Economics, Law and Intellectual Property

Seeking Strategies for Research and Teaching in a Developing Field

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Chapter 20

INTELLECTUAL PROPERTY RIGHTS IN THE WORLD ECONOMY

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Abstract: This chapter broadly summarizes some of the basic economic theory on the working of the patent system. It starts by outlining the role technology plays in economic development, and the way in which economic theory has approached the technology-economy relationship. It then reviews the basic economic motive for establishing a patent system: to solve the incentive problem that firms face when they develop new technologies with potential spillover effects to other firms and consumers. A discussion of alternatives to the patent system is also provided. From an economic point of view, however, a crucial aspect of patents is that they leave some opportunity for spillovers. In other words, patents should not provide a pure monopoly to the inventing firm.

1 An earlier version of this chapter was presented at the WIPO Arab Regional Symposium on the Economic Importance of Intellectual Property Rights, Muscat, Sultanate of Oman, February 22-24, 1999. I thank participants at the conference and Eddy Szirmai for useful comments and discussions. The work for this chapter was sponsored by the Norwegian Research Council under the programme “Globalisering som transformativ kraft”, carried out by TIK.

The economic logic behind this argument is explained and some general (and abstract) theoretical guidelines are proposed to strike a balance between providing incentives (a legal monopoly for the investor) and leaving opportunity for spillovers. The chapter concludes with a summary of the debates surrounding issues of patents (and IPRs more general) in an international context. The role patents may play in stimulating technology transfer is reviewed. Although there are many formal models of the patent system providing incentives (a legal monopoly for the inventor) and leaving opportunity for spillovers, the chapter concludes with a summary of the debates surrounding these issues of patents (and IPRs more general) in an international context. These models are too abstract to be applied in practical terms. It will be argued that only detailed case studies of existing patents in combination with the study of technological systems can provide practical insights into how broad patents should be.

With this background in the economic theory of patents, one may address the issue of the role of IPRs in the global economy, and their implications for the prospects of developing nations. The discussions around this issue are dominated by the role of the main institutional arrangement that has emerged over the last decade: the so-called TRIPs agreement. This agreement, which has been interwoven into the talks on liberalizing trade and investment flows, sets a uniform minimum level of patent protection for all countries that participate in the World Trade Organization (WTO). Whether such a uniform level is beneficial from a global point of view, and whether or not the actually implemented minimum level is too high, has been a major point of debate ever since the first plans for TRIPs. It is the aim of this paper to discuss the economic theory around these issues, and to use this theory to derive some conclusions on where the debate could further develop.

The rest of this paper is organized as follows. Section 2 briefly outlines some developments in the economic theory on growth. It will be argued that patents play a crucial role in modern growth (theory). The section will also introduce the concept of technology spillovers. Section 3 will outline the economic functions of patents, and also introduce the concepts of patent breadth and patent length. Section 4 will come back to the issue of spillovers, and their link to patents. The issue of patent breadth will be analyzed, taking into account the economic importance of spillovers. Section 5 provides an overview of the main factors through which IPRs have an impact on development and technology transfer. This section also outlines the main developments at a practical level, i.e., how international IPR regimes converged into the TRIPs agreement that has been in effect since 1996. Section 6 provides a summary and discussion of the main arguments. Some specific recommendations will be made with regard to supportive policies in the field of international IPRs.
20.2 Technology and the Economy

The importance of technology for economic growth is obvious to anybody who has even a vague notion of the history of technology or the history of the world economy. The prolonged growth of GDP per capita (which, admittedly, is an imperfect measure of what matters for the quality of human life) since the (first) Industrial Revolution was made possible by a combination of entirely new processes and new products, which kept being introduced into the economy at what appears to have been an increasing rate (see, e.g., Landes, 1969, Maddison, 1991 and Freeman and Soete, 1997).

Despite the load of historical evidence, (mainstream) economic theory, however, until very recently, was not very comfortable with the relation between economic growth and technology. Formal theorists as economists are today, they were rather uneasy with the 'qualitative' work by 'pre-modern' economists such as Marx (1981) and Schumpeter (1939), who had kept closer links with the historical evidence and given technology a central role in their analysis.

The dominant theory of economic growth (Solow, 1956) was based on the cornerstone of all modern economic analysis, namely that of 'decreasing marginal returns'. This notion refers to the fact that if one keeps adding more and more capital (machines, buildings) to a production process, the additional value generated by this capital will keep falling, until it eventually becomes zero. This concept, which dates back to Marshall (1890), is very central in economic analysis because it enables the theorist to calculate the outcome of a rational decision-making process. For example, using this assumption, it is possible to derive an upward-sloping supply curve ('the higher the price that can be obtained in a competitive market, the more a firm will supply') as a result of profit-maximization by firms. Without the assumption of decreasing marginal returns, the supply curve would not be upward-sloping.

However, when marginal returns keep falling until they are zero, long-run economic growth is only possible if some 'exogenous' factor is assumed to be present. This could, for example, be technical change that falls as 'manna from heaven', or is given by 'God and the engineers'. Such exogenous factors, by definition, are not affected by economic decisions, and that is why economic models did not have very much to say about growth.

It was only recently (e.g., Romer, 1986, Grossman and Helpman, 1991) that economists were willing to admit that with technological change that is motivated by economic goals, the assumption of zero marginal returns in the long run was impossible to maintain. Investment in technology and R&D is a way to avoid them, and to keep returns to capital positive in the long run. This opened the way for a wholly new class of so-called 'endogenous growth models', in which long-run growth can be explained without resorting to exogenous technological change. In these models, firms' decisions on research and development (R&D) are explicitly modeled as profit-driven activities. Patents are always assumed to exist, and usually they are even assumed to hold forever. The large majority of the 'endogenous growth literature', however, does not analyze the institutional setup of the patent system (notable exceptions are Bucci and Saggi, 2000 and O'Donoghue and Zweimüller, 1998).

Although not all of the new growth models agree on this, some (e.g., Grossman and Helpman, 1991) argue that the mere existence of R&D by firms is not enough to solve the problem that decreasing marginal returns pose for economic growth. They argue that long-run positive economic growth is only possible when technological change displays so-called 'externalities' or 'spillovers'. By this notion, they refer to the idea that a technological invention is of use not only to its inventor, but also to other firms in the economy. The nature of technology, as will be argued in more detail in the next section, makes it possible that other firms than the original inventor can use (parts of) it as well.

