

INTELLECTUAL PROPERTY RIGHTS IN THE WTO ACCESSION PACKAGE: ASSESSING CHINA'S REFORMS

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ABSTRACT: In this paper I consider implications of China's recent and ongoing reforms in intellectual property rights (IPRs) as it attains membership in the World Trade Organization (WTO). I discuss the consistency of China's IPRs laws with WTO requirements and indicate outstanding issues. I then present basic economic theory of the need for IPRs, distinguishing among patents, trademarks, trade secrets, and copyrights. IPRs can be an important stimulus to innovation and economic growth if structured correctly and introduced in an environment of active competition. Otherwise they may diminish growth by limiting imitation and diffusion, leading to difficult policy choices. I compare China's post-WTO IPRs regime with standards that seem appropriate for a middle-income developing economy. Overall, the new legal regime seems sensible for China's position but there are some discrepancies that raise questions about policy. The current IPRs situation in China is analyzed, based on interviews of enterprise managers, public officials, and scholars. China has implemented a strong set of laws but there remain severe problems with enforcement. A final section shows that applications for IPRs are rising sharply but the use of IPRs differs greatly across regions, largely because of significant income disparities.

1. Introduction

After a long period of rapid growth and significant structural change, the Chinese economy increasingly makes use of advanced production technologies, while demand shifts toward higher-quality goods and services. Chinese enterprises place growing emphasis on developing brand-name recognition, reputation for quality, and product innovation. In such an environment, the provision and enforcement of intellectual property rights (IPRs) help promote further economic development. With substantial structural reform ongoing in Chinese enterprises, it is important to establish incentives for the development and expansion of businesses in high-growth sectors and to support innovation in consumer products. Properly structured, IPRs can help achieve these goals.

The Chinese central government recognizes the need for a workable IPRs system. Support is also growing among innovative Chinese enterprises, which likely suffer the largest losses from trademark and copyright infringement in the economy. Chinese enterprises also understand that their access to new foreign technologies depends partially on IPRs.

In response both to changes in internal preferences and to considerable external pressure, China has undertaken a dramatic reform of its intellectual property laws. Since 1990 the government has updated its laws covering copyrights, trademarks, patents, and trade secrets (or “anti-unfair competition”) and has adopted protection for new plant varieties and integrated circuits. The country has joined nearly all major international IPRs conventions and is a member of international agreements on classification of patents and trademarks and the deposit of microorganisms.

Most recently China made further revisions in order to conform to the requirements of the Agreement on Trade-Related Intellectual Property Rights (TRIPS) in the World Trade Organization (WTO). In its accession agreement with WTO members, China agreed to implement intellectual property laws that are fully consistent with TRIPS. When legislative reforms are fully implemented China will have a modern structure for IPRs on a par with many developed economies.

China also has established education and training programs in IPRs, upgraded its administrative and legal systems for enforcing these rights, and undertaken numerous

anti-counterfeiting programs. Nevertheless, problems remain in the administration and enforcement area. Victims of infringement complain about weak monetary and civil penalties, delays in administrative and court procedures, and “local protectionism” that makes enforcement difficult in regional jurisdictions.

The evolving system presents both opportunities and challenges for the Chinese economy. The opportunities arise from the improved environment for technical innovation, product development, and inward technology and investment flows. The challenges include moving resources out of infringing activities into legitimate businesses, coping with higher costs of imitating products and technologies, and absorbing the costs of administering a stronger system.

Over time, stronger IPRs will shift incentives away from encouraging static competition through copying and imitation toward promoting dynamic competition through innovation, technology absorption, and product design. The latter incentives are increasingly appropriate for China with its plans to become a leader in technology development. However, it will place competitive pressures on lagging enterprises and will raise concerns about the distribution of costs and benefits among individuals, enterprises, and regions.

The ultimate objectives of an IPRs system are to increase competition through innovation and technology acquisition and to encourage innovators to make their products available to consumers. Strengthening IPRs improves such incentives but is not sufficient on its own. Rather, the system needs to be developed within a broader set of policies, including further enterprise reform, development of financial and innovation systems, expansion of educational opportunities, and means for sustaining competition on Chinese markets.

The paper proceeds as follows. In Section Two I describe progress in China’s WTO commitments in the IPRs area. In Section Three I briefly overview the economic rationale for intellectual property rights. In Section Four I discuss the intricate relationships between IPRs and economic development, reviewing available evidence on that subject, and assess China’s regime regarding its potential for encouraging growth. I analyze recent trends in the use of IPRs in China in Section Five, considering both data and information learned from a series of interviews in 1998 and 2001. I also develop

some simple indications of how Chinese economic development could be affected by stronger IPRs. In Section Six I provide conclusions and recommendations.

2. WTO Commitments

Since the mid-1980s China has implemented a number of laws and administrative regulations covering intellectual property protection.¹ Many of these changes were made as a result of three agreements, each a Memorandum of Understanding, with the United States. Thus, external pressure has been an important impetus for legal change.

This process has culminated with the introduction of numerous changes in China's IPRs regime in anticipation of joining the WTO. For example, a substantial second revision of the Patent Law was achieved in 2000, coming into effect in July 2001. This revision establishes full TRIPS compliance in patent regulations and clarifies and strengthens certain administrative and judicial procedures, including the use of preliminary injunctions. Similarly, in 1997 the government promulgated new rules on the protection of new plant varieties, establishing *sui generis*, TRIPS-consistent protection along the lines of 1978 UPOV. A new set of regulations for the protection of layout designs of integrated circuits came into force October 1, 2001.

