 (Act No. 617) established the Intellectual Property Corporation of Malaysia as the new patent office. Malaysia joined the PCT in August 2006.[86]

The Protection of New Plant Varieties Act of 2004 (Act No. 634) is largely compliant with UPOV, even though Malaysia has not yet joined UPOV.[87]

In 2003, Malaysia granted 31 patents to residents of Malaysia and 1,542 patents to foreign residents.[88]

Ownership. Under the Patent Act of 1983, employers, including publicly funded research institutions, are the rightful owners of intellectual property created by employees in the course of employment. However, there have been recent ministerial examinations of IP ownership issues in cases where government funding is involved. In 2003, the government announced the Second National Science and Technology Policy, which included the following clauses:

- "*to promote adoption of sound research management practices including intellectual property management and commercialisation of research outputs in all PRIs [public research institutes] and universities.*"
- "*to enhance the management of intellectual property rights including patent advisory and other services.*"
- "*to review existing legislation or to develop new legislation related to policy.*"[89]

In 2004, Malaysia's Ministry of Science, Technology, and Innovation (MOSTI), at the prompting of the prime minister, began a review of incentive systems to attract and retain Malaysian scientists, including the availability of R&D facilities, financial assistance, and venture capital.[90]

The Ministry also considered IP policy options similar to those in the United States under the Bayh-Dole Act.[91] The government then indicated that it would instead pursue a policy of three-way IP rights sharing: the government, research institute, and inventor would all jointly own research results.[92] In a March 2006 announcement, the head of MOSTI announced, "*research work undertaken with government grants should be jointly owned by the Government, the respective university, as well as the scientists involved.*"[93]

Institutional capacities. Most universities and institutes established their internal IP policies under the Patent Act of 1983, asserting institutional ownership of inventions made by employees and managing them accordingly. Currently, 17 out of the 45 or so universities in Malaysia have established TTOs.[94] IP management offices found at leading universities and research institutes include:

- University of Malaya's Technology Transfer and Commercialization Unit (UPTK) was founded in 1998 as part of the university administration, but in 2001 it was transferred to the university's Institute of Research Management and Consultancy (IPPP), which handles the full range of research interactions with industry.
- At Universiti Sains Malaysia (USM), the Research Creativity and Management Office (RCMO) handles many issues related to R&D relations with industry, including IP marketing.[95] Some aspects of patenting and commercialization are also handled by the Corporate and Sustainable Development Division (BPLK).[96]
- Univeristi Teknologi Malaysia (UTM) is the premier engineering institute in Malaysia. In 1993, the university created a Bureau of Innovation and Consultancy to promote technology commercialization within its Research and Consultancy Unit, which has managed research relations with industry since 1981.[97]
- Universiti Malaysia Sarawak (UNIMAS) has recently established the new Intellectual Property and Commercialization Unit (IPMCU) within the university's Research and Innovation Management Centre (RIMC), which was formed in 2005 out of the previous Research Management Unit established in 2003.[98] Some IP commercialization services are also offered by the Centre for Technology Transfer and Consultancy (CTTC), formed in 1993 to facilitate collaboration between university experts and local industry.[99]
- The Malaysian Palm Oil Board (MPOB) has been one of the most successful organizations in the country in using intellectual property to commercialize technology.[100] MPOB offers an extensive list of technologies available for transfer and commercialization, with licensing managed by the Licensing and Enforcement Division.[101, 102, 103]
- The Malaysian Agriculture Research and Development Institute (MARDI) has a sizable technology transfer and commercialization unit and list of technologies available for transfer and commercialization.[104, 105]

3.11 *Mexico*

IP protection. Mexican patent law has been in place since the early 1800s. Today, intellectual property protection is governed under the Industrial Property Law, adopted in 1994 and amended in 1997 and 1999.[106] Mexico joined the WTO and signed TRIPS in 1995. Mexico's Industrial Property Law excludes from patentability any essential biological process for the production, reproduction, and propagation of plants and animals; biological and genetic materials as found in nature; animal species; the human body and its living components; and plant varieties.[107] Patents are administered by the Mexican Institute for Industrial Property (Instituto Mexicano de la Propriedad Industrial).[108]

Mexico protects plant varieties through the 1997 Federal Law on Plant Varieties (Ley Federal de Variedades Vegetales), under regulations implemented in 2000 by the Ministry of Agriculture. Mexico joined UPOV in 1997, but joined under the terms of the 1978 Act.[109]

