Chapter 7
Intellectual Property, Standards

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7.1 Introduction

This chapter examines intellectual property and standards, two important elements of the innovation landscape. First to be highlighted will be intellectual property (IP), a set of rules and institutions designed to foster innovation and ideas. We will discuss different forms of intellectual property protection such as patents, copyright, trademarks, and trade secrets. The chapter will then discuss standards and their role in domestic innovation and in international trade. Standards have the potential to boost innovation, but also have the potential to stifle domestic industrial creativity.

7.2 Forms of Intellectual Property Protection[1]

Intellectual property (IP) is an idea, or a collection of ideas, produced in the expectation of direct or indirect economic gain. Intellectual property regimes are nation-level mechanisms designed to protect these ideas by assigning control over their use to their creator. Generally, governments are concerned about ideas in so far as they

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[1] This section relies extensively on Scotchmer (2005).

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are used to spur innovation and economic growth, and thus the implementation of IP regimes to protect those ideas will have a strong bias towards fostering economic growth.

There are four methods of formal intellectual property right (IPR) protection: patents, copyrights, trademarks, and trade secrets.[2] Patents and copyrights will form the bulk of the IP discussion in this chapter as they are the most complex forms of IP protection related to innovation and trade issues.

- *Patents* are offered to stimulate production of new ideas. They work by providing a limited-time right of exclusion to the creator of an idea. Violators of this right of exclusion often must pay a fine or other penalty to the owner of the idea. Patents must be applied for and must prove (a) patentable subject matter, (b) utility, (c) novelty, and (d) non-obviousness. Patents last twenty years from the date of filing.
- *Copyrights* are offered to stimulate expression. Protection is automatically given to any original work of authorship such as books, software, music, and movies. Copyright gives holders the right to copy, reproduce, distribute, adapt, perform, or display their works. Importantly, copyright allows creators of ideas to prevent others from selling reproductions of the original idea but does not prevent others from expressing similar yet distinct ideas. Copyright lasts for the life of the life of the author plus 70 years.[3]
- *Trademarks* refer to a distinctive word, phrase, symbol or design, or a combination of these that identifies and distinguishes the source of the goods of one party from those of another. Trademarks allow markets to function smoothly by supplying information to buyers. Trademark registration enables the registrant to exclude others from using the trademark in ways that could cause confusion in the marketplace.
- *Trade secrets* protect various types of firm-specific technical and business knowledge. They refer to confidential business information that provides an enterprise a competitive advantage. Trade secrets may include manufacturing or industrial secrets and commercial secrets such as production technologies, sales methods, distribution methods, consumer profiles, advertising strategies, and lists of suppliers or clients. Trade secrets are not registered, but are protected through security procedures and confidentiality agreements. Proof of violation requires evidence that information was obtained by improper means (e.g. industrial espionage). Trade secrets that are discovered accidentally (e.g. in the process of reverse engineering) are not protected.

Informal IPR protection includes the use of secrecy, complex routines, and speed in technological advancement.

- *Secrecy* refers to the ability to keep abstract or applied technical ideas secret. It is probably the most effective informal method for retaining intellectual property proprietary. Whether knowledge can be kept secret is a matter of the technology

[2] The legal details here are based on the U.S. model, but similar criteria apply in other nations.

[3] The importance of copyrights has increased tremendously in the era of the knowledge economy. In fact, various experts argue that the extensive attention on patents in the detriment of other forms of IP protection may be increasingly misguided (Wunch-Vincent 2013).

involved. If reverse engineering is relatively easy, then formal protection is necessary. Secrecy helps avoid the revelation of information to prospective competitors through published patents, thus, avoiding "inventing around" patents.
- *Complex routines* refer to the situation where competitive advantage consists of accumulated experience (routines). In such cases firms may consider themselves reasonably protected from imitators. This may be the case of established companies that deal with complex, systemic products.
- *Speed* refers to the practice of speedy development of ideas in rapidly changing technologies. By the time a competitor obtains the ability to copy an existing product or process, the IP owner has developed a more advanced product or process that diminishes the market importance of the first product or process.