Just prior to China's accession to the WTO at the Doha Ministerial in November 2001, there remained some differences with required TRIPS standards.² Table 1 provides a list of areas in which standards are mandated, the norms (minimum standards) in TRIPS, the status of China's laws and regulations just before Doha, and China's actions in cases where a divergence exists. Most of these discrepancies arose in the trademark and copyright areas. For this reason, on October 27, 2001 the People's Congress enacted a substantial revision to its trademark and copyright laws to make both consistent with TRIPS obligations.³

The trademark law establishes the right of individual Chinese persons to apply to register trademarks. It also clarifies the definition of collective marks and joint ownership and protects collective marks and certificate marks for the first time. It further

¹ See Lacroix and Konan (2002), Maskus, et al, (1998), and Potter (2001).

² See "Draft Protocol on the Accession of China," 10 July 2001.

³ The description in this paragraph relies on information from an interview with a senior judicial official in Beijing and on Lehman, Lee and Xu, *China Intellectual Property Newsletter: Special Issue*, 2001.

broadens the range of symbols that may be used as a distinctive mark, extends protection of well-known trademarks to their unauthorized use on different products, and sets out criteria for ascertaining well-known marks. Finally, it establishes protection for geographical indications in accordance with TRIPS. The copyright law establishes a communication right over the internet, sets out fair use limitations for electronic content consistent with two new treaties reached under the aegis of the World Intellectual Property Organization (WIPO), clarifies broadcast and rental rights, and recognizes that databases are copyrightable. Both the trademark and copyright laws clarify the amounts of compensation available to plaintiffs and methods for their calculation. In copyrights, foreign firms are now permitted to plead their cases with local copyright bureaus in addition to the National Copyright Administration.

This recent and ongoing activity should make China's IPRs legal regime fully consistent with TRIPS in the near term. In Section 4 we consider how appropriate these new standards may be for promoting economic development.

3. The Nature of Intellectual Property Rights

To analyze how IPRs influence economic development, it is important to understand their economic underpinnings. The need for IPRs arises from the social objective of promoting the creation of new types of information adding to the economy's knowledge base. These types of information include new products and technologies, new literary, musical, and artistic expressions, and indicators of product quality. An intellectual property right defines the extent to which its owners may legally prevent others from taking actions that infringe or damage the property. It may also be defined as the legal ability to set terms on which it may be used, subject to public-interest limitations on the scope of that ability. For example, patents provide exclusive use of a technology, but are granted only for a fixed period of time and in return for disclosing sufficient technical information to allow competitors to understand it and try to improve on it.

Public intervention is needed because the outcome of some intellectual effort may be potentially valuable but also easily copied and used by others, leaving little incentive to incur the original investment costs or to improve it. Without public support for

innovation the economy suffers from insufficient incentives to develop new products, technologies, and cultural works, making citizens worse off in the long run. An additional problem is that the social value of information is often greater than its private value because there are external benefits from new inventions. Examples include spillover cost reductions from new technologies to input users and network efficiencies from software systems.

At the same time, IPRs generate costs. Legal excludability imposes a static cost on users, reflected by the excess of price over marginal production cost. In the case of intellectual creations, this distortion can be significant because the marginal cost of supplying additional blueprints, DVDs, and computer programs is small. Additional costs are that IPRs encourage duplication of investment in R&D through patent races and generate wasteful efforts to assert and defend ownership rights and to extend them beyond the scope of those granted. Enforcement costs may be substantial.

Thus, there are complex tradeoffs facing the design of IPRs. China needs to strike an appropriate balance between the needs of creators, developers, and users, in accordance with minimum standards required by TRIPS.

One alternative to IPRs is direct government support for invention, including public monopolies in technology development, research institutes in agriculture and industry, and government subsidies to university research. Many such programs are important complements to IPRs in national innovation systems. However, the performance of China's public organizations and state-owned enterprises in commercializing products and services has been poor in the past. This failure arose largely from inadequate incentives within public research institutions to focus on new and marketable inventions.

It is useful to provide a brief description of the main forms of IPRs. Rights to exploit inventions with commercial uses are granted through patents, utility models or petty patents, and industrial designs. Patents provide the right to prevent for a fixed time (20 years under TRIPS) the unauthorized making, selling, or using the product or process described. Utility models provide exclusive rights for a shorter period to inventions that embody only a small inventive step. The scope of patent coverage is limited to uses of the novelty claimed by the inventor and recognized by patent examiners. The technology

must meet technical criteria for novelty (or non-obviousness), inventiveness, and industrial utility and must also survive procedures challenging validity. Patent applications are published for inspection by interested persons. The essential tradeoff in patents is to create a protected market position in return for disclosure of technical knowledge.

A related form of industrial property is plant breeders' rights (PBRs), which permit developers of new plant varieties to control their marketing and use. These rights operate much like patents, providing for fixed terms, requirements of distinctiveness in new plant strains, and disclosure rules. They are supposed to encourage development of new seed strains for agricultural use.