In 2004, Mexico granted 162 patents to residents of Mexico and 6,677 patents to foreign residents.[110]

Ownership. In Mexico, Article 163 of the Federal Labor Law (Ley Federal del Trabajo), adopted in 1970 and reformed in 1998, governs the ownership of inventions made by employees.[111] The law indicates that results of research are owned by the employer, who has the right to exploit patents. The employee, however, is to be given additional compensation, and in some cases the right of ownership. In all cases, the employee's name is listed as inventor. The Industrial Property Law, Article 14, reflects these protections of the employee. The 2002 Law of the National Council of Science and Technology (Ley de Ciencia y Tecnología), Articles 47–59, discusses invention ownership in cases where the national science council (CONACYT) finances research and development in universities or any other nongovernmental organizations and in the 60 or so public research institutes and agricultural R&D centers in Mexico. In both cases, the ownership of the results is determined according to the policies of the organization where the research is carried out. Many organizations, like universities and large companies, have policies that indicate that the ownership of research results goes to the institution, but in most cases the inventor will get some share of the financial benefits. Usually in the case of universities, the researchers are named as the inventors on the patent but sign full ownership rights over to the university. Within universities, the distribution of benefits follows the terms of an internal agreement or institutional policies.[112]

Institutional capacities. Development of institutional IP policies and discrete offices of IP management is minimal, but includes the following:

- At the National Autonomous University of Mexico (UNAM), the General Counsel's Office oversees IP policy and management. However, according to a critique in *Nature Biotechnology*, "*there is no support, even at the university level, for patenting: the level of technology transfer is low… UNAM has neither sufficiently trained personnel, nor, apparently, the interest to fight for its share on the patents.*"[113]
- Instituto Tecnológico de Estudios Superiores de Monterrey (ITESM) has engaged in several projects involving technology transfer in aerospace and expert systems engineering
- CINVESTAV is engaged in a number of biotechnology projects and has mediated transfers of proprietary biotechnologies.

3.12 *Philippines*

IP protection. IP protection has a somewhat deeper history in the Philippines than in some of its neighboring Asian countries. After achieving independence from the United States in 1946 at the end of World War II, the Philippines provided for the protection of inventions, utility models, and industrial designs under the Republic Act (No. 165) of 1947. Borrowing heavily from U.S. patent law, it provided 17 years of protection from the date the patent is granted and recognized priority based on "first to invent." The Philippines joined the WTO at its founding in 1995 and became a signatory to TRIPS. IP law was brought into compliance with TRIPS provisions in 1998 with Republic Act (No. 8293), the Intellectual Property Code of the Philippines. This changed patent terms to 20 years from date of filing and recognized priority based on first to file. The Act also created the Intellectual Property Office of the Philippines. In accordance with TRIPS provisions, the Act treats as non-patentable plants, animals, and essentially biological processes for the production of plants and animals.[114]

Republic Act (No. 9168) of 2002, titled Act to Provide Protection to New Plant Varieties, provides for sui generis protection of plant varieties and established the National Plant Variety Protection Board. The Philippines is not a member of UPOV.[115]

In 2003, the Intellectual Property Office of the Philippines granted 11 patents to residents of the Philippines and 1,160 patents to nonresidents.[116]

Ownership. The Philippines has no enabling legislation to give ownership of inventions to universities or research institutes, effectively leaving them free to develop their own institutional IP ownership policies.

Institutional capacities. Policies and offices for IP management are being developed both centrally and at leading research institutions:

- The Department of Science and Technology (DOST) has developed IP guidelines and the Technology Application and Promotion Institute (TAPI) to provide centralized services in technology transfer for pubic institutions.[117]
- A central University Intellectual Property Office (UIPO) for the University of the Philippines was established in 1997 to coordinate offices at its six semiautonomous campuses.[118, 119]
- IP and technology transfer needs of faculty at the University of the Philippines, Diliman campus, is served by an intellectual property section within the Research Dissemination and Utilization Office (RDUO) of the Office of the Vice Chancellor for Research and Development.
- The University of the Philippines, Manila, the main medical research university, has an intellectual property rights office in the Office of the Vice Chancellor for Research.
- The University of the Philippines, Los Baños, has an intellectual property rights office in the Office of the Vice Chancellor for Research and Extension.
- The Philippine Rice Research Institute (PhilRice) of the Department of Agriculture created a TTO in 2004.
- The International Rice Research Institute (IRRI) adopted an IP policy in 1994 that specifies that IP protection will only be used selectively to serve the needs of farmers in developing countries. IRRI coordinates intellectual property for some biotech projects for other institutions with which it partners.