Formal IP protection is based on legal measures. With the exception of trade secrets, all other forms of formal protection require the provision of detailed information about the object of protection. Inventors will rely upon them as long as the explicit and implicit costs of doing so appear justified by the potential benefits. Frequently they decide not to use formal protection in order to avoid revealing too much information. Informal protection thus seems to be used extensively.

7.3 Intellectual Property in the Innovation Ecosystem

Nations have separate sets of regulations to protect IP and physical property because they are fundamentally different types of valuable goods. Today's global economy is built largely off of the exchange of knowledge-based goods (Harris 2001; Powell and Snellman 2004; Godin 2005; OECD 2013). These are goods with significant value added from scientific research and the application of learning and technical ideas, and it is the knowledge behind these goods that is protected by IP regimes.

But how exactly are IP and physical property different? For one, knowledge is a cumulative good, that is to say that knowledge follows a path dependency (Malerba et al. 1999). A country may aspire to be world leader in nanotechnology, but if there is no prior accumulation of nanotechnology expertise in that country, then it will be difficult to innovate in that arena. In contrast, a country with a tradition of agricultural excellence likely is able to swiftly and efficiently adopt and adapt new agricultural techniques. A second characteristic of knowledge is that it is irreversibly transferrable; once someone learns something, that knowledge cannot be taken away. From an industrial standpoint, this means that personnel do not forget what they know when they move to a different company or country, and once a competitor understands a firm's internal processes, that understanding cannot suddenly disappear. Third, knowledge is subject to increasing returns to scale, meaning that outputs stemming from knowledge increase at a proportionally greater rate than an increase in inputs for its production. It is this characteristic of increasing returns that allows knowledge-based economies to be so dynamic.[4] Fourth, knowledge has high initial costs and much lower marginal costs of production (in some cases close to

[4] It is this feature of knowledge that underlies the explanations of economic advance of new growth theory discussed in Chap. 2 of this volume.

zero). Piracy of software receives so much attention exactly for this reason; it takes significant resources to create, and virtually no resources, training, or skills to illegally copy and resell. The same holds for music and many other knowledge-based goods.[5]

The major impact of IP, specifically patents, is in the ability of the owner of a piece of knowledge to appropriate rents stemming from the development and commercialization of that knowledge. In order for company A to invest in the creation of a new piece of knowledge (an invention), that company must have reasonable expectations that it can profit from the invention, and thus it wants to be sure that it can appropriate that invention and keep it private. Employees can jump to new firms and carry knowledge over with them and competitors can reverse engineer a finished good. Secondary parties then could exploit the knowledge company A paid to create.[6] As one of the characteristics of knowledge is high up-front costs for its production and low marginal costs for its reproduction, competing producers of products largely based on this specific piece of knowledge appropriated without proper payment to the owner are now at a huge cost advantage which can allow them to profitably undercut company A in the market.

It is critical that any IP regime be reflective of and incorporated into the overall innovative framework of a nation; it is not a stand-alone mechanism (World Bank 2010). For instance, there could be strong IP laws in a country, but if the legal system was not able to enforce those laws due to lack of resources, training, or enforcement authority, then it would be as if the laws did not exist; there would be no encouragement for innovation.

7.4 Intellectual Property and Development

The previous section asked what the role of IP in the innovation framework was. Now we ask a more nuanced question: what is the role of IP in the innovation frameworks of countries at varying stages of development? What does it mean to the global economy that in 2012, for the first time, China, not the US, held the top positions for both destination and source of patent filing? How do we interpret the recent spike in patent application filing abroad of BRICS origin?