Rights to market goods and services under exclusive names and symbols are protected by trademarks and service marks. Registration may be renewed indefinitely, subject to use requirements. An important related device is the geographical indication, which permits the use of a particular place name where a good was produced to ensure that the product embodies quality characteristics of that region. Trademarks provide incentives for firms to invest in brand-name reputation and product quality and for their licensees to produce and sell high-quality goods. If marks were not protected, rival firms would ruin their value by selling cheaper items under those marks. Thus, the social benefits from trademarks include greater product variety and lower consumer search costs due to the absence of confusion.

Firms develop technological know-how that is important for production but may not be patentable or may have greater economic value if it remains undisclosed. Such trade secrets are protected by legal rules against unfair misappropriation. There is no exclusive right to the process if it is discovered by fair means, such as reverse engineering. Trade secrets protection is important because it supports the introduction of sub-patentable technological processes into commerce and also promotes competition through reverse engineering.

Artistic and literary creations are protected by copyrights, which are exclusive privileges to copy and distribute particular creative expressions for a fixed term. Related IPRs include neighboring rights of performers and broadcasters and moral rights of original creators to prevent future alterations of their works. Copyrights are subject to

limitations for social purposes, with the most prominent exception being the fair-use doctrine, under which others may use copies for scientific and educational purposes. Countries vary widely in the scope of their fair-use exceptions to copyright, particularly with regard to reverse engineering of computer programs.

Some new technologies do not fit easily within this framework. Computer software contains elements of both literary expression and industrial utility, raising questions about whether it should be covered by copyrights or patents. The TRIPS standard is for copyright protection, but the United States, Japan and other countries also provide patents. Similar questions arise regarding semiconductor chip designs, which achieve a special form of protection under TRIPS. Electronic transmissions of internet materials, databases, and broadcasts also raise concerns about the adequacy of copyright protection to encourage their development.

IPRs are enforced both to deter and punish infringement and to discipline rights holders that abuse their market power. Enforcement against basic infringement involves seizing unauthorized copies, destroying the associated facilities if necessary, and imposing fines and criminal sanctions. However, as claims about infringement or abuse, particularly in the patent realm, become more complicated courts must decide on their legality, which requires considerable legal and scientific expertise.

4. Intellectual Property Rights and Economic Development

Relationships between IPRs and economic development are extremely complex and available evidence is difficult to interpret.⁴ However there is a growing consensus that stronger IPRs can improve development prospects if they are properly structured.

4a. How IPRs Stimulate Economic Development

There are a number of ways in which IPRs protection can spur economic development and growth. To begin, a weak regime can stifle both invention and innovation even at low levels of economic development. Most inventions are specific to local market circumstances and can benefit from patent or utility model protection.

⁴ For extensive reviews see Evenson and Westphal (1997), Maskus (2000a), and Primo Braga, et al (1998).

Innovation usually involves minor adaptations of existing technologies, management systems, and quality control mechanisms, which can stimulate growth. Such investments tend to have high economic and social returns by raising productivity toward international levels. Evidence from Brazil and the Philippines suggests that effective systems of utility models can promote innovation.⁵ Another study demonstrated econometrically that Japan's system of utility models contributed positively and significantly to its postwar rise in productivity.⁶

Trademarks provide incentives for entry of new firms and development of new products, even in poor nations. Firms find it easier to innovate cumulatively as they grow larger and their trademarks are better recognized. This process has two positive effects on industrial development. First, it stimulates entry of small and medium-sized enterprises into specific markets. Second, it encourages more successful enterprises to grow and take advantage of scale economies through interregional production and marketing. Some may even become significant exporters as they improve quality.

Similar comments apply to copyrights. Sectors that are dependent on copyrights, such as publishing, recorded entertainment, and software, will experience limited entry by local firms in their absence. Creation of new films, music, and software is expensive and little worth the investment by local entrepreneurs if their products will be copied. Accordingly, society's long-run cultural and economic development is impaired.

Innovation goes beyond developing new products to establishing marketing and distribution networks. It is difficult to do this in an environment of weak IPRs because rights holders cannot readily prevent infringement. IPRs improve the certainty of contracts, permitting better monitoring and enforcement of rights at all levels of the supply network. In turn, both innovative firms and their distributors are more willing to invest in marketing and brand-name reputation.

As firms build reputations through trademarks, incentives grow to deter false use of those marks. Fake products sold under a misappropriated trademark can ruin reputations, particularly for new firms, and it is costly to overcome such damage. Thus, effective trademark enforcement should increase the average quality of products over

⁵ See Evenson and Westphal (1997).

⁶ See Maskus and McDaniel (1999).

time and permit consumers to be less wary of counterfeit goods. This is particularly important in cases of beverages, foodstuffs, and medicines.

Finally, IPRs can help disseminate knowledge. Patent claims are published and competitors may use the disclosed technical knowledge to develop further inventions. This cumulative process of invention, which depends on the narrowness of patent claims, can be an important source of technical change.⁷ Moreover, patents provide a legal basis for trading and licensing technologies. Trademarks and trade secrets also facilitate information exchange through ensuring that licensees do not abandon their contracts.