Grossman and Helpman, as well as other 'new growth theorists', argue that without spillovers, long-run economic growth will cease. The intuition behind this finding is that while innovations keep occurring, there will be more and more competition and therefore profits for each (new) innovation fall. Spillovers provide a source of falling R&D costs, without which R&D becomes too expensive relative to the eventual pay-offs. Although their models, as well as this specific proposition, remain to be tested empirically (e.g., Jones, 1995), their assertion clearly illustrates the importance of the spillover concept for the economy. The question arises, however, why a firm would invest in R&D if other firms may reap (part of) the benefits of this investment. Obviously, this is where a system of intellectual property rights (IPRs), more specifically a patent system, comes in.

20.3 Patents as Incentives for R&D

20.3.1 The appropriability problem

In a sense, technological knowledge is an economic good in which firms (and governments) invest money. Competition between firms is based on
product quality (including service) and price. In both of these aspects of the
cOMPETITIVE PROCESS, technology plays an important role. The price of a good
depends on productivity and the costs of inputs such as labour, raw materi-
als, machines and buildings. By enhancing productivity, technological
change may lead to a dramatic fall of the price charged by the firm that im-
pleMents such process innovations. Other firms in the same business are then
forced to drop their prices as well, or else they will be driven out of the mar-
ket. How this may lead to dramatic price falls is illustrated well by an his-
torical example quoted in Freeman and Soete (1997, p. 60). Over the period
1870-1898, the price of steel (in $ per ton) fell by 83%, or an average of al-
most 3% per year. This tremendous drop coincided with a period in which
important innovations in steel-making (most notably the Bessemer process)
were applied in the American economy.

Investment in technological change may also be aimed at product innova-
tion. Moore’s law is perhaps the most famous example of rapid product in-
novation. Gordon Moore, the co-founder and chairman of the Intel corpora-
tion, predicted in the 1960s that the complexity (measured as the number of
components put on one chip) of so-called integrated circuits would double
every 18 months. For the firm that was leading this development (i.e., Intel),
this high rate of product innovation led to a dominant market position,
which, nowadays, is challenged by only a handful of competitors.

It would thus appear from such anecdotal evidence that firms have more
than enough reason to invest in research and development (R&D) in order to
increase their competitive position. Why then is a system of intellectual
property rights necessary to stimulate investment in R&D? The answer to
this problem lies in the fact that technology has a number of special charac-
teristics that are not often found in other economic goods. A normal eco-
nomic good (say, an orange) is both rival and excludable. This means that
only one person can consume or use the orange (rivalry), and the supplier of
the orange can exclude persons from consuming it (i.e., those who are not
prepared to pay for the orange). These two characteristics, which hold for the
large majority of all goods in modern economies, ensure that these goods
will be produced in a market economy. A farmer is willing to grow oranges
because, due to the rival and excludable character of the orange, she is able
to sell the oranges on the market and earn a profit.

Technological knowledge is a good for which the characteristics of ri-
vality and excludability do not hold perfectly. Imagine a situation without
intellectual property rights. If a firm were to invest to develop a new chip, its
competitors would be able to copy the knowledge embodied in this circuit by
buying a single unit of the new product, and reverse-engineer it. In other
words, the knowledge embodied in the chip is non-rival (the fact that one
firm uses it does not imply that other firms cannot use the same knowledge),
and is non-excludable (there is no way the inventor can exclude others from
using the knowledge she developed, except for the trivial case that the
knowledge is not used in any way).

There would thus be no incentive for a firm to invest in such knowledge.
Without protection of its intellectual property, other firms can free-ride on
the efforts of the inventor, and, hence, assuming that imitation is cheaper
than developing the invention, put the new product on the market for a far
lower price than the original inventor. This is why non-excludability pose a
problem in terms of incentives to produce these goods. Non-rivalry (or spill-
overs), however, implies at least a potential economic benefit: from the point
of view of the economy as a whole it is rather desirable that something is
produced by only one firm can be used by many.

Besides technological knowledge, there are a number of other goods that
have the characteristics of non-rivalry and non-excludability. Examples are
national defense and clean air (one cannot exclude individual citizens from
either of those goods, and they can be consumed by numerous people at the
same time). In economic theory, these goods are said to be characterized by
market failure, i.e., a free market economy will either not produce these
goods at all, or produce them in quantities far too small for the existing de-
mand. National defense and clean air (as well as other examples one may
think of) are goods that are usually supplied by public governments. This is
why these goods are called public goods.

However, public provision is not the only way in which market failure of
non-rival and non-excludable goods may be dealt with. The system of IPRs
can be considered as an institution that tries to solve the problem of market
failure by providing private producers with incentives to supply public
goods. As such, a system of IPRs is thus one of the possible ways to solve
the problem of market failures. The next section will provide an overview of
all of these mechanisms, and discuss the advantages and disadvantages of
IPRs (relative to the other remedies for market failure) in some detail.

20.3.2 Ways of stimulating invention

David (1993) discusses the three P’s of trying to solve market failure in
the area of technological change: Patronage, Procurement and Property
Rights (or Patents). All three mechanisms are actually used to stimulate the
development of new knowledge in practice, although they are related to different parts of the R&D infrastructure. The first P, Patronage, refers to the process where government finances a group of researchers to undertake R&D, and thus provide new knowledge. This is the system that is most widely used for basic science, where publicly financed universities or public research labs play a large role in pushing forward the frontier of knowledge. Note that this is similar to the solution of market failure in the case of standard public goods such as defense.

Procurement refers to the process where governments engage in contracts over the development of a specific piece of knowledge. Thus, public authorities may identify a specific problem for which a technical solution seems feasible, and they contract a specific group of researchers to develop this solution. Of course, often, the same researchers who work in universities or government labs are engaged in competitive bids for government-procured research projects, so that the two systems overlap in practice.

As David (1993, p. 32) notes, the procedures of procurement and patronage suffer from the problem of setting the prices right. How much should governments invest in research grants to universities, and how much should they be prepared to pay for a specific project undertaken to solve a predefined technical problem? These are questions that are difficult, if not impossible, to answer. The third P, Property rights, provides at least a theoretical way out of this problem, for a special class of technological knowledge.