Let's start from a basic idea, at the core of economic thinking since at least Arrow (1962). The economic rationale for IP protection rests on the trade-off between allocative efficiency and dynamic efficiency. Simply put, allocative efficiency means that, assuming no future inventions, the efficiency of the economic system is maximized by spreading knowledge around: everybody knows everything. Dynamic efficiency changes the basic assumption: if there is knowledge to be created and things to be invented in the future, then some sort of monopoly power expectation must be created to incentivize the necessary expenditure from individuals or organizations. In the extreme, allocative efficiency corresponds to the absence of IP protection. In

[5] For more details on knowledge as an economic input see Romer (1996), OECD (1996), Grandstrand (1999).

[6] Albeit at a cost. Research has shown that the costs of imitation vary across industries and across activities and can be significant. See Mansfield (1985), Mansfield et al. (1981), Levin et al. (1987).

contrast, dynamic efficiency requires such protection. The problem is that in actuality we need both: prospective inventors must have some guarantee of legal appropriability, whereas the economic system will progress with people other than the inventor eventually getting hold of the specific knowledge. Extant IPR regimes have sought the middle ground by providing monopoly rights for new patentable ideas but for a price and for a limited time period after which the knowledge becomes public.[7,8]

China Assumes Leadership

For the first time, China holds the top positions for both destination and source of patent filings. In 2012, for the first time, residents of China accounted for the largest number of patents filed throughout the world. In addition, State Intellectual Property Office (SIPO) of the People's Republic of China accounted for the largest number of applications received by any single IP office. Residents of China filed 560,681 patent applications; this compared with those filed by residents of Japan (486,070) and residents of the United States of America (US, 460,276). Similarly, SIPO received 652,777 applications, compared to 542,815 for the USPTO and 342,796 for the Japan Patent Office (JPO).

Source: World Intellectual Property Organization (WIPO) 2013 World Intellectual Property Indicators (Fig. 7.1)

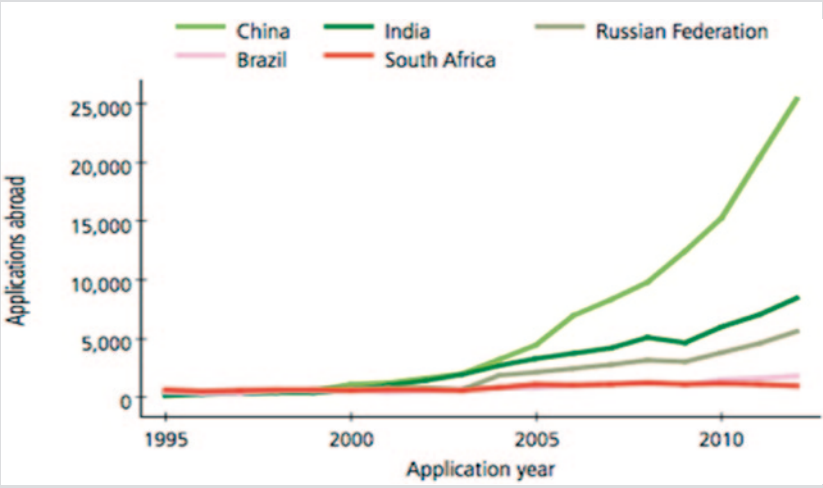

Fig. 7.1 Patents of BRICS Origin. (Source: WIPO Statistics 2013, p. 60)

[7] For an excellent historical exposition of how IPRs came to be and what they mean see David (1992).

[8] Other more esoteric issues are also relevant here and have been widely discussed by economists regarding the warranted strength of the patent system including the breadth of protection (how broad a patent is) and the number of claims on a single patent. We refrain from these topics herein.

In addition, one might ponder the question whether all countries need the same extent of intellectual property protection. In particular, could it be that countries at different stages of economic development would benefit from different degrees of protection? The answer may well be affirmative given that countries at the top of the development ladder base their competitiveness on the creation and application of state-of-the-art technologies based on advanced scientific research, whereas those on the other end often find it more profitable to concentrate limited resources to the identification, adaptation and adoption of extant technologies and broad dissemination of information (Lall 2003). In other words, advanced nations are expected to push for stricter IPR regimes focusing primarily on dynamic efficiency whereas lesser developed nations are expected to push for laxer IPR regimes as they are primarily concerned with allocative efficiency.