Considerable evidence suggests that international flows of technology depend on the strength of IPRs, among many other factors. For example, international trade in manufactures is positively affected by the strength of patent regimes in large developing countries.⁸ This trade often embodies technical knowledge that may be learned in recipient countries and adapted to local technological capabilities.⁹

Foreign direct investment, joint ventures, and technology-licensing contracts also transfer production knowledge. It is clear that the strength of IPRs influences choices by multinational firms on where to invest and whether to transfer advanced technologies. Studies of U.S.-sourced FDI find evidence that firms limit their investments in countries with weak patents.¹⁰ Survey evidence indicates that the level of technology transferred depends on the ability to maintain control over the technology through defense of intellectual property.¹¹ Licensing also tends to rise with stronger IPRs because of reduced contracting costs and greater legal certainty.¹²

4b. How IPRs Limit Economic Development

Tightened IPRs also impose economic costs. In poor countries there may be net losses in the short-run because the dynamic gains tend to take a long time to emerge.

⁷ See Scotchmer (1991).

⁸ See Maskus and Penubarti (1995) and Smith (1999).

⁹ See Coe, Helpman, and Hoffmaister (1997).

¹⁰ See Maskus (1998a) and Lee and Mansfield (1996).

¹¹ See Mansfield (1995) and Contractor (1980).

¹² See Yang and Maskus (2001).

The costs of administering and enforcing a modern IPRs system are high. For China they easily will amount to annual sums in excess of \$10 million.¹³ These costs include training of examiners, judges, lawyers, and enforcement officers, along with the costs of running various offices. Many of these costs may be covered by administrative fees charged to apply for and register patents and trademarks, while others may be reduced by using international registration agencies such as the Patent Cooperation Treaty (PCT), as does China.

The most visible aspect of IPRs infringement in China is unauthorized copying of recorded entertainment and software and selling products bearing counterfeit trademarks. Undoubtedly there are significant amounts of labor employed in copying and retailing illegitimate products in China. Thus, an important short-run cost of stronger IPRs will be labor displacement. The adjustment costs tend to be smaller in economies with flexible labor markets and rapid growth, making it easier to shift workers into legitimate activities. China has mixed prospects on this score and it is conceivable that copyright and trademark enforcement will contribute significantly to looming unemployment problems associated with economic reform.

Because IPRs raise the costs of copying and imitating products and technologies, learning technological knowledge through simple imitation could become more expensive in China. There is considerable anecdotal evidence that firms operating in China lose technologies to potential rivals through defection of technical personnel, misappropriation by input suppliers, copying of blueprints, and so on. Without effective trade secret protection, these activities are common and help establish competition. However, some important practical effects are that foreign firms tend to transfer older technologies, engage in less technical training, hide key aspects of know-how from sub-contractors and suppliers, and tend not to establish first-rate R&D facilities.

Thus, there is a balancing act to resolve. Stronger IPRs make uncompensated imitation more difficult but improve the quality of technology flows. Countries wishing to become significant technology developers should favor IPRs for that reason.

¹³ UNCTAD (1996) presents estimates of such costs in several developing countries.

Stronger IPRs create market power, from which firms may be able raise prices to monopolistic levels. This concern is particularly relevant in developing countries for two reasons. First, applications for protection come overwhelmingly from foreign firms, meaning that the associated profits are transferred abroad. Second, market competition may be weak, supporting monopolization. As will be discussed in the next section, China is in an intermediate position in this regard. Patent applications by domestic firms are rising rapidly but lag behind foreign applications. Broader economic reforms have improved competitive processes but the economy remains far from a situation of free entry and vibrant competition in technology and product markets.

Chinese authorities may be especially concerned about the implications of patent rights for prices of medicines. There is evidence that patents can support markedly higher prices for protected drugs than for copied and generic drugs.¹⁴ However, the extent of these price increases depends on the competitive aspects of markets. The more competitive the local drugs market is before patents are awarded, the larger is the share of drug production that consists of copies of patentable drugs, and the more inelastic is demand for medicines, the higher will be the price increases caused by patents. These conditions suggest that countries with extensive drug imitation and high demand could experience substantial price increases for protected drugs. In this regard, China's policy of public procurement at negotiated prices is appropriate for providing public health services.

Another area of concern is computer software. It is often claimed that software would be much more expensive with enforced copyrights because the current prices of legitimate copies in developing nations are very high compared to prices of unauthorized copies. However, in countries with high piracy rates software producers (or their distributors) tend to sell at low volumes and high markups, reflecting small markets with inelastic demand. In China such markets are largely limited to foreign-owned enterprises and government agencies. As markets broaden under copyright enforcement, foreign and domestic firms should supply more legitimate copies at lower prices, suggesting that ultimate price increases could be modest.¹⁵

¹⁴ See Watal (1999) and Lanjouw (1998).

¹⁵ Prices of copyrighted goods have fallen sharply in Taiwan since the aggressive crackdown on counterfeiting in the mid-1990s, in part because of additional competition from legitimate local developers.

Thus, there are legitimate concerns about market power supported by IPRs. However, competitive markets and appropriate regulation can mitigate these impacts without unduly reducing innovative incentives. IPRs need to be introduced into markets in which other competitive processes, such as firm entry, labor flexibility, distribution systems, and international trade, are operating effectively.

Competition is important because IPRs may be abused, as shown by litigation problems in the United States, the European Union, and elsewhere. Such abuses include bad-faith lawsuits, hidden ownership of intellectual property, restrictive patent pooling agreements, refusals to license technologies, tie-in sales in related markets, and insistence on exclusive rights to competing technologies. Thus, China must develop mechanism for ensuring competition maintenance in markets affected by IPRs.