A part of knowledge generated through research and development leads to possibilities for products and processes that have commercial value. With a system of property rights, i.e., a (temporary) legal monopoly granted to one firm, these goods can be supplied on the free market. Thus, a system of property rights leaves to the market to decide what a ‘fair’ price for technological knowledge embodied in a product or process is. The incentive problem is solved by legally excluding others than the inventor (or patent holder) from using the technical information. Thus the patent holder is enabled to make a profit on her research.

Obviously, there are also certain disadvantages to granting a monopoly. With ‘normal’ economic goods (i.e., rival and excludable goods), economic theory clearly shows that a market with many suppliers and many buyers produces more welfare than a market in which only one (monopoly) or a few (oligopoly) suppliers are active. Put in simple terms, monopoly firms charge too high prices from a societal point of view. This is why public governments often pursue an active anti-trust and pro-competition policy. The trade-off between the advantages of a monopoly provided by patents and the disadvantages is often discussed as the trade-off between static efficiency (stimulating competition) and dynamic efficiency (stimulating invention through patents) (see, e.g., Kamien and Schwartz, 1982). The trade-off also plays an important role in the tension between government policies aimed at science and technology and anti-trust policy. In the context of European integration, for example, strict rules have been set to technology policy in order to ensure that it does not intervene with competition policy.

Besides the problem of monopolies charging too high a price, there are also a number of other disadvantages to the patent system. David (1993) discusses the so-called ‘common-pool’ problem. This refers to the notion that firms often compete for the same invention, which leads to so-called patent races, in which the winner typically takes all (see, e.g., Dasgupta and Stiglitz, 1980). The common pool problem presents two problems from the point of view of social benefits and costs. According to David (1993), first, “it is likely that from the viewpoint of society there will be too many contestants in the races for priority in discovery and invention. Those entering consider only what they individually stand to gain, and they do not take into account the effect of their participation on the expected outcomes of all the other competitors” (p. 33). These effects on the outcomes of other contestants are obviously negative, for the more competitors there are, the smaller the probability for each of them to be first. In other words, when potential inventors fish in a common pool of knowledge, resources will be spent in a wasteful way (from the point of view of the total economy). Second, again citing David (1993), “there is a tendency for private rents to be dissipated in the scramble for the prize of priority and all that it would bring. The private value of arriving at a new finding a little sooner than the second-place contestant is likely to exceed greatly the benefit that society would derive from the slight advantage in the date of discovery” (p. 33).

Thus, although patents do not only entail positive effects on welfare, most economic treatments of the subject would conclude that overall, the benefits of a patent system are positive (e.g., van Dijk, 1994, Scherer and Ross, 1990). For example, Mazzoleni and Nelson (1998, p. 281) conclude: “In some areas, patent rights certainly are economically and socially productive in generating invention, spreading technological knowledge, inducing innovation and commercialization, and providing some degree of order in the development of broad technological prospects. However, in many areas of technology this is not the case”. This conclusion leaves, however, at least

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2 Business research sponsored by the European Commission is limited to the so-called pre-competitive phase.
two issues to be resolved. First, whether patents (or IPRs in general) are efficient means of reaching their goal (stimulating invention and commercialization thereof), and second, whether anything can be said about the design of patents.

With regard to the first question, it has been argued that firms have alternative options for appropriating the return to R&D investment, and that these alternative options are often used more than patents. Levin, Klevorick et al. (1987), in a survey among large firms in the U.S., and Arndel and Van de Paal (1995) for European large firms, found that secrecy, establishing a lead-time, an effective marketing campaign, and learning effects were measures of protecting knowledge that were considered to be more effective than patents by many (although not all) firms. Similar conclusions had been reached in earlier studies such as Taylor and Silberston (1973). Mazzoleni and Nelson (1998) argue that the above-mentioned studies which arrive at the conclusion that patenting is often only a minor tool in appropriating knowledge are biased towards large firms. Many of the ways in which these large firms appropriate knowledge are closely related to their size (marketing budget, learning effects), and hence small firms may have to rely more on patents.

Important differences in this respect exist between industries, or the knowledge bases underlying and the institutions surrounding them. For example, in the pharmaceutical sector, due in part to the fact that copying of chemical substances is very precise and rather cheap, and given that authorities request detailed information about the contents of medicines, patent protection is considered to be very important. In the electronics sector, short product life cycles often make patents relatively inefficient, although most of the larger electronic firms hold large patent portfolios. Thus, the so-called 'propensity to patent innovations' differs considerably between different industries.

With regard to the issue of the design of the patent system, economic analysis has mainly analyzed the question how an 'optimal' patent should be designed. An optimal patent is one that maximizes the welfare of the invention it concerns, or, in other words, one that strikes the best balance between the positive and negative effects of patents as outlined above. In this respect, the issues of patent length (duration of the monopoly right) and patent breadth (scope of protection) have been widely analyzed.3

Increasing the length of a patent obviously increases the amount of profits the inventor may draw from her invention, but it also increases the welfare losses due to monopoly power. Nordhaus (1969) was the first to address the issue of patent length in a formal setting. In his analysis, the optimal patent length depends on the price elasticity of demand, and the elasticity of the extent of technical improvements with regard to R&D expenditures. With higher price elasticity of demand for the new product, the optimal patent length is shorter, because the high monopoly price implies a large welfare loss. If larger productivity increases are achieved with a given level of R&D, the optimal length of the patent will also be shorter, because R&D is cheap, and hence the incentive does not need to be very large.

Following Klemperer (1990), the formal literature mostly considers the issue of patent breadth in a context of so-called horizontal product differentiation. In this approach, technological innovation is seen as a process that produces more variants of a consumption good. Because consumer tastes differ, each new variant creates its own demand, without fully capturing the market. A broad patent then captures a large part of the horizontally differentiated product space. As in the case of patent length, the optimal breadth depends on a number of model parameters, such as various elasticities. Van Dijk’s (1994, p. 113) conclusion that “the exact conditions for choosing an imitation or improvement strategy are not particularly important because they depend on specific modeling assumptions” in a strict sense refers only to his own model of patent height and breadth, but strikes me as reasonably valid for the field as a whole.