The question above proves, in fact, to be one with no easy answer. Intellectual property has different impacts on innovation for countries at varying levels of development largely because of trade. In less developed countries innovation occurs primarily through importation of technology from more developed nations (World Bank 2010). Firms engaged in selling technology in international markets want to be assured of protection for their investments, and most are more eager to sell in countries where a reasonable IPR regime is in place (Branstetter et al. 2005). The presence of a functioning IPR system is a strong market signal to prospective market entrants.

Are, then, countries that lack a reasonably functioning IPR regime effectively cut off from technology imports? Not at all, as firms will export technology in a format appropriate to a customer nation's level of absorptive capacity. Two characteristics determine absorptive capacity. The first is appropriability, which conditions technology transfer on the ability of domestic R&D concerns to incorporate foreign technology and learning into their own production processes. The second is usability, which argues that the level of technology imported depends on the level of development of the target country (Gibson and Smilor 1991; Javocik 2005; Park and Lippolt 2008). For example, a less developed nation may import semi-conductor technology in the form of finished computers (usability), but there might not be any domestic firms that could import the latest semi-conductor know-how and use it to develop a new computer themselves (appropriability). Firms, then, generally will export finished, high tech goods to areas with weak IP protection and are more comfortable exporting know-how in a country with stronger IP protection.[9] Know-how exports may be in the form of a factory or processing facility, or a collaborative venture with local firms, or outright licensing agreement.

Just as firms have determinants for the type of technology they are willing to export, developing countries have determinants for the type of technology that is imported. Less developed nations will see much more efficient outcomes by focusing on importing technology rather than creating the infrastructure to create it locally (WIPO 2011). Moreover, IP regimes that are too stringent for a developing

[9] Usability and appropriability are also time specific; as a country develops, its technology capacity changes. See the text box on South Korea's technology development.

nation may lead to technology-associated economic rents being directed to foreign firms (Ganslandt et al. 2005; World Bank 2010), thus decreasing the efficiency of a national system. On the other hand, developed nations will see much more efficient outcomes by pushing the boundaries of a technology through constant innovation (Abel et al. 1989). In this situation, strong IP regimes encourage domestic producers to invest in innovative activities by providing a more secure appropriability of rents.

Overall, the complex set of factors determining the transfer of technology from abroad include the country's IPR system, its position in the global value chain, the size of its existing or prospective domestic markets, and strong public policy preference.

7.5 Determining the Need for and Impact of Intellectual Property

Evaluating IP policy involves understanding the innovation ecology of one's country and the impact on the whole system. Broadly speaking, IP policy affects two populations to varying degrees. First, it affects those entities active in invention and innovation, such as firms, universities, and entrepreneurs. If the policy encourages innovation, and if innovation is associated with economic growth, then IP can affect the economic climate of the entire country. Determining if an IP policy is effective, therefore, involves more than just counting the number of patents, or relying on any single measure of impact. For example, Branstetter et al. (2005) point out that stronger IPRs will attract more technology investment from foreign firms, but that measurement alone does not tell us if the new investment is putting domestic firms out of business, leading to a trade imbalance, or over-burdening existing infrastructure. Second, consumers stand to be affected if stronger IP rules attract more foreign technology imports with the unplanned effect of pricing that technology out of the reach of the domestic consumer (Fink and Maskus 2005).

