UN/ECE Advisory Group for the Protection and Implementation of Intellectual Property Rights for Investment

Background paper for the workshop ‚Technology Transfer'
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1. Introduction

Economies in transition have demonstrated relatively good innovative performance in the past, but this situation has changed. Nowadays innovation mainly comes from abroad. Although bolstering patent systems in economies in transition is clearly beneficial to foreign companies investing in these countries, the gains reaped by local players so far are less apparent. One important element to improve this situation is to analyze the efficient role of intellectual property rights in the process of transition.

Local innovation is one of the keys to long-term economic growth. For economies in transition it is necessary to identify where innovation comes from, and, in particular, how much of it is foreign and how much is local in origin. How much is transferred via foreign direct investment, licensing, imports or imitation is also of use. The aim of this workshop is to elaborate patterns of innovation in Croatia and neighbouring countries and to clarify the role of intellectual property rights (IPR) for economic growth and innovation within these patterns.

The purpose of this paper is to facilitate discussion at the workshop 'Technology Transfer'. The paper provides a rather technical overview of the economic state of the art of research in the field. It aims at providing evidence and background information for the interested workshop participants. The reading of the paper is, however, not a necessary requirement for participation. The workshop itself will focus on the practical aspects of IPR and technology transfer, guided by the questions in the grey boxes after each paragraph.

- *How did innovation perform in Croatia and neighbouring countries in the past? How does it comparatively perform nowadays? What might the future innovation trend be?*
- *Where does innovation in Croatia and neighbouring countries come from? Is it local or foreign in origin?*
- *How is the role of IPRs in Croatia and neighbouring countries perceived by foreign innovators and by local innovators?*
- *What is the pattern of local innovators? Which are the dominant industries? Where are the industries located? Where does foreign innovation come from?*
- *Based on your practical experience, how would you describe the major changes of the IP system from the socialist past to the present?*

2. Economic growth, the innovation process and IPR

2.1 The Scope of IPR

Discovering a novelty for the second time is not rewarded in science and 'rediscovering' the same invention a second or a third time does not create additional social value. Science is guided by the rule of early disclosure (Dasgupta and David [1994]). In industry novelties of technological knowledge have to be protected against competitors and secrecy or protection via intellectual property rights are the only means for maintaining market shares.

Protection is meaningful for the kind of knowledge where transfer is relatively easy. This means that the evaluation of intellectual property protection for technology is essential there, where the relative proportion of explicit knowledge, or information, is dominant to the non-explicit (tacit) part of the knowledge.

	Codified	Tacit
Public	Publications, etc.	Generic, (e.g., skills)
Proprietary	Patents, trademarks, etc.	Firm-specific skills (e.g., know-how)

Table 1: Knowledge classification[1]

In table 1 each field corresponds to different knowledge-generating processes and different mechanisms for the accumulation of knowledge. The table shows that IPR can only cover and protect the proprietary and codified part of knowledge. Table 1 also makes clear how closely IPR are related with the dimensions of knowledge and that their good application and performance can only work within the overall framework of a knowledge-based society.

- *How would you describe the relationship of proprietary knowledge and tacit knowledge in your company? How do they interact?*

2.2 Micro-level

Intellectual property rights can potentially stimulate growth in two ways: Firstly, by providing the right incentive structure to encourage innovation, and secondly, by providing a framework for the dissemination of technological knowledge. However, they are only one factor of influence in the innovation process. From a policy perspective IPR cannot be the objective in itself but the overall aim should be the facilitation of technology transfer, local innovation and, finally of economic growth. Therefore it is essential to clarify the role of intellectual property rights in the innovation process as well as their general scope.

The simplistic standard model of the innovation process is a linear input-output relationship between various factors. Basic science leads to applied science and technology which then undergoes commercial development and production on relevant markets. The process is spurred by public and private funding and the general availability of public knowledge and proprietary knowledge.

The linear model of the innovation process covers only the scientific-technological conditions for innovation. It does not include the draw-backs from the market or the demand side of innovation, such as market conditions, relevant prices, market demand and market structure, which are predominating factors for innovation. Hence the model gives a good explanatory ground for the “science-push” hypothesis, but it does not consider the “demand pull“ hypothesis.[2]

[1]Taken from Georghiou and Metcalfe [1990] page 43.

[2]This includes the whole dispute on the relationship between market structure and innovation. See again Baldwin and Scott [1987] and Kamien and Schwartz [1982].