4c. A Scorecard for China's IPRs Regime

With this background it is useful to assess informally the legal standards China has adopted in terms of how they may affect prospects for technical change and the provision of certain public goods.¹⁶ For this purpose, I compare China's regulations in several critical areas against benchmark standards, which are consistent with TRIPS requirements, for middle-income countries as set out by the World Bank (2001). China has characteristics of the dynamic middle-income countries, including a growing base of human capital and sophisticated capabilities in science and technology, suggesting that this comparison may be appropriate. However, it also suffers from substantial rural and urban poverty and many of its enterprises use technologies that lag significantly behind those in the modern sectors. Thus, it is difficult to provide definitive analysis of the nation's laws in this context and the following analysis is offered largely for purposes of illustration and discussion.

An overview is provided in Table 2. Thus, in the copyrights area, China provides TRIPS-standard terms of protection for creative goods, such as a once-renewable 25-year term for software copyrights (50-year maximum period). The essential question is whether the particular conditions of legal protection are sensible for China. For example,

¹⁶ See also Potter (2001).

it is recommended that middle-income countries provide fairly wide exceptions for fair use of copyrighted materials in education and scientific research. China's Copyright Law embraces this concept, permitting free use of copyrighted material in journals, periodicals, and broadcast media for purposes of disseminating news. It also allows the uncompensated making of copies for classroom use and scientific research and allows a free right to translate works from Han into minority languages. In software, users are permitted a limited right of decompilation for purposes of developing new programs, which should help the industry remain fairly open to incremental innovation and competition. However, the government is considering extending patents to computer programs, a standard that would exceed TRIPS requirements and is found only in the United States, Japan, and Australia.¹⁷ For a software sector that remains young and subject to considerable cross-fertilization of software through learning and reverse engineering, such a choice seems questionable for the medium term. Neither should China extend patents to methods of instruction or of doing business.

Other important issues exist in the copyright area. China has relatively weak complementary institutions for realizing economic returns to creative activity, including collection societies for licensing recorded music and gathering royalties. Indeed, only under the Amended Copyright Law of 2001 were copyright owners given the right to authorize collection associations to administer their rights. Further, because contract enforcement can be weak and uncertain, the ability of enterprises to allocate rights in creative works is limited. Such institutions are important for providing a full framework within which the development of artistic and literary work can grow beyond intermediate stages.¹⁸ To date China protects databases solely with copyright protection, as mandated by TRIPS, and clarifies that such protection cannot interfere with the independent rights of those who develop components of compilations. This minimum standard is appropriate for a country with a strong interest in access to information databases, and China should be wary of moving toward the much stronger standards in the European Union. Finally, ratification of the WIPO Copyright Treaty and the Treaty on

¹⁷ The European Union has moved recently toward the provision of patent protection.

¹⁸ See Caves (2000).

Performances and Phonograms could be beneficial in sorting out copyright protection for internet transmissions, so long as appropriate fair-use limitations are provided.

The Amended Trademark Law of 2001 clarifies the definition of well-known trademarks by setting out five criteria that must be met for achieving protection without registration. It remains to be seen whether these criteria will limit the unauthorized use of such marks by others and the regulation is unclear about how widely the restrictions on use will apply across sectors of business. That law also recognizes that well-known marks should be applicable to domain names on the internet, a provision that should promote wider content available to Chinese internet users.

Protection of confidential test data from disclosure provides applicants for patents in pharmaceutical and chemical products a period of exclusivity in the use of results from clinical trials. It seems advisable for middle-income economies with domestic research capabilities in medicines and biotechnology to provide such exclusivity for some period, but TRIPS is silent on the length of any such requirement. Surprisingly, China has opted to protect it for six years from application date, in comparison to the U.S. standard of five years. China's law may thus be overly protective from the standpoint of the encouragement of domestic competition. Next, China's law on unfair competition has no explicit language on the legality of restraints on the ability of employees to reveal technical secrets to rivals that may hire them, other than to declare void unfair "promises of gain". It is unclear what this statute covers and the ambiguity may be costly in terms of sorting out the scope of unfair competition in this area.

In its 2001 patent law, China retains appropriate exemptions from coverage for discoveries of nature, mental methods of arriving at results (such as computer algorithms and mathematical formulas), diagnostic and surgical treatments, and plant and animal varieties. Thus, China does not patent higher-order life forms or biological research tools. These limitations are widely advocated for developing countries with emerging biotechnology sectors in order to avoid locking up critical technologies that support additional research and learning. China's patent law does not permit experimental use of patented materials, however, which may be overly strong in the context of its development strategies. The country's standards covering government use, compulsory licenses, and utility models and designs are typical of middle-income economies.

Finally, China's plant variety law also seems appropriate for its needs. The patent law excludes such inventions from coverage, leaving them to variety protection. China's regulation permits the farmers' privilege to use propagating materials for re-planting and also permits experimental use for science and for rival breeders to develop new varieties.

4d. The Issue of Enforcement

As amplified in the next section, the largest remaining obstacle to effective use of IPRs in China is weakness in enforcement procedures. Recent legal changes increased the scope of enforcement considerably. As noted in Table 1, criminal sanctions are now available for cases of willful infringement, while the maximum permissible monetary sanctions were increased. Preliminary injunctions and orders for seizure of suspected infringing goods now may be issued, which are important components of timely relief for IPRs owners. Courts may also order compensatory damages, though this standard is weaker than what might be required to deter infringement *a priori*. Finally, enhanced access to judicial review is provided, which is consistent with prior efforts by the Chinese government to strengthen its enforcement mechanisms.