20.4 Patents and Technology Spillovers

The technological knowledge that is described in a patent application is useful not only to the patent applicant but also to other inventors in the same field. Although these other inventors are not allowed to use the patented knowledge in a product or process that will be used for economic purposes, the knowledge in a patent may still be useful to them in different ways. For example, this knowledge may give them new ideas for inventions. Also, the knowledge described in a patent often increases the general stock of knowledge in a field, such as would, for example, be the case if a patent describes

3 Van Dijk (1994) also uses the concept of height, which refers to the novelty requirements.

4 With horizontal product differentiation, products are differentiated into variants that cannot be ranked in terms of some objective quality measure, but are nonetheless distinct (for example, the commodity fruits is horizontally differentiated into apples, oranges, etc.). With vertical product differentiation, product variants can be ranked according to quality, e.g., French wine has a higher quality than Norwegian wine. In the latter case, consumers will choose on the basis of quality-price ratios.

5 In terms of the example in the previous footnote, some people will always prefer oranges to new (e.g., genetically engineered) variants of fruit.
that some technical procedure is possible to carry out. Also, some patent systems, such as the European one, require the patent applicant to reveal so-called non-claimable knowledge if this is relevant to the device or procedure described in the patent.

Thus, even if a patent precludes pure imitation of an invention, it does not rule out all externalities related to it. The patent provides the inventor with a monopoly that enables her to generate profits and hence provides an incentive for the research effort, but it leaves certain aspects of the technological knowledge to be exploited by others than the original inventor. How much is left to others to explore, and, thus, how much can be appropriated by the inventor, depends on the breadth of the patent.

The fact that patents, at least patents that are not too broad, leave open externalities is an important distinction with other types of IPRs. For example, trademarks and, perhaps to a lesser extent, copyrights do not induce any externalities, or at least not to the same extent as patents do. When a firm takes out a trademark, it basically seeks protection for its marketing activities. Obviously, marketing does not carry the same amount of spillovers as research and development, although, in some cases, it might be just as effective a means of strategic advantage for a firm. Given the economic importance of spillovers (or externalities) that was underlined above, this clearly establishes the special importance of patents as compared to certain other types of IPRs. One could say that a patenting system has an important bearing on the dynamic efficiency (growth potential) of an economy, while this is less obvious for other types of IPRs.

This also implies that the breadth of patents has important consequences for the growth potential of the economy. Usually, however, the models of optimal patent design, which were discussed briefly in the previous section, do not consider these dynamic effects. They are limited to the static welfare effects of patents, i.e., they compare the welfare costs and benefits of a patent without taking into account the effect a patent may have on future innovation (through spillovers). Important exceptions to this are Scotchmer (1991) and Scotchmer and Green (1990), as well as the less formal, qualitative literature on patent breadth. The latter branch of literature started with early contributions by Kitch (1977) and Beck (1981), while Mazzoleni and Nelson (1998) is a recent contribution.

Taking into account the spillover effect of patents on the productivity of future research, one is faced with a familiar trade-off. On the one hand, broader patents reduce spillovers to other firms than the inventor. Although in principle these spillovers could be 'internalized' by the patent holder, i.e., the beneficial effects on future invention could be captured by the patent holder, this internalization is unlikely to be complete. For example, in the case of a 'general-purpose technology', the scope of the firm that holds the patent is unlikely to cover the complete spectrum of possible applications of the spillovers, and/or transaction costs for licensing may be too high to allow efficient spread of the spillovers to other firms. Thus, broad patents are bad for spillovers, and, hence, bad for dynamic performance of the economy.

On the other hand, broader patents increase the (potential) pay-off to the patent holder, and hence the incentive for invention is increased. By increasing the number of inventions, obviously, also the amount of spillovers is increased. Whether broader patents increase or decrease the amount of knowledge available for spillovers thus depends on the various elasticities involved in this process.

How this trade-off turns out, and hence whether or not broad patents are good for dynamic performance of the economy, is hard to judge in a purely theoretical approach. Without an idea of the empirical facts, it is likely that such theory runs into the same problems as were signaled above for the 'static' models of patent breadth. The outcome depends on model parameters, and the models are too abstract to make empirical estimation of the parameters possible. Thus, case studies of specific sectors, technologies and countries are very useful with regard to the question of patent breadth.

For example, recent practical discussions in the field of IPRs focus on the scope of protection that should be offered on inventions in fields such as computer software, integrated circuit designs, and biotechnology (life) (see, e.g., Chapters 11-15 in Wallerstein, Mogee et al., 1993, as well as Van Wijk and Junne, 1993). The general tendency of the discussion has been to offer more extensive protection for these technological fields than was possible on the basis of the legal arrangements some years ago (when these technologies were just coming into existence).

Mazzoleni and Nelson (1998) warn against such a trend of broadening patent protection. They argue that when technological change proceeds in "cumulative systems" (p. 281), broad patents are potentially hampering to the rate of invention. The danger they see is that an early, broad patent in

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6 Trademarks, for example, are mainly used for advertising, and this does not obviously generate externalities. Copyrights on, for example, computer code do not imply disclosure of the underlying 'blueprints' (source code) and hence also generate limited externalities. Clearly, this does not mean that copyrights or trademarks are not important for the economy. There are good economic, legal and other reasons for the existence of these forms of IPRs.
such a field locks out firms who do not have access to this patent, especially if transaction costs for licensing are high. In other words, although they do not use the term 'spillovers' or 'externalities', they make exactly the same argument against broad patents as has been made above using the idea of spillovers. Merges and Nelson (1990) discuss a number of specific examples from the (recent) history of technology to support the case that broad patents hinder spillovers, due to, among other things, high transaction costs for licensing.

I tend to support the Mazzoleni and Nelson conclusion that broad patents are potentially dangerous. There is no need to use the patent system to aim to internalize all the spillovers of invention to a single firm (i.e., the inventor). This would essentially come down to eliminating a large part of the potential benefits to the economy at large, because no single firm is large enough to fully exhaust the possibilities of important inventions in key technology fields. The aim of a patent should be to provide a firm with the possibility to make a fair profit in order to earn back its R&D costs. It is therefore perfectly sound to leave a large part of the spillovers to outsiders, and thereby increase the overall benefits to the economy. As was argued in Section 2, this is the basic idea behind modern growth theory, a part of which argues that without such spillovers, long-run growth would converge to zero.