Thus far, only a few dozen patents have issued to public sector institutions in the Philippines.[120]

3.13 *Poland*

IP protection. Poland's IP system is relatively mature, with the Polish Patent Office formed in 1918. However, the intervening years of socialist government had some effects, with Poland joining the PCT only in 1990. Poland became a signatory to TRIPS along with WTO membership in 1995. The Industrial Property Law of 2000 (in force since August 2001) brought Polish patents and trademark law into compliance with TRIPS, and its amendment in 2002 brought Polish law into harmony with E.U. directives on biotechnology intellectual property, including patentability of biological materials, methods, and uses.[121]

The Law on Seed Industry of 1995 conforms to UPOV, of which Poland has been a member since 1989.[122]

In 2004, Poland granted 778 patents to residents of Poland and 1,016 to foreign residents.[123]

Ownership. The Industrial Property Law, Article 11(3) stipulates that an employer or a contractor is the rightful owner of an invention produced under work for hire or contract, unless otherwise agreed upon by the parties involved. This gives universities flexibility to arrange for ownership through terms of employment and research agreements.[124] In recent years the Polish government has been shifting R&D spending away from relatively inefficient industry research institutes and state-owned companies and toward universities.[125] This shift in funding, however, has not been accompanied by any new policy specifically affirming or denying institutional ownership of IP rights resulting from research conducted with state funds.

Institutional capacities. In practice, universities own the intellectual property resulting from research they conduct.[126] IP management offices in Poland are still developing and are found mostly at the leading universities, including:

- The Wroclaw Center for Technology Transfer (WCTT) formed in 1995 at the University of Wroclaw.[127]
- The Technology Transfer Center (Centrum Transferu Technologii - CTT) formed in 1997 at the Cracow University of Technology.
- The Centre of Innovation, Technology Transfer, and University Development

(CITTRU), formed in 2003 at Jagiellonian University.[128]

- The Technology Accelerator and the Innovation Center at the University of Lodz[129] formed in 2003 through a mentoring collaboration involving technology commercialization and entrepreneurship established between the University of Texas at Austin and the University of Lodz. This was an offset commitment under an agreement between Lockheed Martin and the Polish Government for the purchase of F-16 fighters.
- Poland has four regional Innovation Relay Centres (IRCs) hosted at university technology centers, such as the IRC South Poland, which is coordinated by the CTT at Cracow University of Technology.[130] The IRC Network was established by the European Commission in 1995 and now consists of 71 regional centers throughout Europe. It seeks to support innovation and transnational technology cooperation through coordinated activities and a common technology database.

3.14 *Russia*

IP protection. Russia has a history of intellectual property that dates to the time of the czars. The first patent law was adopted in 1812, and then reformed in 1896.[131] During the Soviet period, the State effectively exercised monopoly power over all technological innovations, including those arising from universities and research institutes, with a Committee on Inventions and Discoveries issuing authorship certificates to inventors.[132] In 1991, the U.S.S.R. Law on Inventions radically departed from the Soviet system, creating a form of patent protection that gave exclusive rights of ownership to inventors. In 1992, following the establishment of the Russian Federation, a range of IP legislation was adopted, including the Patent Law of 1992. The Committee for Patents and Trademarks was created, and in 1996 it was changed to the current Federal Service for Intellectual Property, Patents, and Trademarks or ROSPATENT.[133] In 2003, the Patent Law was amended to bring it into alignment with the provisions of TRIPS.[134] As of 2006, the Russian Federation is still only an observer to the WTO and is thus not bound to compliance with TRIPS.

The Russian Federation provides for PVP under the Law on Protection of Achievements in Plant Breeding, adopted in 1992 when the range of new IP legislation was introduced. In 1998, Russia became a member of UPOV under the terms of the 1991 Act.[135]

In 2005, Russia issued 19,447 patents to residents of Russia and 3,943 to foreign residents.[136]