Developing nations face a clouded path to IP implementation. The pure allocative or dynamic efficiencies discussed earlier will not apply uniformly across their economies. Some areas of technological skill in a developing nation will be far from the cutting edge, while others might be much closer. The rapidly advancing BRIC nations—Brazil, Russia, India, and China—represent this middle ground on a grand scale. All of them, in various fields of technology, are innovative leaders and followers (Tseng 2009). From an IP policy standpoint, this is a difficult position to occupy and all four of these nations have tried varying forms of IP legislation in an effort to encourage simultaneously domestic innovation and foreign technology investment. The act of balancing domestic innovation needs and foreign IP requirements, while stimulating growth at home, have at times attracted sanctions or threats of sanctions from more developed nations (Bird and Cahoy 2007). In general, patent applications have been increasing worldwide with new patent offices emerging as key players such as China's State Intellectual Property Office (SIPO) (Figs. 7.2 and 7.3).

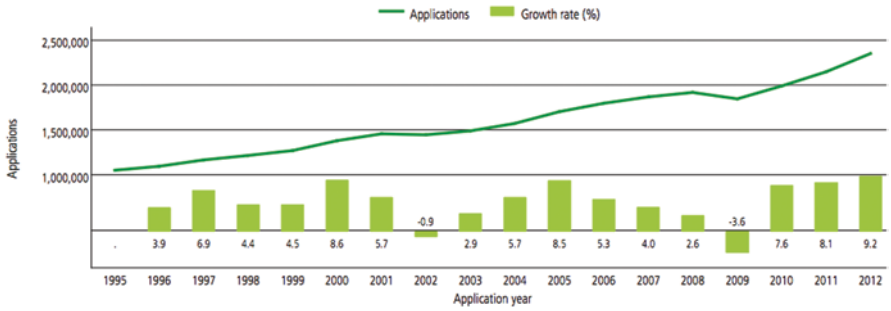

Fig. 7.2 Trend in patent applications worldwide (Source: WIPO Statistics 2013, p. 46) Trend in Patent Application for the Top Five Offices

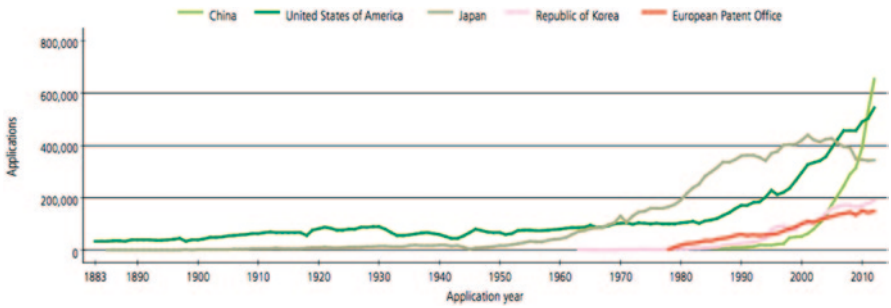

Fig. 7.3 Trend in patent applications for the top five offices (Source: WIPO Statistics 2013, p. 52)

Countries further away from the cutting edge of a technology may find it beneficial, or at least tempting, to relax IP rules and enforcement. While this increases access to knowledge from foreign sources and lowers the barrier to innovation for domestic producers, care must be taken that laws are enforced appropriately. Purposeful lax enforcement of strong rules or creation of weak rules that deliberately allow domestic firms to "legally" appropriate foreign technology can drive away foreign investment and technology and harm the domestic innovation landscape. For example, in the early 1980s, South Korean IP laws tacitly allowed for what essentially amounted to theft of foreign IP. In one instance, trademarks were considered valid only if the brand was familiar to most Koreans, a loophole that meant many foreign-made goods de facto lacked protection. The response of foreign technology suppliers was a round of steep trade sanctions (Ryan 1998).