In many respects, the studies by Mazzoleni and Nelson (1998) and Merges and Nelson (1990) reach conclusions opposite to those in the early contributions by Kitch (1977) and Beck (1981). These authors were arguing in favour of broad patents, essentially to rule out inefficiencies in the coordination between many contestants in a patent race following an early basic patent in a field. They recommend that such an early basic patent should be broad, so that the firm that holds it may either explore the field on its own, or license the patent to the other firms that are most promising with regard to success in R&D. It is thus seen that no strong conclusion has yet been reached in this literature. Some recommendations for future research will be made below.

The World Bank (1998), finally, although it argues in general terms for increasing the breadth of patents on a worldwide scale (the so-called TRIPs agreement, see below), warns against too broad protection in the specific field of gene splicing, on the account that this is a technology with such a broad range of applications that patents run the risk of locking out too many spillovers.

20.5 Patents and Technology Transfer: a Short Review of the Debate

Intellectual Property Rights (IPRs) are an important factor in the debate on the role of institutions in technology transfer (Yankey, 1987, Van Wijk and Junne, 1993). As was already seen above, patents are the form of intellectual property rights most closely associated with technological inventions. By technology transfer, this paper will refer to the process in which technological knowledge developed and (first) applied in the developed countries (say, OECD countries) is transferred to countries with lower levels of technological knowledge (as embodied in their productive process). It has to be recognized that the latter set of countries is in fact a very heterogeneous group, including, for example, the so-called Newly Industrialized Countries (NICs), as well as countries with pre-industrial agricultural economies.

The twofold aim of the patent system – first, to protect an inventor from imitation and hence to increase the incentive for inventive activity, and, second, to stimulate the dissemination of technical information, so that it can be used in further inventive activity, thereby increasing the system-wide rate of invention – is again relevant for the debate here. Obviously, the second aim (diffusion) is closely associated with technology transfer, something that is actively pursued by both national governments and international organizations. However, just as in the general case for a patent system discussed above, there might be some tension between appropriation (first aim of the patent system) and technology transfer. Broadly speaking, the literature discerns four different ways in which patents have an impact on development and/or technology transfer (e.g., Yankey, 1987, Van Wijk and Junne, 1993):

1. Strong(er) patent protection in developing nations may increase the inventive efforts in the developing countries themselves, and thereby increase the rate of growth in these countries.
2. Patents allow for (international) licensing, so that firms in developing countries may buy technology from firms in (technologically) more advanced nations (technology transfer).
3. Strong(er) patent protection may be necessary to induce firms from developed countries to engage in one of many different economic transactions that may lead to technology transfer. One may think of Foreign Direct Investment (FDI), exports (to developing nations) of capital goods embodying technological knowledge, joint ventures between firms in developing and developed...
countries, etc. Without some form of protection of their knowledge in the foreign markets, firms from developed nations may choose not to engage in these activities, because they run the risk of their knowledge being copied.

4. Developing nations that do not provide a system for protection of intellectual property of imported technology run the risk of retaliation in terms of trade restrictions. Especially the U.S. government has (recently) been active to enforce protection of intellectual property of U.S. firms by means of trade measures (Van Wijk and Junne, 1993).

All of these reasons are not only subject to academic debate by theorists, they were and are also subject of intense negotiations in international organizations such as the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO) (see, e.g., Mody, 1990, Van Wijk and Junne, 1993, and World Bank, 1998). Van Wijk and Junne (1993) describe how in the 1960s and 1970s, the large majority of developing countries began to oppose the implementation of a (strong) patent system in their own economies:

"Developing countries did not deny that industrial property systems could encourage industrialization, but contended that in developing countries, due to the weak economic and technological structures, they did not bring the desired benefits. It was argued that in developing countries the privileges created by the industrial property systems failed both to stimulate inventions among their own nationals and did not encourage the rapid transfer, appropriate adaptation or widespread diffusion of imported technology" (p. 22).

Thus, the argument was twofold: first that the technological capabilities of firms in developing countries were too low to generate important new innovations (point 1 above), despite the existence of a patent system, and, second, that the desired technology transfer (points 2-4 above) did not materialize. In 1975, UNCTAD published a study (UNCTAD, 1975) that presented a lot of evidence in favour of this position. For example, the report outlined statistical trends illustrating the marginal role of developing countries in total patents granted in the world. Moreover, it showed that in developing countries, the large majority (typically, more than three quarters) of patents granted was controlled by foreign firms (from the developed world).

The argument that developing countries can hardly contribute to the advancement of the technological frontier remains valid, even more so today. This is related to the limited amount of resources available in these countries, in terms of human capital, funds to be invested in frontier research, and cumulated experience in research. Corporate R&D, and patenting, are a matter for the developed nations and, within them, mostly for the five or so largest countries (European Commission, 1998). Thus, without policy measures aimed at increasing the indigenous research capabilities of developing countries, a patent system can hardly be expected to be an efficient means of stimulating innovations in the poorer parts of the world, especially in a political climate where free trade is high on the agenda.

The role of licensing (factor 2 above) was also shown to be important only for a limited set of countries. In order to use licensed knowledge effectively, firms in developing countries need a certain level of technological sophistication of their own. Analogous to the point of indigenous research capabilities raised above, this is exactly what was often lacking, due to shortages of human capital etc. Some even went so far as to suggest compulsory licensing as a means to effectuate technology transfer, but this is extremely difficult, because mere licensing without the transfer of (tacit) knowledge from the side of the patent holder cannot be expected to be efficient (Yankey, 1987). The ineffectiveness of compulsory licensing is also shown by the limited number of cases of such arrangements (typically less than 5 per country over the period of a decade; see Yankey, 1987, Table 2.1).