A more modern understanding of science includes also "the creation, discovery, verification, collation, reorganisation and dissemination of knowledge about physical biological and social nature".[3]

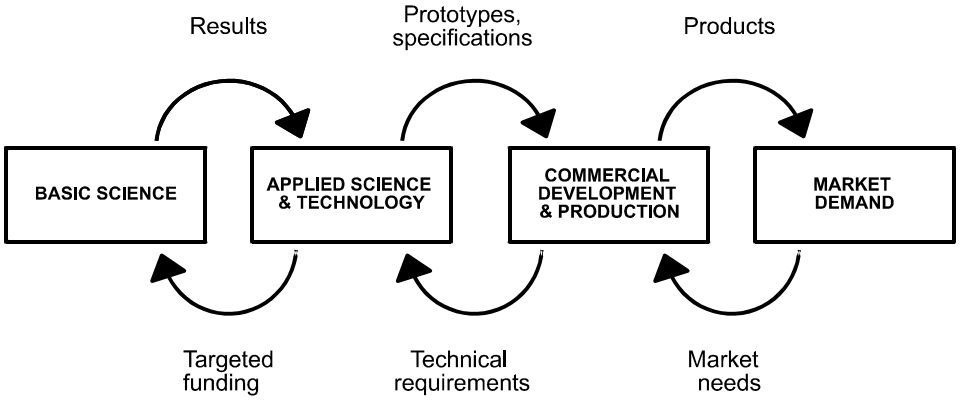

Figure 1: Interactive model of knowledge and innovation systems[4]

The characteristics of the interactive model of innovation systems (figure 1) include feedback loops within the chains, including both links from basic science to applied science and technology and the other way round, as well as the numerous feedbacks that link and co-ordinate science, development and the market. Like this, the model comprises both the "science push" and the "demand pull" understanding of the innovation process. Nevertheless, the innovation process is unlikely to be described comprehensively by one single model. Some additional key features have to be considered:

- Innovation is inherently uncertain.
- From an economic point of view, innovation is also a cost of staying in the marketplace.
- Science is most frequently not a direct causal link with innovation but it enters primarily through knowledge already in the heads of the people in the innovative organisation and to a lesser degree through information quickly accessible to them.
- Much essential support of science itself comes from the products of innovative activities, i.e. through tools and instruments (feedback loops).

Intellectual property rights are important at several points of the model both as input and incentive for basic and applied science and as output of the innovation process. On the one hand, they constitute part of the relevant market conditions as they tend to monopolise the market. On the other side, they are output factors of innovation as legally institutionalised measures (market/bargaining value, strategic tool).

[3]Kline, Rosenberg [1986] page 287.

[4]European Commission [1999] page 8.

- *At which points in the innovation process of your company do IPRs play an essential role?*
- *What is the relevance of IPRs for innovation in your company?*
- *What is the relevance of IPRs for economic growth in your company?*
- *How important are your patents to*
  - *protect technology from imitation*
  - *prevent patenting and application activities of competitors,*
  - *generate licensing income,*
  - *improve the situation of R&D co-operations,*
  - *improve inter-firm negotiations,*
  - *prevent patent infringement suits,*
  - *improve the technological image of your company,*
  - *acquire venture capital?*
- *How important do you perceive the role of your own patents/trademarks for technology transfer (IPRs as facilitator of knowledge diffusion)?*
- *How important do you assess the role of IPRs for the development of basic science/applied science?*
- *How do you assess the economic value of your IPRs? Are they important marketing/bargaining tools?*
- *Do you use your IPRs for strategic uses other than the protection of your own technology?*

2.3 Macro-level

Traded goods require a guarantee for their proprietary knowledge. Thus, the performance of trade depends, at least partly, on property rights. Exporting companies tend to base their export decisions on the existence of IPR systems. At the macro level, two economic effects of intellectual property rights are relevant: the “market-power” effect and the “market-expansion” effect. Stronger protection of intellectual property in the domestic markets of transition economies can reduce the elasticity of demand faced by importers because it gives them a type of monopolistic market power. This encourages companies to import into the market in question (“market-power” effect). The “market-expansion” effect, on the other hand, increases demand for the foreign importer when it is conquering new markets, thus raising its sales. Both effects can be related to the size of the country. The market-power effect is thought to be stronger in smaller countries whereas the market-expansion effect is, by definition, stronger in larger countries.