As the above examples emphasize, designing an IP system that both encourages domestic innovation and supports the legal importation of foreign technology is difficult. It is critical for policymakers in these situations to understand the needs and capabilities of prospective domestic innovators and be able to revisit and rebalance the national IPR regime. The tools to do so are variable. Surveys are a useful tool because they assist in obtaining detailed information such as frequency of patents and copyrights, ease of obtaining IP protection, income generated from

IP-protected goods, whether IP owners consider the process a good investment of resources, manufacturing, marketing, or distribution problems solved or caused by IP, etc. Generally, it is not feasible to survey every entity involved in an innovation ecosystem, but making contact with as many business owners as possible, both innovators and those who use their innovations, is critical.[10]

Another method of determining the effectiveness of an IP policy is through analysis of patent data. Patents have the advantage of being a distinct, quantifiable phenomenon. Patent data can be broken down into a number of useful categories, such as: area of technology, location of inventor, location of owner if different from inventor, and previous knowledge on which the patent is based. The danger of patent data alone, however, is that it lacks context. Mowery and Sampat (2005) describe a good example of the need for context. In the US, there has been a surge in patenting by universities, which many interpret as validating the government's efforts to have universities participate more in the innovation process. But such an increase in patenting may be missing a possible long-term effect in decreased innovation as universities redirect their focus towards short term research.

IP Case—Korean Pharmaceutical Industry and Development

In the 1960s and 1970s, Korea, like many industrialized, developing nations, was building its technology base by copying mature foreign technology. With relatively cheap labor costs, Korean firms were able to produce these mature technologies for domestic and international consumption at competitive prices. As the nation developed economically, however, those labor costs rose. Sensing that this is hardly a long-term strategy, the country relentlessly tried to upgrade. In the 1980s, Korean firms began to manufacture more sophisticated, value-added technological goods with increased technological know-how coming from three sources: copying cutting edge foreign technology, increased spending on R&D, and a base of domestic technology experience developed from copying mature foreign technology.

Intellectual property became a concern for Korea in the 1980s. Prior to that period, the foreign technologies that Korean firms were able to copy were mature, with innovation coming mainly in the marketing and manufacturing processes and costs highly driven by worker wages. IP played a much smaller role in maintaining a competitive advantage then and, thus, foreign firms were less likely to block Korean firms from using that technology. However, once Korean firms began to create and copy more value-added products like pharmaceuticals, they came into more frequent conflict with foreign firms who owned the more advanced IP.

[10] Good examples of survey use regarding innovation are the OECD Country Innovation Policy Surveys. For further information see also WIPO (2013) and references therein.

The pharmaceutical industry in Korea grew very rapidly in the 1980s, and this was almost entirely due to the copying of foreign products. At first, Korea officially honored process patents, but not product patents, which allowed domestic firms to jump into high-tech manufacturing once a product's manufacture was deciphered. Meanwhile, Korea's trademark law only allowed trademarks for products that were well-known to the Korean people, thus tacitly allowing the copying of any foreign good. Foreign governments cried foul, and the Korean government created tougher laws. However, enforcement was notoriously lax, and the copying continued. By the end of the 1980s, nearly 90% of the Korean pharmaceutical market was supplied by domestic firms, a percentage much higher than equivalently developed nations at that time. Eventually, threats of sanctions from international partners forced the institution of real IP enforcement.

Today, Korea has a thriving pharmaceutical industry. Certainly, this path of development is not conducive to winning the trust of international partners. It is also important to not allow lax IP enforcement to undercut one's own internal development by de-incentivizing investment in domestic high-tech industries. The Korean experience provides lessons on both the balancing of IP enforcement and technology development as well as the trade problems associated with IP as a nation moves up the development curve.

Sources: Ryan 1998; UNCTAD 2003

The principal take-away is that IP is a necessary but complex policy tool implemented in a complex innovation environment. Not only does the national IPR regime need to be calibrated to encourage domestic innovation and remove barriers to the spread of new technology but, for developing nations especially, it must provide foreign technology providers with confidence that their knowledge investments will be safe. This is a difficult path to navigate, and requires policymakers to pay careful attention to the creation and implementation of laws and institutions. Hence, the efforts of both developed and developing countries to protect their patents in major markets. The figure below shows that the US is still the main destination for filing for top five origins and BRICS origins (Fig. 7.4).