Ownership. Attempts were first made to clarify the question of ownership by public research organizations in 1998 with the Decree of the President No. 863 "*On state policy for the introduction of the results of scientific and technological activity and objects of intellectual property into economic turnover,*" and implemented in 1999 by Resolution No. 982 "*On the use of the results of scientific and technological activity.*"[137, 138] While stating in principle that a research organization might take IP rights over inventions made under work funded by the federal budget, in effect, the policies gave the Russian government first right to any intellectual property by giving the government rights to any military, dual-use, or other technologies deemed "*of use to the State,*" and by requiring all inventions made under federal funding to be recorded with the federal government. These conditions meant that very few publicly funded inventions were reported and that few patents were sought through official channels.[139] A fundamental shift in the government's position, which provided clarity over the rights of the organization conducting the research, only came about in the 2003 revision of the Patent Law. Article 9 states that the right to patent an invention created under state funding belongs to the contracted research organization, unless the research agreement specifies that the right belongs to the government.[140]

Institutional capacities. Despite the State centralization and lack of formal IP rights under the Soviet system, some attention was paid to developing mechanisms for the administrative management of technology transfer at the institutional level. While technology transfers were free of charge, they did occur between public research

organizations and state companies in the Soviet Union and in other Soviet bloc nations.

As a result, a significant number of universities and research institutes today have well-developed technology transfer policies and offices in place. In addition, a number of private, third-party companies and centers have emerged to coordinate technology transfer services for multiple clients, including universities, institutes, and companies, within particular regions or particular fields of technology. Leading examples include:

- the intellectual property and technology transfer department of the St. Petersburg State University, founded in 1967 as the Patent and Licensing Department (PLD) of the university[141]
- the Puschino Center for Technology Transfer of the Puschino Scientific Center[142]
- the Innovation and Technology Center of the University of Nizhny Novgorod[143]
- the Patent Service Center of the Saratov State University[144]
- the Obninsk Center for Science and Technology, which manages technology transfer and business development projects for the Institute of Physics and Power Engineering (IPPE), as well as for R&D centers in the Russian Ministry of Atomic Energy and the Russian Ministry of Science and Technology. [145]
- the Urals Regional Technology Transfer Center [146]
- the Southern Center for Technology Transfer [147]

In 2005, a professional association for technology transfer was launched in Russia and other former Soviet republics, called the Eurasian Association of Technological Transfer Managers (EATTM).[148]

3.15 *South Africa*

IP protection. IP law in South Africa historically derives from U.K. law. South Africa's first Patents Act (No. 37) of 1952 was modeled on the British Patents Act of 1949.[149] It was superseded by the Patents Act No. 57 of 1978, which is in force today, though amended at least eight times.[150] South Africa signed the TRIPS agreement in 1995. Patent Amendment Act No. 58 of 2002 was largely responsible for bringing the provisions of the Patents Act into line with TRIPS requirements. The Act excludes from patentability "any variety of animal or plant or any essentially biological process for the production of animals or plants."[151] Patents in South Africa are administered by the Companies and Intellectual Property Registration Office (CIPRO).[152]

Plant varieties are protected in South Africa under the Plant Breeder's Rights Act No. 15 of 1976. South Africa became a member of UPOV in 1977 and still adheres to the 1978 Act.

In 1995, the last year in which data was reported to WIPO, 5,549 patent applications were received from residents of South Africa, and 5,501 patent applications were received from foreign residents.[153]

Ownership. The patent law of South Africa contains IP ownership terms typical of many countries, but it does not detail public sector employers' rights of ownership or provide terms for publicly funded research.[154] However, a national policy for the ownership of patent rights by public research organizations is currently in development.[155] In the absence of such policies, the question of ownership has historically been shaped by institutional IP policies. But these are not uniform across or within institutions. While most universities prefer to take ownership of intellectual property whenever possible, a relatively high level of their research funding (about 58%) comes from industry contracts, which typically stipulate industry control of IP rights resulting from the funded project.[156] As a result, most universities maintain flexible policies and relinquish ownership of intellectual property as needed to obtain industry research funding.[157]

The National R&D Strategy of 2002 contained language recommending improved protection and commercialization of intellectual property from public research.[158]

In 2006, draft legislation embodying these recommendations was proposed: the Framework for Intellectual Property Rights from Publicly Financed Research. The Framework is largely modeled on the U.S. Bayh-Dole Act. It seeks to

unify IP policies across different government agencies that fund R&D and gives primary rights and responsibilities over intellectual property to the funded research organization. The draft legislation also retains certain privileges for the government to use protected technologies and gives preference for licensing to domestic companies.[159]

Institutional capacities. In order to support their important funding relationships with industry, a cadre of elite research universities in South Africa has developed significant IP policies and internal capacities for IP management. These include:[160]