In most economic models the analysis of international intellectual property rights is done within the framework of a two-country model. A rich and innovative country is compared with a poor and technologically dependent country. The basic situation between the two countries shows similarities in the situation of innovators and imitators (generic producers and infringers) at the firm level. As a result of imitation, innovators, if they are exporters of technology, can lose their market shares in the imitating countries. Innovators have to face their increasing price-elasticity of demand and a reduction in their monopolistic prices to the market level. Consumers in both the innovating and imitating country gain due to lower product prices, but innovators lose their producer surplus and thus the incentive to invest in R&D.

A. Restricted intellectual property right protection:

(simplified economic situation)

- Consumers in the unprotected regions get a full free ride on innovation (assuming complete diffusion)
- Innovators lose profits (producer surplus)
- Less incentive to innovate (detrimental effect on the innovation rate)
- No incentive to transfer technology
- No technology spill-overs

B. Extended intellectual property right protection:

(simplified economic situation)

- Consumers in formerly unprotected regions have to bear higher product prices (loss in consumer surplus)
- Innovators achieve higher (monopolistic) profits
- Increasing innovative activity
- Incentive to transfer technology
- Technology spill-overs are encouraged

- *Have Croatia and neighbouring countries perceived higher product prices due to the IP system?*
- *Have Croatia and neighbouring countries perceived a higher product supply due to the IP system?*
- *Did strengthening IPRs raise the incentives for foreign firms to transfer technologies to Croatia and neighbouring countries?*
- *Does the establishment of stronger IPR limit local imitation?*
- *Are there positive examples for technology spill-overs in Croatia and neighbouring countries?*

3. Technology transfer

Technology is fundamental to economic growth. The essential ways in which technology transfer takes place are via foreign direct investment, licensing, exporting (trade) and imitation. The objective here is to observe the influence of IPR on the different means of technology transfer.

Previous to 1989, economies in transition demonstrated extremely high investments in R&D with high innovative performance. Innovation was mostly based on massive investment in R&D and human capital. Then, in the first period after 1989, a strong decline in R&D investment took place. In general, economies in transition possess a high level of education and good human resources (both accumulation of physical and human capital is necessary for economic growth). A key issue is to identify how economies in transition can attract foreign technologies, particularly by stimulating foreign trade and foreign direct investment. Clearly, IP laws and regimes play an important role, but the nature of this role is still not fully understood.

Strengthening IPRs will most likely raise the incentives for foreign firms to transfer their technologies to these countries. Stronger IPRs could, however, limit local imitation (generics and infringement) of new technologies, reduce the supply of new technologies (monopoly) and increase the prices of new technological goods. Anecdotic evidence for China showed a great reluctance to locate R&D facilities in China due to fear of misappropriation and patent

infringement. Enterprises reported that they transferred only technologies that are at least five years behind global standards or that will be obsolete within a few years.

Table 2: Exports of technology-intensive goods, royalty income earned and Net FDI Outflows from high-income OECD countries, USD billion & percent (high income=OECD countries minus Mexico, Korea and Turkey. High technology goods are defined on the basis of R&D intensity. Source: Maskus 2004

	High-technology exports		Royalties		Net FDI outflows	
Value ($bn)	**1970**	**2001**	**1970**	**2001**	**1970**	**2001**
High income	25.8	739.3	2.8	71.2	6.9	472.1
Low income	1.2	16.1	0	0.02	0.3	8.1
Lower middle income	3.5	104.3	0	0.7	0.9	105.6
Upper middle income	3.8	200	0	1.8	0.6	69.4
sub-Saharan states	0.7	5.6	0	0.02	0.1	5.5
Shares (%)						
High income	75.4	69.8	99.7	96.7	79.9	72
Low income	3.5	1.5	0	0	3.2	1.2
Lower middle income	10.1	9.8	0	0.9	9.9	16.1
Upper middle income	11	18.9	0	2.4	7.1	10.6
sub-Saharan states	2.0	0.5	0	0	1.2	0.8

High technology exports and royalties from OECD countries rose from 1970 to 2001, in particular for lower and upper middle income countries, but less so for low income countries. Upper middle-income nations constitute the fastest-growing market for technology-intensive exports from OECD countries.

Whatever the role of IPRs, they are only but one important factor of a list of factors that influence international technology transfer. These factors include the investment climate, efficient governance, market size and growth, proximity to suppliers and demanders, infrastructure, and, in particular, local engineering skills and R&D efforts.