In practice, one observes that only certain countries are able to use technology licensing as an effective way of (inward) technology transfer. Typically, in these cases, technology licensing goes hand in hand with the build-up of domestic technological capabilities. Freeman (1994) discusses the case of the Korean firm Samsung, which effectively used licensing agreements with various Western European and U.S. companies to build up its own technological capability. Over time, Freeman observed a rapid tendency for Samsung to switch from reliance on licensing agreements to developing its own frontier technology. In fact, taking R&D intensity and patenting as indicators, Korea, as well as other South-East Asian NICs, can be seen to converge rapidly to the technology frontier in the course of the 1990s (e.g., European Commission, 1998, for recent data, and Soete and Verspagen, 1993, for a theoretical and empirical analysis). In general terms, the conclusion seems justified that technology licensing may be a useful part of a policy aimed at building up local technology capabilities, but it is only a part of such a policy.
Based on the arguments on the role of patenting in developing countries, a political discussion took place in the 1970s and 1980s between developing countries and developed nations, in which the issue of patent protection in developing nations was heavily debated. In broad terms, the developing nations argued for less strong patent protection in their own economies, while the developed world called for global strengthening of patent protection. Van Wijk and Junne (1993) provide an overview of this debate, as well as some of the finer (legal) details as they were discussed at various conferences organized by WIPO. They also describe how, at the end of the 1980s, the developed nations started to pull away this debate from WIPO, trying to integrate the issue of intellectual property rights with issues of free trade. This trend had started in the US in the first half of the 1980s (Granstrand, 1999, Ch. 2). In practical terms, this meant that negotiations about intellectual property rights were integrated into the Uruguay Round. This implied that negotiations about free trade were coupled with negotiations on IPRs, leading eventually to the so-called Trade Related aspects of Intellectual Property (TRIPs) agreement.

The TRIPs agreement is a part of the WTO, and sets minimum levels of intellectual property protection for the whole range of forms of IPRs (patents, copyrights, trademarks, industrial designs, etc.). It also requires signatories to establish certain basic legal measures to prevent infringement. Disputes over TRIPs are subject to the same settlement procedures as WTO in general. TRIPs became effective in 1996, but developing countries are granted several transition periods applying to specific parts of the agreement, so that it will become fully effective only in 2005.

The TRIPs agreement means that countries that do not respect the minimum levels of IPRs set can now expect retaliation measures in terms of trade restrictions (point 4 above). Van Wijk and Junne (1993) point out that this is an especially effective measure in combination with the trend found in many developing countries to switch from a policy of import substitution to export-led growth. Obviously, export-led growth crucially depends on access to world markets, and hence the pressure to respect the IPR levels set by TRIPs becomes larger.

Thus, in the late 1990s, the debate on the role of patents in technology transfer mainly focuses on points 3 and 4 of the above list. The first two points, i.e., the (direct) impact of a patent system on domestic inventive activity in developing nations, as well as the issue of technology licensing, were shown to depend crucially on domestic technological capabilities. These can only be built up by means of a broad policy which includes, besides IPRs, also elements such as (semi-)public research facilities, education and training of the labour force, and industrial and trade policies.

With the TRIPs agreement in effect, the consensus on the issue of IPRs and technology transfer seems indeed to converge to the points 3 and 4 listed above. The uniform and strong IPRs are generally considered to stimulate technology transfer by means of FDI, joint ventures and by stimulating international trade in general. Mansfield (1993, 1994, and 1995) provides some empirical evidence for this assumed relationship.

The first two of these papers by Mansfield analyzes survey data obtained for 100 U.S. firms in a range of industries. About half of the firms in this sample reported that strength or weakness of IPRs has a strong effect on whether or not direct investment will be made. This effect was found to be strongest in the chemicals and electrical equipment sectors, and to apply mostly to investment related to R&D facilities and facilities to manufacture complete products. The top countries that were reported as having too weak IPRs to permit investment in joint ventures with local partners were India (44% of respondents indicate IPRs are too weak), Nigeria (33%), Brazil (32%), Thailand (31%), Indonesia and Taiwan (28%). The same countries were reported to have IPRs too weak to permit transfer of the newest or most effective technology to wholly owned subsidiaries, or to permit licensing of the newest or most effective technology. Mansfield (1995) extends the survey to Japanese and German firms, and also undertakes more sophisticated econometric testing. The findings, again, show that weak IPRs may be an important barrier to technology transfer.

The World Bank, in its World Development Report 1998/99, also champions strong and uniform IPRs as in the TRIPs agreement. Their empirical evidence mainly consists of the Mansfield surveys mentioned above. Despite this apparent consensus, the academic debate on the issue of TRIPs is far from conclusive. Siebeck (1990) concluded that the theory did not provide any strong answers on how strong IPRs in developing countries should be, and that the empirical studies on the issue were too few to allow firm conclusions. In 1992, a conference was convened at the National Academy of Sciences in the U.S., which debated the issues. In the proceedings, which were published as Wallerstein, Mogee et al. (1993), no firm conclusion was reached on whether a uniform system of strong IPRs was to be preferred over a system with international differentiation in IPRs. Since then, although the first of these two variants now seems the de facto situation since

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7 See, e.g., the contributed chapters by Sherwood (1993) and Frischtak (1993).
TRIPs came into effect, the theoretical debate has not supplied the final answer, as will be argued in the next section.

20.6 Discussion and Issues for Further Research

The debate on the strength and scope of IPRs briefly outlined in the previous sections is still largely unresolved, at least at an academic level, and more theoretical and empirical research is necessary to arrive at useful conclusions. This section will attempt to outline three angles from which further contributions may be made. These three points are all somewhat preliminary, and must be considered as starting points for further research, rather than finalized and testable propositions.

The first issue relates to the dynamic effects of patent breadth. The economic models we have available now provide a clear-cut, although admittedly somewhat abstract, argument about the static effects of patent breadth. From a static point of view, i.e., when looking at only one invention without taking into account the cumulative nature of inventions, and hence the effect that an individual patent may have on future technology, broader patents give up benefits for the consumer but they provide incentives for the inventor. An optimal point in this trade-off may be calculated under certain (abstract) assumptions. These models could be extended to take into account dynamic efficiency by analyzing how one invention may generate future inventions, and hence also what the welfare effects of these future inventions may be. The main challenge here is to find a satisfactory way of representing the dependence of one invention on previous ones. This dependence structure is often quite complicated and also usually quite impossible to predict. Hence the standard models of fully rational firm behavior may not be very useful here, and an alternative would have to be developed. In this respect, knowledge from the engineering sciences on how inventions are made, and which relevant sources of knowledge exist, as well as from practical studies on the use of patenting literature by engineers, are very relevant as inputs to more realistic economic models.

The second issue relates to the question of whether a patent regime with (more or less) uniform protection levels is desirable from a point of view of total world welfare (see Sherwood, 1993, Frischtak, 1993). As was seen above, microeconomic theory analyzes the length and breadth of patents. The length of a patent refers to its duration, while the breadth refers to the scope of protection. Nordhaus (1969) analyzed the ‘optimal’ patent length, and concluded that this depends on variables such as the price elasticity of product demand, and the elasticity of the extent of technical improvements with regard to R&D expenditures.