- University of Stellenbosch has a technology transfer officer in the Office of Research and has established Unistel, a wholly owned subsidiary, to commercialize research through start-up companies.
- University of Cape Town (UCT) has a well-developed IP policy and an office called UCT Innovation with a staff that handles a range of activities, including management of research contracts, protection of intellectual property, and technology commercialization and entrepreneurship.
- University of Pretoria and the Council for Scientific and Industrial Research (CSIR), the national research agency, have collaborated to form a private company, the Southern Educational Regional Alliance (SERA) Ltd., to handle licensing and commercialization for both institutions.
- The South African Medical Research Council has a technology commercialization unit called the MRC Innovation Centre.[161]

With the pending advent of the Framework, the government has also proposed a centralized office, the Innovation Fund Commercialization Office (IFCO), to assist public institutions with IP management and to help cover some of the costs associated with IP protection.[162]

In 2002 a regional association for technology transfer professionals was launched, called the Southern African Research and Innovation Managers (SARIMA).[163]

3.16 *Tanzania*

IP protection. Like other east African countries, Tanzania inherited a colonial IP system from the U.K., including the Patent Registration Ordinance 217 of 1931. The patent ordinance was superseded by the Patent Act No. 1, adopted in 1987 and implemented in 1994. Tanzania joined the WTO and became signatory to TRIPS in 1995, but under the terms for developing countries it had until 2006 to become fully compliant with its provisions. In 1997, under the Government Executive Agencies Act No. 30, the Business Registrations and Licensing Agency (BRELA) was established to administer industrial property. Tanzania has been a member of the African Regional Industrial Property Organization (ARIPO) since 1983.[164, 165]

Tanzania is not a member of UPOV, but in compliance with its obligations under TRIPS, it adopted the Plant Breeder's Right Act No. 22 in 2002 to provide protection for new plant varieties.[166]

In 1989, the last year for which data were reported, Tanzania granted 23 patents, all to foreign residents.[167]

Ownership. Similar to other African nations, the Patent Act serves as the policy for IP ownership. Public sector research institutions make up most of the R&D infrastructure in Tanzania; private sector R&D is almost nonexistent. The public institutions are neither specifically prohibited nor mandated by law to take ownership, but are left to adopt institutional policies and capacities to assert any ownership under the terms of national IP law.

Institutional capacities. Several of the leading universities and research institutes have taken the first steps to establish institutional IP policies and are just beginning to set up IP management offices:[168]

- Sokoine University of Agriculture, the first institution in Tanzania to develop an institutional IP policy, adopted in December 2003
- Dar es Salaam Institute of Technology
- Tanzania Industry Research and Development Organization
- Tropical Pesticides Research Institute

3.17 *Uganda*

IP protection. After independence in 1962, Uganda maintained a patent system inherited from the U.K. until the Patents Statue No. 10 was adopted in 1991. Subsequently, the Patents Act, Chapter 216 was passed and regulations were implemented in 1993. Section 3 created the Office of the Registrar of Patents and a patent registry office to administer the granting of patents. Uganda was a founding member of the WTO and became signatory to TRIPS in 1995. The Patents Amendment Act No. 7 of 2002 brought Uganda into the PCT mechanism, but Uganda is still developing legislation to bring patent law into full compliance with TRIPS. Uganda has been a member of the African Regional Industrial Property Organization (ARIPO) since 1978.[169, 170]

Although not a member of UPOV, Uganda is a member of the Organization of African Unity (OAU), which has advocated a separate set of standards for PVP in African countries. Uganda passed the Agricultural Seeds and Plants Act in 1994 to provide for the registration of new plant varieties.

In 2001, Uganda granted no patents to residents of Uganda and 34 patents to foreign residents. That year only two patent applications were received from residents of Uganda.[171]

Ownership. No specific requirements, constraints, or distinctions are made in Ugandan law regarding the ownership of intellectual property by public sector research institutions or ownership of intellectual property from work funded by the Ugandan government. As such, universities and research institutes are left to adopt institutional policies and capacities to assert IP ownership under the terms of national IP law.

Institutional capacities. IP management in Ugandan institutions is, at best, embryonic, with the following developments reported for the country's leading research institutions:[172]

- The Uganda National Council for Science and Technology (UNCST) has plans to develop an IP management policy and office that could serve as a central advisor on IP management issues for R&D institutions that lack such capacity.
- The Ugandan Industrial Research Institute, which is very active in collaborating with local industry, has a single liaison officer in charge of IP issues.
- Makerere University, the oldest and largest university in Uganda, has no IP management policy or office.