Whether improvements in enforcement are liable to be in China's favor as a development issue depends on how economic agents respond to the changed incentives. As noted above, it is likely that this factor will generate higher equilibrium inflows of technology transfer. However, the essential question is whether it will expand incentives for local business development. The following section provides evidence that this expansion should occur.

5. The IPRs Situation in China

To provide more concrete perspective on the potential impacts of IPRs reform, consider the current situation regarding the use and adequacy of such rights. First, I discuss results of interviews conducted in 1998 and 2001 of public officials, university scholars, and enterprise managers. The evidence paints a consistent picture and is not much changed in 2001 from three years earlier. In fact, a number of interviewees described the situation with respect to enforcement of IPRs to have deteriorated in that

period. Second, I consider recent patent and trademark statistics in China. These figures suggest that the use of formal IPRs is growing rapidly but there are significant regional disparities. Overall the analysis suggests that the IPRs regime for invention and innovation is improving in China but there remain significant problems.¹⁹

4.1 Discussion of Interview Findings

Management officials and intellectual property managers of enterprises from several IPR-sensitive industries were interviewed. The enterprises represented a mix of state-owned enterprises (SOEs), private Chinese enterprises, joint ventures with international firms, and majority-owned subsidiaries of multinational enterprises. Most firms in the last category are in high-technology sectors and have significant R&D programs in their home countries, though some do in China as well. Thus, the sample is not representative of the bulk of Chinese industry at this time but is more focused on product and technology development.

Overwhelmingly, enterprise managers believe that the legal structure for IPRs in China has improved markedly and is now adequate. However, the majority think the enforcement environment remains quite weak, while the rest find it to be weak but improving. Interestingly, Chinese enterprises tend to view the system as improving more rapidly than do foreign-owned enterprises and joint ventures. Many high-technology Chinese enterprises applaud the new legal climate, which allows them scope for defending their intellectual property.

Unquestionably the main problem facing firms wishing to exploit intellectual property in China is inadequate enforcement. There can be long delays in enforcement actions and court rulings. Prior to the legislative changes in 2001, monetary penalties were small even in cases of significant infringement and there was little scope for criminal prosecution of willful and ongoing violations. The new laws increase maximum fines and clarify the nature of criminal activity, but some interviewees thought these changes would be insufficient to deter infringement. Enforcement actions can be arbitrarily taken and non-transparent. The central government and certain regional and

¹⁹ See also Dahlman and Aubert (2001).

municipal governments are taking steps to reduce these problems. Several enterprise managers in 2001 positively commented on this change.

There are several structural sources of weak enforcement. First, trademark infringement and illegal copying remain profitable and face little opposition, especially in rural and inland regions. Second, enterprises engaged in infringement often are important employers and sources of revenue for local governments. Third, low salaries for public officials may reduce their effectiveness as enforcement agents, while administrative programs may be underfunded. Fourth, legal and technical expertise for administrative and judicial operations is limited despite the existence of special training programs in IPRs.

Among these problems, “regional protectionism” in IPRs is regarded as the most difficult to confront by enterprises suffering infringement. There is little coordination among regional bureaus of the Administration for Industry and Commerce (AIC). Moreover, the regional AICs have weak administrative powers and actions of municipal governments may supercede them. Municipal government officials may well have priorities that take precedence over IPRs enforcement.

Managers of both Chinese and foreign-affiliated enterprises expressed the view that weak enforcement of IPRs results in widespread copyright and trademark infringement. A major problem is that trademark violations often target innovative Chinese enterprises and thereby deter local business development. Examples were given of problems facing Chinese-brand producers of such consumer goods as medicines, soft drinks, processed foods, tobacco products, and clothing. Enterprises selling electronics products seemed particularly vulnerable. Once brand recognition is achieved, domestic enterprises find their trademarks applied to unauthorized products of lower quality, damaging the original enterprise’s reputation. In some cases, Chinese enterprises either had to give up on their trademarks and become licensees of better-known enterprises, or undertake extensive private and public enforcement actions. It is impossible to know how much this problem hampers industrial development but the impact could be significant.

Weak enforcement also impedes efficient use of patents and trade secrets. Patent infringement seems to be most common in utility models, which are easy to copy but are

overwhelmingly owned by Chinese enterprises. Several foreign enterprises also claimed to have lost patented technologies through unfair means, such as former employees selling design specifications and technical manuals. According to one industry association, such cases are becoming more common and increasingly targeted on sophisticated technologies. Interviewers claimed that many foreign companies are considering more carefully whether they wish to transfer advanced technologies into the Chinese economy.

Defection of technical and managerial employees remains a basic problem for both foreign-owned and Chinese enterprises. In economic terms a balance is needed between promoting mobility of skilled labor, which raises diffusion and competition, and discouraging uncompensated losses of technical knowledge, which can reduce competition over time. Both foreign and domestic enterprises attempt to manage the problem with temporary anti-disclosure clauses, but such contracts have been difficult to enforce in China. As noted earlier, recent changes in the law have not clarified this issue.