- *How do you perceive the role of the patent/trademark system in Croatia and neighbouring countries for technology transfer?*
- *How did the R&D investment develop in Croatia and neighbouring countries before the process of transition started and after?*
- *How would you assess the educational level in Croatia and neighbouring countries? How is the education with respect to IPRs?*
- *What is your personal perception of the role of IPRs in Croatia and neighbouring countries based on your experiences (public/company)?*
- *According to your experiences what is the role of IPR in the increasing trade/business relationship of Croatia and neighbouring countries with OECD/EU countries?*

4. The relevance of IPRs

4.1 Economic growth

Joshua Lerner (2002) found that strengthening local patent laws in history typically did not increase domestic patent applications but did lead to statistically and economically significant increases in patenting by foreigners in the reforming country. In theory IPR fulfil a double growth promoting function by providing the right incentive structure for innovation and by distributing technological knowledge across countries and industries. When investors in one country file a patent application in another country it signals a willingness to deploy that technology in the recipient nation. Eaton and Kortum (1996) find that a significant amount of productivity growth in most OECD nations could be attributed to international patent flows as a source of technology diffusion. In their model, for all countries other than the five main research nations (United States, Germany, Japan, France and UK), ideas that originated abroad (measured by foreign patents) accounted for over 90 percent of productivity growth. 'Trade in ideas' is a major factor in world economic growth.

Park and Ginarte (1997) found that patents have a strong and positive impact on physical investment and R&D spending which in turn raises growth. The degree of growth depends on the relative technological advance of countries. Technological leaders will profit more from IPR than less developed countries. Park and Ginarte conclude by emphasizing that the burden of establishing an intellectual property rights system is relatively stronger for technological successors.

Gould and Gruben (1996) found that stronger intellectual property rights protection corresponds to higher economic growth rates in a cross-country sample. This trend was stronger in more open economies.

- *How do you perceive the influence of IPR on economic growth from your company's experience?*

4.2 Company Profits

Stronger IPR are expected to considerably raise the economic rents earned by international firms from patents. McCalman (2001) studied the potential effects of harmonising patent regimes at a high level on changes in bilateral rent transfers in a sample of developed and developing countries. He found that such harmonisation had the potential to influence considerably net outflows of royalty payments as developing countries increased their patent strength. Smith (2001) found significant evidence that better-enforced patents could increase affiliate sales and licensing payments on average.

Gould and Gruben (1996) found that IPR are more important in markets with greater competition. This finding is in agreement with the consideration that IPRs hardly ever grant entirely monopolistic power to their owner but rather beget a small competitive advantage until competitors can leapfrog with another advanced technology. Although brief, this temporary competitive advantage is sufficient enough to enhance the dynamic market competition and contribute positively to the growth of the relevant market.

- *Does your own IP help your company to go abroad?*
- *Do IPRs provide you with security for investment?*

4.3 Trade

Gaps of technological differences between countries are one main source of international trade. The production of new commodities takes place according to relative technological advantages. According to classical trade theory, technology-rich countries will specialise in technology-intensive products and technologically less-developed countries will specialise in traditional goods. The size of the technology gap determines the velocity of the process of convergence. The larger the gap, the higher is the speed of convergence. Catching-up strongly depends on international channels of diffusion of knowledge, such as technical communication, multinational trade and foreign direct investment. IPR-systems are part of the social capacity of a country to attract technology diffusion. As such, they belong to the national innovation systems of a country. They constitute part of the local attractiveness for investment in innovation and as such they are an important means of technology diffusion at an international level.

Differences in the way countries approach the protection of intellectual property rights can in certain cases distort the flow of international trade and investment. They can, intentionally or not, have the effect of protecting nationals against foreign competition or of tilting the balance of advantages in favour of these nationals. Such discrepancies are akin to non-tariff or technical barriers to trade.

Maskus and Penubarti (1995) were the first to relate international trade flows to the cross-country strength of patent laws. The strength of patent rights is measured by an index from one to five across importing nations (Rapp and Rozek 1990). The authors found that import volumes are positively and significantly affected by increases in this patent index across most manufacturing categories, in particular in large and middle income countries. Other follow-up studies show similar results.