3.18 *Vietnam*

IP protection. Chapter II of Part Six of the Civil Code of 1995, on intellectual property and technology transfer, covers industrial property and was the first legislation to introduce IP protections and include basic TRIPS provisions. Decree No. 63/CP of the Government, promulgated in October 1996, contained detailed regulations concerning Industrial Property.[173] Enacted in November 2005 and entered into force in July 2006, the new Intellectual Property Law has introduced comprehensive TRIPS-compliant IP standards, with the decrees and circulars needed to implement this law likely to be out by the end of 2006.[174] Vietnam entered into a bilateral free trade agreement with the United States in 2004, which obliges it to protect U.S. intellectual property. Vietnam also joined the WTO in December 2006, bringing with it the formal commitment to comply with TRIPS obligations.

Vietnam introduced PVP in 1995. However, only the new Ordinance on Plant Varieties of March 2004 made it a workable system. PVP is also included in the new Intellectual Property Law of 2006. Vietnam's membership in UPOV is slated for late 2006.[175]

In 2005, Vietnam issued 17 patents to residents of Vietnam and 756 to foreign residents.[176] So far, only about 14 instances of PVP have been granted in Vietnam, almost all going to foreign entities. There are currently 18 new applications for PVP, with some coming from domestic companies and universities.[177]

Ownership. In general, property rights are still weak in Vietnam. There are few mechanisms in Vietnam to clarify and ensure the rights of ownership over technology created at universities and research institutes.[178] The situation is further complicated because, despite

increasing autonomy, universities are still in many respects regarded as part of the State apparatus.[179] Industry is also still in the process of being privatized, and in most cases the State still holds a large minority stake in, if not outright control of, private companies.

Institutional capacities. Currently, university researchers and administrators in Vietnam do not have much understanding of intellectual property. Their organizations largely lack IP management capacity, although some are beginning to seek patents and plant variety protections. Leading research institutions in the life sciences are beginning to orient toward intellectual property as a tool for technology transfer. These institutions include:

- The Institute for Biotechnology of the Vietnam Academy of Science and Technology, which does not yet have a formally adopted IP policy, has registered about 20 patents. Inventions and royalty distributions are decided on a case-by-case basis.
- Hanoi Agricultural University's Science Management Office has handled IP issues for its researchers. Estimates are that university faculty members have registered three or four patents and six to seven trademarks, largely on new crop varieties.[180]
- The Institute of Agricultural Genetics of the Ministry of Agriculture and Rural Development states that technology transfer is an important goal of new research projects, particularly technology transfer to farmers, but it has not registered intellectual property over any inventions.
- The University of Technology of Hanoi: In the last five years, 20 of the leading technical and agricultural universities in Vietnam have signed 13,000 contracts worth VND 1,188 billion (approximately US$74 million). From 2000 to 2004, 22 Technology and Equipment Fairs, called Techmarts, were held in Vietnam, through which universities and research institutes sold more than 2,000 technology contracts worth up to VND 4,000 billion (approximately US$250 million).[181]

4. TRENDS AND CONCLUSIONS

The 18 countries examined above provide a representative cross-sampling of emerging and developing economies. They represent an enormously broad cultural, social, and economic landscape. Still, trends are discernable in the three areas reviewed: the availability of IP protections, the ownership of intellectual property over publicly funded research, and the institutional exercise of IP rights.

4.1 *Trends in IP protection*

Trends in the availability of IP rights follow several fundamental determinants. The first is the domestic science and technology capacity in the public and private sector and the level of economic development, both of which serve to drive the formation of IP policies and the use of the IP system by residents. A second and somewhat correlated determinant is the history of IP laws within the country; this factor is more difficult to measure than the first. Some countries have had systems in place for over a century, particularly in Europe (Russia and Poland) and those that were major European, and particularly British, colonies (India and South Africa). This leaves a legacy of IP practices, even if IP rights have not been extensively used or enforced. Third, national agreements, in particular TRIPS and UPOV, have driven IP legislation in virtually every country reviewed.

Roughly three tiers emerge when gauging the robustness of domestic IP systems (Table 1). The first tier consists of a handful of countries that have functioning IP policies and institutions, along with substantial numbers of domestic patent applications. These countries include the most-advanced innovators among emerging and developing economies, such as Brazil, China, India, and Russia.