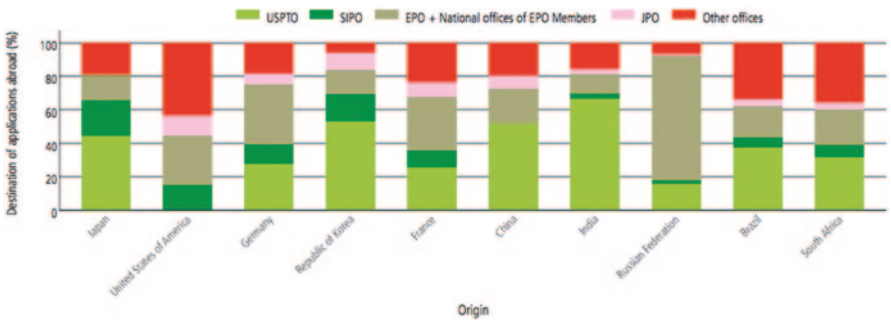

Fig. 7.4 Destination of applications abroad for the top five origins and BRICS origins, 2012 (WIPO Statistics 2013, p. 61)

7.6 Standards

Standards constitute another driver of innovation, and they are becoming more important as markets expand and internationalize. Goods and services are increasingly designed and developed to be sold internationally, thus, required to satisfy a variety of markets and cultures with different requirements on materials and processes and different preconceptions of what is good or bad. "Standards are not only a technical question. They determine the technology that will implement the Information Society, and consequently the way in which industry, users, consumers and administrations will benefit from it" (EC 1996). Standards encompass an increasingly wide range of manufacturing, process, and ethical requirements placed on commercial goods. Standards can be imposed by governments, international bodies, trade associations, or can be the outcome of regular market transactions.

Typically, only those countries on the technological frontier will be able to set the standards for technologies for which they are the primary producers, users, and sellers. Specific technologies develop along a series of steps, one of which involves the intentional or circumstantial setting of standards (Gort and Klepper 1982). Technology followers by definition come upon a technology after it has already been in development for some period of time, and often miss the standard-setting stage. However, specific circumstances occasionally provide the opportunity to developing countries close to the frontier of a specific technological field to set or influence standards. Market size is one of those circumstances. A great example is China's attempt to set its own signal security standard for all wireless devices sold in China, including imports. Makers of wireless devices from other nations balked at this proposal, as it would have created a second set of security standards for makers to meet, upending international markets and virtually forcing foreign firms to provide Chinese manufacturers with proprietary information (Gibson 2007). While the proposal for the new standard was ultimately withdrawn due to international resistance, the chain of events indicated a couple of things: (a) China was advanced enough technologically to set their own wireless security standard; (b) China had a large enough internal market that international makers could not simply ignore.

There are three common ways for standards to be set: the marketplace, negotiation, and a standards leader (Varian et al. 2004). First are standard wars conducted in the marketplace. A classic example of this is the VHS and Betamax technology battle (Hall 2005) replayed today in Blu-Ray versus DVD. The benefit of allowing markets to set standards is that it follows the path of least resistance in terms of existing innovation. Technology flows where the skills and the markets already exist. Governments are not required participants in setting standards in this manner, but clearly, the legal, IP, innovation, and trade environments all play a part in determining how markets operate, and these are all areas in which governments set the tone. For countries that have national champions, allowing the markets to set standards can be tricky, as there is no guarantee that the home country's firm will survive the standard war. Nor is there a guarantee that consumers will direct the market to the best possible outcome; small events at different stages of development of a technology and a market can decide the outcome of a standards race, regardless of which product is technically superior (Arthur 1989; Malerba et al. 1999; Gallego 2010).

The second channel for setting standards is negotiation. Governments can play a direct role here. Recall the example of wireless signal security and China, and how it was resolved with international negotiations (primarily the US government). Negotiation typically involves compromise, which means that all players may have to sacrifice some element of gain for the betterment of the whole. Consumers can be the big losers in these situations as negotiations might not settle on the most cost effective or well-functioning standard. It is also difficult to determine exactly when a standard would be set naturally (Jakobs 2000) leading to the possibility that the necessity of entering into negotiations artificially sets the limit to further standard development.