International trade flows, especially in patent-sensitive industries, respond positively to increases in patent rights among middle-income and large developing countries. However, trade flows to poor countries are not responsive to patent rights. Changes in the IPR regime can affect the scale and distribution of foreign modes of entry: Firms may switch from exporting to engaging in FDI. Thus some firms expand their exports while others establish affiliates abroad so that, all things considered, total trade expands less. An additional purpose of IPRs is to encourage investment in improved product quality which is essential for breaking into export markets.

- *In what kind of products do Croatia and neighbouring countries specialise (technology intensive, labour intensive, capital intensive)?*
- *To what extent do traded goods require security for proprietary knowledge according to your experience?*
- *Do foreign companies rely on the IP system in Croatia and neighbouring countries, i.e., file for patents and trademarks?*
- *Do companies rely on the IP system abroad?*
- *Has there been a perceivable import increase into Croatia and neighbouring countries due to IP regulations?*
- *Has there been any difference in treatment of locals compared to foreigners with respect to IP ('not invented here')?*
- *Have Croatian companies perceived any different treatment in comparison to nationals abroad with respect to IP rules?*
- *What kind of goods are predominately transferred to Croatia and neighbouring countries (low-tech, medium-tech, high-tech)?*

4.4 Foreign direct investment (FDI)

The strength of IPRs has important effects on the decisions by multinational firms regarding where to invest and whether to transfer advanced technologies through FDI. Alternative means of protection are lead time advantages and brand name reputation. In certain industries, this ´natural protection' may forgo seeking IPRs. Intellectual property rights can potentially stimulate growth in two ways: Firstly, by providing the right incentive structure to encourage innovation, and secondly, by providing a framework for the dissemination of technological knowledge. IPRs are clearly also an important part of the institutional setting needed to promote international commerce, but what is less clear is whether they can promote the exchange of technology and help narrow technology gaps. Spill-over effects run parallel to IPR. 1) Companies adopt, through imitation or reverse engineering, technologies introduced by multinational firms. 2) Technology diffuses via labour turnover, i.e., through workers trained by, or previously employed by, multinational firms who may transfer important information to local firms. 3) And, multinationals agree in vertical technology transfer to firms which either supplying them or buy their products.

Lee and Mansfield (1996) found a positive relationship between IPR strength and FDI. They found that lagging technologies were transferred to nations with weak IP enforcement and that production centres in those countries were less likely to be established than distribution centres in those countries. Other studies (Primo Braga, Fink, 1998) could not prove this statistical relationship.

Lesser (2002) found that imports are positively associated with the IPR strength index. A one point rise in the IPR score (10%) is associated with a $8.9 billion increase in imports and a $1.5 billion increase in FDI. These numbers have to be interpreted with care. The more important political message is that even a small change in policy can potentially boost trade and FDI.

The OECD (2004) found indications that the IPR/FDI relationship with strengthened patent protection was largest for those countries where IPR regimes are weakest, but in general strongly positive correlated. Thus, patent rights appear to have a positive but diminishing association with increased FDI as the strength of those rights increase (market power effects prevail).

- *Has the local production of goods in particular benefited from IP regulations in Croatia and neighbouring countries?*
- *Has there been a perceivable increase of foreign direct investment due to IP regulations in Croatia and neighbouring countries?*
- *Do IP regulations in particular contribute to the dissemination of technological knowledge?*
- *Do IP regulations promote the exchange of technology and help to narrow technological gaps?*
- *Have there been cases where technology was transferred from foreign companies to local SMEs (spill-over effects)?*

4.5 Licensing

Strengthening IPRs shifts international technology transfer from exports and FDI to licensing. The sophistication of the technologies transferred rises with the strength of intellectual property. Patents are used for licensing and their aim is to exploit them as much as possible for economic benefit. More and more companies are realizing that aggressively asserting their patents can generate considerable business advantages. Many companies spend large amounts of money

in identifying the economically relevant patents in their patent portfolio (portfolio audit), as well as in cluster and bracket analysis, where clustering around the core technology assures that a core technology has been protected.

Licensing and the generation of licensing revenue as part of an intellectual property strategy play an important role for companies in the United States and in Japan (Cohen et al. 2002). Other surveys (OECD 2003) report increased overall licensing activity, with a trend towards inward-licensing in the information technology sector and outward licensing in the pharmaceutical sector. Ferrantino (1993) found that patent rights have a strong impact of on the volume of royalties and license fees.