These countries all generate something in the range of 3,000 to 30,000 science and engineering articles per year. Their national patent offices grant 1,000 to 30,000 patents per year. Crucially, residents account for at least 50% of patent recipients, signifying a significant level of domestic innovation that is generated by national IP systems.

Table 1: Determinants and Indicators of the Status of National IP Systems

	Country	Per capita GDP by PPP, 2005[182]	Number of science & engineering articles, 2003[183]	Number of globally top-ranked universities[184]	Date of first patent law	Date joined TRIPS	Date(s) patent law amended for TRIPS compliance	Date of PVP law	Date joined UPOV	Patents to residents/ patents to foreigners (yr)	Ratio of resident to foreign
	United States	**41,399**	**211,233**	**168**	**1789**	**1995**	**-**	**1930**	**1981**	**84,271/80,020 (2004)**	**1.05**
TIER 1	Russia	11,041	15,782	2	1812	-	2003	1992	1998	19,447/3,943 (2005)	4.93
	China	7,198	29,186	8	1984	2001	1992, 2001	1997	1999	18,241/31,119 (2004)	0.59
	South Africa	12,161	2,364	4	►1925	1995	2002	1976	1977	5549[A]/5501[A] (1995)	1.01
	Poland	12,994	6,770	3	►1925	1995	2000	1995	1989	778/1,016 (2004)	0.77
	India	3,320	12,774	3	1856	1995	1999, 2002	2001	-	851/1,466 (2004)	0.58
	Brazil	8,560	8,684	4	1809	1995	1996–1997	1997	1999	666/1,366 (2002)	0.49
TIER 2	Argentina	14,108	3,086	1	►1875	1995	1996–2001	1973	1994	145/1,442 (2000)	0.10
	Mexico	10,186	3,747	1	►1850	1995	1997,1999	1997	1997	162/6,677 (2004)	0.02
	Chile	11,936	1,500	1	►1850	1995	2005	1997	1996	32/569 (2000)	0.06
	Indonesia	4,459	178	0	1989	1995	1997	2001	-	16/615 (1996)	0.03
	Malaysia	11,201	520	2	1983	1995	2000	2004	-	31/1,542 (2003)	0.02
	Jordan	5,095	263	0	1999	1999	1999, 2001	2000	2004	4/56 (2004)	0.07
	Vietnam	3,025	216	0	1995	2006	2005	2004	2006	17/756 (2005)	0.02
	Philippines	4,923	179	0	1947	1995	1998	2002	-	16/1,437 (2004)	0.01
TIER 3	Ethiopia	823	99	0	1995	-	-	2006	-	0/1 (2000)	0.00
	Kenya	1,445	258	0	1914	1995	2001	1972	1999	0/33 (2001)	0.00
	Tanzania	723	86	0	1931	1995	-	2002	-	0/23 (1989)	0.00
	Uganda	1,501	90	0	►1950	1995	-	1994	-	0/34 (2001)	0.00

[a] Patent applications filed.

The second tier contains the bulk of middle-income countries that have recently developed or improved their IP policies but that still grant most of their patents to foreigners. These include countries like Argentina, Indonesia, Malaysia, and Mexico. These countries have some research capacity, evidenced by the generation of 300 to 3,000 science and engineering articles per year. Their national patent offices are functioning, granting several hundred to several thousand patents per year. Crucially, however, domestic inventors are receiving less than 10% as many patents as foreigner applicants. Thus, the patent system is primarily being used to protect imported technologies. Still, companies and governments are typically seeking ways to better exploit the IP system's R&D efforts.

The third tier consists of the lowest-income countries, in which there is neither a strong IP system in place nor a great number of domestic patents applicants. These include countries like Ethiopia, Kenya, Tanzania, and Uganda. In this survey, all of the representatives of the third group are in Sub-Saharan Africa. These countries have little research or technological capacity, generating less than 300, and on average less than 100, science and engineering articles per year. Their national patent offices are not very active, granting less than 50 patents per year. Most significantly, no patents are granted to domestic inventors, only to foreigners.

4.2 *Trends in IP ownership policies*

On the question of ownership over inventions developed from government-funded research, policies appear to be converging on the practice of giving the rights and responsibilities of ownership to research institutions, with some flexibility for exceptions depending on the national context. This convergence typically stems from strengthening IP protections and/or increasing government spending on R&D, but it also grows out of an awareness of global policy trends and a desire on the part of governments to enhance the impact that their spending on R&D will have on economic development.