Most respondents agreed that the environment for selling copyrighted materials is improving in China, though pirating of software, games, DVDs, and music remains common. While large foreign firms claim significant harm from such copying, it is likely that relatively larger losses are suffered by Chinese entertainment and publishing interests. For its part, the Chinese software industry is growing rapidly, largely because of a substantial base of skilled software engineers and managers. However, according to many interviewees, such firms concentrate on developing small-scale programs that attract less copying, such as business applications or limited-run games. This problem could delay the establishment of Chinese-developed software standards and networking software.

There are significant differences between Chinese and foreign-owned businesses in their ability to deal with trademark and other IPRs-related violations. Foreign companies have more resources to combat infringement than domestic enterprises. An enforcement action is a significant expense for a small or medium-sized Chinese operation. In that sense, enforcement difficulties are biased against Chinese business development. Furthermore, foreign companies, particularly Western ones, are more inclined to seek legal solutions to IPRs problems.

Foreign companies may undertake more defensive actions in the presence of weak IPRs. Managers of most foreign enterprises indicated a reluctance to locate R&D facilities in China, though this is changing rapidly as the legal environment improves. Nearly all indicated that in the past they transferred technologies that are at least five years behind global standards in the expectation that those technologies would be lost to local competition, or brought in technologies that would be obsolete quickly. Foreign enterprise managers are often reluctant to license technologies, preferring joint ventures and majority-owned subsidiaries in which they can exercise greater control of proprietary secrets. Enterprises are unlikely to integrate fully their Chinese operations, splitting various production processes among facilities in order not to reveal fully the underlying know-how.

Other defensive measures are used by both Chinese and foreign companies. One is to sell only to established customers that need assured quality, such as hospitals, large enterprises, and public agencies. This acts as a barrier to entry of small firms needing the associated products or inputs. A second is to establish strict vertical supply and distribution chains to permit monitoring of quality. A third is to employ technical safeguards, such as software locks and encrypted source code that must be decoded to operate software upgrades.

It is impossible to know how these distortions associated with weak IPRs contribute to economic inefficiency in China, though the effects presumably are significant. If so, stronger IPRs over time will generate important static and dynamic efficiencies.

For their part, public officials often raise concerns about the potential impacts of stronger IPRs on prices and competition. Some officials also recognize that stronger IPRs need to be accompanied by other policy measures to build technological capacities and maintain competition. However, this recognition only recently has been translated into such policy initiatives as the Standards Office within the State Industry Commission, which will establish uniform national standards for information networks, including copyright provisions.

4.2 Patent and Trademark Activity in China

Despite these problems, data on patent and trademark use indicate that both foreign and domestic enterprises are applying for more protection. Table 3a presents figures on applications to the State Intellectual Property Organization for all three types of patents from 1994-2000. Domestic enterprises more than doubled their applications for invention patents, while foreign applications rose by 235 percent. From 1996 through 1999 foreign applications considerably exceeded domestic applications. A significant rise in Chinese domestic applications in 2000 virtually equalized the number for that year, however. On this measure, Chinese enterprises are now applying for nearly as many invention patents, with their higher inventive content, as are foreign enterprises.²⁰

In contrast, applications for utility models and design patents overwhelmingly are filed by Chinese organizations. In both categories domestic applications rose far faster than foreign applications. Thus, these rewards aimed at encouraging small-scale invention seem to be having their desired effect on domestic innovation.

Table 3b shows data for patent grants and the ratio of cumulative grants to cumulative applications over the same period. There was a rapid increase in grants of invention patents to both domestic and foreign applicants, with the former nearly catching up to the latter by 2000. The aggregate grants ratios for invention patents are surprisingly low, perhaps reflecting long examination delays. Grant rates are much higher in utility models and design patents, which are easier to examine and carry shorter protection periods.

Tables 4a and 4b indicate trends in bilateral invention patenting activity between China and key trading partners.²¹ Chinese patent applications abroad rose sharply between 1996 and 1998 in all countries listed save India, suggesting an increasing international orientation of Chinese innovation. However, China remains well behind most developed countries in terms of bilateral applications flows, with the United States and Japan together applying for some 37,000 patents in 1998 in that country. Despite the increase in Chinese applications abroad, only Japan actually granted rising numbers of invention patents to Chinese inventors.

²⁰ It is conceivable that the increase in Chinese applications come primarily from joint venture partners of foreign enterprises but unfortunately the available data do not make this distinction.

²¹ Because these data were taken from WIPO they include applications made under the Patent Cooperation Treaty.

Table 5 provides a breakdown of total domestic patent applications for the top eleven patenting regions in China over 1985-96 and 2000. Residents of Guangdong applied for over 21,000 patents in 2000, while people in Hebei applied for less than 4,000. Better measures of inventive capacity are given in the final two columns as applications per million people and applications per million yuan of regional GDP. In these rankings Beijing is at the top of the list, with far more applications per capita and per unit of output than any other province. This reflects both Beijing's status as a technology developer and the fact that many patent registrations come through legal offices in the capital. Shanghai has the second highest applications per person, but ranks sixth in applications per yuan of GDP. Fujian and Hebei rank low in both categories.

The middle column ranks these regions in terms of average income per capita. There are large regional disparities in income levels, ranging from Sichuan at the bottom to Shanghai at the top. The difference between them is a factor of 5.6, which is extraordinarily high for regions within a country. It is interesting to correlate per-capita GDP with the relative patent application figures. There is a strong positive correlation (0.54) between GDP per capita and patent applications per million people. Thus, richer provinces apply for more patents (develop more products) per person than poor provinces. The correlation between GDP per capita and applications per million yuan of GDP is higher (0.78). Accordingly, higher incomes are associated with greater innovation propensities, which in turn raise regional economic growth.