- *Is there any accounting of licensing income in Croatia and neighbouring countries?*
- *Does licensing income work as an economic incentive for local firms?*

5. Individual country expertise

5.1 Japan

Under pressure from the US, Japan has radically strengthened its patent protection between 1988 and 1993. No increase in R&D spending or innovative output by Japanese firms could plausibly be associated with this expansion of patent rights (Sakakibara and Branstetter, 2001). However, foreign firms have increasingly transferred technologies through patent applications, indicating that the incentive effects of patent reform tend to favour international firms.

5.2 Korea

Korea is a case of a 'technology follower' which has transformed itself into an increasingly innovative and high-technology economy. In its early stages of industrialization, through the 1970s, Korean firms undertook learning via 'duplicative imitation', in which they took advantage of mature technologies that foreign firms had permitted to enter the public domain or were willing to provide cheaply because they were no longer cutting-edge. Korea was by then an example of a low-wage economy producing labour-intensive goods at the end of the product cycle. Korea's success raised its labour costs in relation to other developing countries and forced it up the product cycle to an economy undertaking 'creative imitation' in the 1980s and 1990s. This process involved more significant transformation of imported technologies, increasing domestic R&D and causing additional production differentiation in order to generate greater added value. Korea undertook major upgrades of its intellectual property system from 1987 to 1993. It has since moved up to the rank of a technologically inventive nation. Korea had the highest growth rate in the world in private R&D expenditure per dollar of GDP in the 1980s and 1990s. Unlike Japan, this explosion in domestic innovation accelerated after the patent system was strengthened. The rise in patenting also seems to be due to improved technology management and extensive concentration in Korean industry.

Japan and South Korea both moved from being crude imitators to creative imitators and then knowledge-intensive innovators.

5.3 Brazil, Mexico, Malaysia

Similar findings have been made for Brazil, Mexico and Malaysia. As production processes have become more mature, and the depth and complexity of knowledge for effective absorption has grown, firms have increasingly resorted to formal means of international technology transfer. In general, the interests in IPRs follow a form of technology ladder related to basic product-cycle ideas. Many middle-income developing and transition countries are essentially at

the duplicative imitation stage, hoping to absorb free or cheap foreign technologies into labour-intensive export production and evolve higher, value-added strategies over time.

- *How would you describe Croatia and neighbouring countries? A 'crude imitator', a 'creative imitator' or a 'knowledge-intensive innovator'? Why?*

6. Summary

For middle-income countries and large developing economies that pose both an imitative threat to IPR holders and have some domestic innovation capacity, enforceable patents can attract significantly more FDI and licensing contracts. For these countries, as IPR regimes become more protective and are more clearly enforced, there is a tendency for international firms to switch their technology transfer decisions at the margin towards licensing and away from FDI.

The quality of technology transferred rises with the strength of the intellectual property protection and domestic technological capabilities. With stronger IP protection, firms offer enhanced capacities to absorb and improve technology and foreign firms become more willing to transact more advanced products and processes. The IP system is integral to efforts to promote learning from international technology transfer and follow-on innovation. Attention should be paid to selecting IP standards that recognise the rights of inventors but encourage dynamic competition.

An adequate supply of human capital is required, including engineering and management skills. In this regard, domestic education and technical training policies are an important component of national innovation strategies. An adequate supply of engineers and management skills is also essential in order to make IPRs work efficiently.

In the long run, foreign technology will probably help close technological gaps, where they exist. Furthermore, the technology transferred should also help to reinforce local innovation. It is difficult to evaluate whether the establishment of patent systems in transition economies has proven to be of direct benefit for local firms and inventors, although they clearly are for multinational companies. In the long run, the patent system should spur the local innovation process. Moreover, it is in a country's political interest to try to harmonise with the western standards of the European Union as part of the accession process. For economies in transition, it would be valuable to investigate the role of intellectual property rights in a country's capacity to innovate.

For long-term, sustainable, economic growth, local innovation is the most essential. Much work remains for future research, such as the evaluation of the market-power effect and the market-expansion effect from stronger IPRs, a more detailed analysis of the relationship of IPR and foreign direct investment, as well as an analysis of the relationship between IPR and technological needs in economies in transition.

Various studies have confirmed a positive correlation between stronger patenting, trade and FDI. Intellectual property rights, however, are by far not the only factor of influence. Other factors, such as market size, input costs, resource abundance, quality of legal institutions and infrastructure, have to be taken into consideration. In the end, the efficacy of IPR reform and its effect on trade and FDI will ultimately depend on the environment in which the IPRs operate.

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