Having a standard leader is the third form of standard setting. Such a leader can come out of a market fight, or by virtue of being the first to develop and disseminate a technology. Those wanting to supplant the standard may face extreme barriers to entry erected simply by the standard having been in place for a long period of time, or requiring a vast infrastructure that is infeasible to duplicate for a new standard (Gallego 2010). Perhaps no greater example exists of this than the Internet.

Standards Case—Brazil's Personal Computer Endeavor

In 1985, Brazil passed the National Information Technology Policy in an attempt to turn its burgeoning, domestic IT industry into a pillar of productivity and growth. The law blocked imports of some foreign computer and IT-related goods and for those imports that were permitted; foreign firms were required to interact with Brazilian-owned firms for in-country sales. This protectionist move had two goals: boost domestic technology growth by keeping out foreign competition; and provide an avenue for domestic economic development.

At the time of the passage of the Informatics Law, as it was called, Brazil did have a small computer manufacturing sector. Most of the domestically produced computers followed international standards and were clones of foreign market-leaders, while peripherals and software tended to have a higher degree of local content. The Informatics Law shifted all of the standard-setting to domestic producers.

Of the three methods for setting a standard—marketplace, negotiation, a standard leader—at the time of the passage of this law Brazil could not meet any. The market was not large enough to be self-sustaining, the protectionist move was unilateral and involved no negotiation with other countries or multilateral bodies, and Brazil possessed no domestic producer that was already a standard leader.

Brazil did see a growth in the domestic technology capability of some producers as the vacuum of foreign goods was filled. However, consumers suffered as the Brazilian products generally were more expensive and less reliable than their foreign competition. By the end of the 1980s, policymakers saw how countries like Taiwan and Korea were enjoying booming IT growth

through much more liberal trade policies. Consequently, the Informatics Law was changed to allow for more foreign competition in the IT sector, and to de-emphasize the need for Brazil to set internal standards in that sector. Today, decentralized knowledge spillovers, as opposed to protectionist standards, are credited with boosting the IT growth of Brazil.

Sources: Botelho and Smith 1985; Perini 2006; Magalhaes et al. 2009

For developing country practitioners, care must be taken when agreeing to standards. Standards can be a benefit to a country's innovation efforts by providing guidelines for entrepreneurs entering the international market. Standards also can inhibit local innovation by preventing entrepreneurs from selling their products on the global market (Gibson 2007; World Bank 2010). The OECD recently compiled a review of empirical assessments of the impact of standards on international trade. Importantly, the studies examined found a mix of positive and negative impacts of both national and international standards on the conduct of international trade (Swann 2010). For a fitting example of variable impacts of a standard, one needs look no further than the well-documented controversies associated with one of the most important modern efforts at international standardization, that of IP under the TRIPS agreement.

7.7 Conclusion

Intellectual property protection is critical for innovative, knowledge-based firms. A company must be able to exclude others from using its research and inventions or else it will not be able to capture all of the value from its intellectual property. When a company is unable to exclude others, most commonly accomplished by enforcing a patent, another company can profit from using an invention without bearing any of the costs of the invention's development. The creator of the invention then becomes an unwilling subsidizer of a competitor.

A country must have enforceable intellectual property rights to protect the money and resources a company invests in research and development, or else investors in the company will not want to run the risk of having a knowledge-intensive company's most valuable asset, its intellectual property, stolen by a competitor. This both devalues the assets of knowledge- intensive companies and lowers the potential for profits. Weak property rights increase risk and discourage investment.

Policymakers must consider the impact of standards on domestic innovation. In the same manner as IP legislation discussed earlier in this chapter, any decision on standards must be made in light of factors such as the level of domestic innovation, domestic technology appropriability and usability (absorptive capacity), specific areas of technological strengths and weaknesses, and areas of potential trade growth.

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