Following Klemperer (1990), the literature mostly considers the issue of patent breadth in a context of so-called horizontal product differentiation. In this approach, technological innovation is seen as a process that produces more variants of a consumption good. Because consumer tastes differ, each new variant creates its own demand, without fully capturing the market. A broad patent then captures a large part of the horizontally differentiated product space.

Van Dijk (1994, Chapter 7) presents a model in which two countries, which trade with each other, choose the optimal level of patent breadth. He arrives at the following conclusions:

“[W]hen countries place equal weight on profits and consumers’ surplus of their own citizens (...) patent breadths are too narrow. This result reflects the existence of a positive externality flowing from each country’s patent breadth to the profit and consumers’ surplus enjoyed by citizens of the other country. (...) Except in very special circumstances, equilibrium patent breadths are not identical in the two countries. (...) Further, if equilibrium breadths are sufficiently asymmetric, there is no symmetric patent policy that Pareto dominates the original equilibrium” (p. 153-4).

In practical terms, these results establish three main points. First, in an international context, spillovers between countries are relevant decision variables in designing national regimes of intellectual property rights. More specifically, national governments may want to set the scope of protection at a broader level than they would if they based their policy just on national considerations. Second, there is not much theoretical support for the preference of a uniform worldwide level of patent protection (breadth) over a system with differentiated patent breadth. Third, international coordination of the scope of patent protection (breadth) does not necessarily lead to unequivocally ‘better’ results than a regime in which each country sets its patent policy independently of the rest of the world. In fact, in discussing his results, Van Dijk makes the following, quite strong, statement:

In the latter conclusion, the concept of ‘Pareto-optimality’ plays a large role in Van Dijk’s analysis. This concept refers to the notion that it is difficult to weight individuals’ welfare level. A so-called Pareto-improvement is one in which all individuals in the economy at least have the same level of welfare as before the improvement, and at least one individual has a
"In terms of our model, one could say that the north has a high and the south has a low innovation density. The model predicts that asymmetric innovation densities lead to extensive patent protection in the innovation-intensive region and narrow protection in the weaker region. This situation can indeed be observed in the world (...). The proposal of northern countries, however, to extend their standards of protection to the south does not Pareto-improve the global welfare if innovation densities are too different (as they seem to be)." (p. 154-5).

Obviously, Van Dijk’s model is but one in a large literature in this field. Other models of the role of international property rights regimes and international trade are, for example, Deardorff (1992), Diwan and Rodrik (1991), Helpman (1993) and Chin and Grossman (1990). All of these models are highly stylized theoretical constructs, for which one needs a great deal of imagination to apply them to practical situations. Other models, such as the one by Deardorff (1991) and the one by Diwan and Rodrik (1991), are more positive towards the idea of strengthening global patent protection. All in all, the conclusion reached by Primo Braga (1990), namely that economic theory does not provide a clear-cut answer to many questions in relation to technology transfer and intellectual property rights, still seems to be valid.

Nevertheless, one may draw some positive conclusions from the theoretical debate, despite its high level of abstraction and relative indeterminacy. First, it seems unlikely that the uniform and strong IPRs in TRIPs will prove beneficial from a point of view that takes into account the interests of both developed and developing nations. A case for differentiation of patent protection by levels of development can be made from an economic point of view as well as from a humanitarian or ethical (e.g., AIDS medicines) point of view. However, more empirical research is highly welcome in support of such a view. Second, it is clear that supportive measures in terms of technological capacity building may greatly increase the efficiency of technology transfer, and thus, in a way, make the TRIPs agreement (as it is presently outlined) more efficient.

The debate of the 1970s and 1980s already clearly showed that in order for (strong) IPRs to be effective in developing countries, the domestic capability of these countries to generate and use new technologies needs to be enhanced (see above). Relatedly, the model by Van Dijk cited above points to the fact that a regime with uniform and strong worldwide IPRs may be more efficient (in terms of welfare) when differences between countries in terms of technological capabilities are small. In the above-mentioned World Development Report 1998/99, the World Bank also points to the importance of building local knowledge bases. Thus, I would argue that TRIPs is not to be considered as the final solution to problems of technology transfer and development, but rather as a most useful step in awareness of the importance of IPRs and technology in general. In addition to agreements of IPRs, the developed and developing world should continue to focus on building up domestic technological capabilities in developing countries. IPRs play an important role in this process, but there is more to it than just IPRs.

What role could international organizations such as the World Bank, WIPO and WTO play in this process? WTO, although it is the platform at which TRIPs was negotiated, and at which conflicts on TRIPs must be submitted, does not seem to be a likely candidate for such a role. Its nature as a body to enhance free trade does not easily conform to policy goals that concern domestic issues, such as the stimulation of R&D infrastructure. Moreover, IPRs are only of indirect relevance for WTO, since its main role is the promotion of free trade. The World Bank obviously has a task in this area, and the World Development Report contains many examples of how this organization attempts to help build up local knowledge infrastructures.

One may well argue that also WIPO may play a role in this process, despite the fact that one may argue that WIPO is an international platform, much like WTO, which should not ‘intervene’ in local issues. However, the issue of international IPRs, which is, of course, a main concern of WIPO, is indeed closely related to domestic technology capabilities, and thus the issue seems to be more at the heart of the matter for WIPO than for WTO. As I have tried to argue here, the new institutional environment (TRIPs) adds another dimension to this issue, rather than making it obsolete. Thus, given the increased need for international attention to technology capacity building in developing countries, one may imagine that WIPO would, in some way, address this issue.

The third issue that I want to address in this section builds, in a way, on the first one, because it considers the issue of patent breadth. In the econometric literature on international R&D spillovers, one of the ‘hot issues’ is
the question whether or not such spillovers are embodied in traded goods and/or FDI. Coe, Helpman et al. (1997) have forcefully argued that R&D spillovers are indeed embodied in trade goods, while Lichtenberg and Van Pottelsbergh (1996) found that R&D spillovers are connected to FDI flows between countries. These papers do not investigate the causal effect between embodied (either in trade or FDI) spillovers and IPRs. Thus, a first line of research that may prove useful to the debate outlined in the previous section could be to incorporate IPRs in such models of spillovers.