The mechanisms through which policies on ownership of intellectual property arise are more diverse (Table 2). These include:

- ownership clauses in patent law
- ownership clauses in labor law
- national R&D system laws
- ministerial rulings

In several countries (Jordan, Malaysia, South Africa) new policies are currently under review or exist in draft form. In a number of other countries, no explicit policy addresses IP ownership by universities or research institutes under public funding. In these cases, ownership questions are typically covered by the general ownership clauses of patent law, without specific reference to universities or research institutes, publicly funded R&D, or technology transfer.

4.3 *Trends in institutional IP management*

The more than 80 specific institutions named in this survey have all to some degree developed an IP policy and management infrastructure. They cover many of the leading research universities and institutes in the countries surveyed. Many more IP management programs, in hundreds of other emerging and developing countries, could not be mentioned here. Still, the range of strength and sophistication in this representative sample is vast. Some operations efficiently review hundreds of technology disclosures and file dozens of patent applications a year; in others, IP policy is in draft form and no action has been taken to implement an IP management system.

If anything, strong, sophisticated institutional IP management is most strongly correlated with the underlying determinants of scientific and technological capacity, including, most importantly, the amount spent annually on R&D at universities and in the public sector. Institutional IP management is more weakly correlated with the adoption of national-level policies explicitly encouraging IP ownership by public sector research institutions. In a number of cases, the practice of IP management has preceded policy changes governing IP ownership.

4.4 *Conclusions*

While the call for policy reforms modeled on the U.S. Bayh-Dole Act has been made around the world, the particular policy reforms and

Table 2: Specific Policies on Ownership of Intellectual Property Arising from Research Funded by the Government

	Country	Year	Policy specific to ownership of intellectual property
	United States	**1980**	**Patent law: ownership of inventions made under federal government funding (Bayh-Dole Act)**
TIER 1	Russia	2003	Patent law: ownership of inventions made under government contract
	China	1985 2002	State Council on Technology Transfer regulations Ministry of Education and Ministry of Science & Technology joint ruling: university ownership and transfer of intellectual property
	Poland	-	-
	South Africa	In process	Legislation on national research system: ownership of inventions made under government funding
	Brazil	1996	Patent law: ownership of inventions by employer, with terms of revenue sharing for public-sector employers
	India	2000	Ministry of Science & Technology ruling: ownership under ministry funding
TIER 2	Argentina	1990 1995	Law on national research system: universities and institutes establish TTOs Patent law: ownership of inventions by employer
	Mexico	1998 2002	Labor law: ownership of inventions by employers Law on national research system: ownership of inventions to be determined by policy of the institution
	Chile	1991	Patent law: section on university ownership and transfer of inventions
	Indonesia	2002	Law on national research system: universities and institutes to establish TTOs
	Malaysia	In process	Ministry review of incentive system for scientists, including ownership of intellectual property
	Jordan	In process	High-level commission review of all relevant legislation and regulations for technology transfer
	Vietnam	-	-
	Philippines	-	-
TIER 3	Ethiopia	-	-
	Kenya	-	-
	Tanzania	-	-
	Uganda	-	-

proposals exhibited in developing and emerging economies have varied. In some, the Bayh-Dole model is clearly discernible, but in many others the approaches to reform are more specifically adapted to local legal, political, and economic situations. Some national policies, such as those of China or those emerging in South Africa, clearly attempt to institute stronger IP protections in the economy and to emulate Bayh-Dole in the public sector. But many others merely make perfunctory efforts at conforming to TRIPS and only borrow the basic idea of encouraging institutional ownership of IP. Some national policies set institutional ownership and management of IP as the default option among several possible modes of technology commercialization. Others provide it as one alternative among multiple options, without a clearly defined preference. This survey noted one general trend: that strong IP protections and the institutional capacity to manage them grow in tandem, driven primarily by the amount of R&D being conducted and, secondarily, by the ability of the local economy to absorb new technologies into existing industry or an entrepreneurial sector. These insights may offer lessons for policymakers and practitioners seeking to use IP as part of an integrated strategy to drive economic development through the public financing and commercialization of innovation. ■

AUTHOR'S NOTE: By their nature, the policies and institutions reviewed in this chapter are constantly evolving and changing. The author invites any corrections, updates, and additional information, including policy studies or institutional case studies. New information will be used to update future reviews on this topic and may be added to the online version of the IP *Handbook* at www.IPHandbook.org.

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