However, Fagerberg and Verspagen (1998) also introduce into these models so-called disembodied spillovers. They follow earlier work by, among others, Cornwall (1977) and Abramovitz (1979) in relating these disembodied spillovers to the initial level of labour productivity in an industry. An estimated negative sign on this variable is interpreted as evidence of the hypothesis that relatively backward countries benefit from the international diffusion of technology. Because a variable taking into account trade-embodied R&D spillovers à la Coe, Helpman et al. is also present in the Fagerberg and Verspagen model, the effect related to initial labour productivity is interpreted as disembodied spillovers.

Fagerberg and Verspagen find that in a sample of 14 OECD countries for the period 1975-1995, disembodied spillovers have a much stronger impact on productivity growth than trade-embodied spillovers. In other words, the international diffusion of technology mainly takes place through other channels than international trade in goods. Admittedly, Fagerberg and Verspagen do not consider the effects of FDI embodied spillovers. Still, their results seem to underline the crucial importance of spillovers through other channels than embodiment (think of international mobility of labour, international contacts at conferences, scientific and technical literature, patent specifications, etc.).

One important caveat must be placed with regard to the application of these results to the relationship between technology transfer and patents. Verspagen (1991), in an empirical model that did not include any type of embodied spillovers, found that disembodied spillovers, of the type that Fagerberg and Verspagen estimate, tend to decrease with the level of the technology gap between two countries. In other words, for countries lagging far behind the world technological frontier, 'technological congruence' (Abramovitz, 1979) may be too low to allow them to benefit from disembodied spillovers. Thus, the results that Fagerberg and Verspagen find may indeed be rather specific to the set of countries included in their analysis.

Although much more research is necessary to extend the Fagerberg and Verspagen results to the issue of North-South technology transfer (e.g., extending the set of countries in the analysis, as well as taking into account FDI), the results do seem to indicate that, to a certain extent, free-riding on foreign knowledge is possible. Whether or not such a process involves substantial infringement on patent holders' rights is not clear from the Fagerberg and Verspagen analysis. However, it is well imaginable that making IPRs 'stronger', especially in those countries benefiting from the spillovers, i.e., the developing countries, reduces the scope for such disembodied spillovers. At the same time, according to the arguments set out in the previous section, such stronger IPRs may stimulate trade and FDI, and thereby increase technology transfer related to these factors. Whether or not the net effect on the amount of spillovers taking place is positive or negative is highly speculative, given the current state of the art in this field of research.

In the models discussed very briefly here, the patent system, licensing and trade in know-how do not play an explicit role. The models are rather abstract, although well-founded in historical research. A useful venue for further research seems to be a more explicit analysis of IPR systems. This could well start from an historical investigation of the role of these systems in development and catching-up-based growth, and from there be included in the existing (empirical) models.

The fourth and final issue that I would like to raise in this section concerns the topic of appropriate technology. As is well-known from the development literature, not all technologies developed in OECD countries can readily be used in developing countries. Many of these technologies, or at least their specific implementation, are specific to the (advanced) needs of the societies they are developed in, or depend on infrastructures that are not commonly found in many of the developing countries. Abramovitz (1994) has termed this 'a lack of technological congruence'.

This implies that not all R&D efforts by firms in OECD countries are relevant for the issue of technology transfer. In general, it is quite difficult to make a clear-cut distinction between sectors with more or less appropriate technology. For example, although much of the research in the electronics sector is obviously beyond the reach of many developing economies, the relatively high-tech field of mobile telephony is a well-known example of a field where diffusion potential is large in many developing countries, due to a low level of commitment to an installed base of wired communication.

However, one field for which the outcomes of R&D carried out in OECD countries clearly have large consequences for developing nations, is biotech-
nology (see, e.g., Acharya, 1995 and Van Wijk and Junne, 1993). The impact of biotechnology on developing countries is a vast area of research in which I cannot claim any expertise, but I would nevertheless like to conclude this paper with two observations on this field.

The first observation I would like to make is that in a field where the economic relevance of a technology is larger for developing countries than for the developed world (as one may argue biotechnology is; tropical diseases are another, perhaps even more clear case), the importance of IPRs in developing countries is especially high. Given that the market for products based on these technologies is small(er) in developed countries, strong IPRs in the developed world may simply prove to be too small an incentive to stimulate R&D (Van Wijk and Junne, 1993). This shows that generic policy recommendations may be misleading, and specific knowledge of technologies and economic, social or political circumstances is very valuable. In terms of the implications for further research, this means that case studies, well-formulated with both theoretical and policy concerns, remain of great value.

The second observation is that the ‘old’ concern that multinational companies from the developed world gain control over technologies that are crucial to the fate of developing countries is also especially great in those cases. The World Bank (World Development Report 1998/99, Box 2.6 and related text) discusses the issue of compensation when ‘bioprospecting strikes gold’. Examples are mentioned of cases where large pharmaceutical companies from the developed world “appropriate valuable biomedical knowledge from indigenous peoples” (WDR, Box 2.6). However, a trend is also signaled in which companies provide compensation in the form of lump sum payments and/or royalty sharing to local communities. It seems to me that such a trend might well be formalized into international rules to prevent such ‘reverse technology transfer’ without adequate compensation.

20.7 Literature References


Economics, Law and Intellectual Property


Chapter 21

SUMMARY AND REFLECTIONS UPON FURTHER DEVELOPMENTS

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Abstract: This concluding chapter summarizes the preceding chapters, using a common structure, which throughout the chapters highlights their main focus, key/novel concepts, approach/empirical data, main findings/arguments, and suggestions for further research. The diversity of the chapters in these respects is rich, which is perhaps not so surprising, but there are also clear differences between the two groups of chapters representing economics and law. This observation gives reason to reflect over the past and future interaction between these two disciplines in the IP field. The need for pluralism in choice of research problems and methods, as well as for discipline perspectives complementary to economics and law, is pointed out. At the same time, the advent of the IP era has led to a rapidly growing research agenda, calling for some priorities. The chapter also reflects on some priorities for interdisciplinary research and teaching on the economics and law of intellectual property. The chapter ends with a speculative reflection about the future of the IP system and its interaction with the economic and legal systems.

1 Helpful comments on this chapter have been received from Ulf Petrusson.