We do not show data for trademark registrations but they tell a similar story. In particular, trademark applications have risen rapidly since 1994, especially those through the Madrid Protocol. Far more domestic marks are registered than foreign ones but foreign applications have increased at a faster pace. In terms of regional performance, Guangdong had the largest absolute number of applications in 2000, followed by Zhejiang and Jiangsu. Scaled by population, however, Shanghai ranked first by a large margin, followed by Beijing, Zhejiang, and Guangdong. There is a very high correlation (0.81) between per-capita GDP and per-capita applications, reflecting again that trademark applications rise with income levels.

Thus, the use of patents and trademarks is rising rapidly in China. One reason is that laws have been strengthened and fees reduced, encouraging more applications. A

second is that as trademark and patent infringement have increased, both domestic and foreign enterprises recognized the importance of establishing intellectual property protection, even in an environment of weak but improving IPRs. A third is that Chinese markets are getting deeper as income grows, despite the substantial barriers to interregional integration. Registration of IPRs is important for exploiting deeper markets. The final reason is that Chinese research organizations and enterprises are engaged in more invention and Chinese firms are undertaking more innovative activity.

5. Conclusions and Recommendations

In recent years China has made significant progress on the legislative end of intellectual property rights, especially in preparation for its entry into the WTO. The specific standards it has adopted across the range of intellectual property regimes are largely consistent with what might be recommended for middle-income developing countries with strong innovation potential. However, in some dimensions the new Chinese standards may be overly protective for an economy that remains largely a net importer of new technology and information. At the same time, China continues to experience severe enforcement problems. Enforcement is likely to be problematic for the intermediate term because of structural difficulties with the system and because costs of copying and counterfeiting remain small relative to prices of legitimate products.

China is undergoing a long process of increasing sophistication in technology use and development. Three important problems arise with IPRs as concerns this transition. First, inadequate enforcement of IPRs limits incentives to develop products and brand names, especially on the part of small and medium-sized domestic enterprises. This structural difficulty likely limits entry of new firms and the development of entrepreneurial skills. It also restricts the ability of enterprises to market nationally and to take advantage of economies of scale, and tends to reduce investment in quality improvements. Over time, this situation could make it increasingly difficult to break into export markets for high-quality and high-technology goods.

Second, Chinese enterprises and research organizations are engaging in more innovation, as suggested by the patent and trademark statistics. However, as shown elsewhere the country remains behind global standards in allocating resources to R&D and science (Maskus, et al, 1998). Moreover, interviewees noted that SOEs and state

research institutions face structural difficulties in commercializing the results of invention. This points out the importance of continuing to develop a technology innovation system that encourages innovative activity.²² The state has important roles to play in promoting pre-competitive research and removing disincentives to commercialization. China has made progress toward these goals, with support programs in information technology, biotechnology, and other important areas, along with efforts to raise the flow of knowledge from institutes and universities to producing enterprises. Nonetheless, ambiguities remain about effective ownership of intellectual property rights. This is another reason that the new system of IPRs should be an important component of the evolving innovation system.

Third, stronger IPRs alone are not sufficient to establish effective conditions for further technology development and growth. Rather, they must be embedded in a broader set of complementary initiatives that maximize the potential for IPRs to be pro-competitive over the long term.²³ An important complement is development of human capital through education in science, technology, and law and acquisition of skills through training in enterprises. Enterprises should be more willing to undertake such training under an improved IPRs regime. Both directly and indirectly, then, effective IPRs can help Chinese enterprises raise their technological capabilities, which is critical for adaptation of foreign technologies and innovation of new products.

Another supporting factor is to ensure that competition on domestic markets is sufficient to prevent stronger IPRs from becoming a damaging source of market power. Further enterprise reform and deregulation, are important in this context. Over time the liberalization commitments made in the WTO will provide important competition as well.

Finally, like other countries China has the right to safeguard its interests in competition and social objectives through effective regulation of IPRs as those rights become stronger. Thus, the government should think through the appropriate form of pricing regulations and compulsory licensing in its drug procurement programs as medicines receive stronger protection.

²² Dahlman and Aubert (2001) discuss this in detail.

²³ See Maskus (2000a) for more detailed discussion.

Moreover, an opportunity arises for China to consider what form of competition regime it will implement as it shifts further toward the market. Currently China tries to maintain competition through centralized regulation of market structure, ownership, and innovation, a system that will become increasingly incompatible with needs for technological change. Thus, a shift toward anti-monopoly regulation of such IPRs abuses as monopoly pricing, restrictive licensing arrangements, and refusals to deal is important. China may also need to employ compulsory licenses for this purpose. Such regulation needs to be well defined, non-discriminatory, and professionally applied by the competition authorities and courts in order to be effective. This points again to the need for building legal expertise in IPRs over the long term.

The authorities in China expect that the stronger IPRs regime set in place by new legislation and increased efforts at enforcement will support dynamic gains in technology acquisition and innovation. This outcome seems achievable in those regions and sectors that are technologically dynamic. At the same time, however, substantial differences in incomes, education, and entrepreneurship persist among regions, while much of the country remains poor. It will be a significant challenge for China to develop a comprehensive approach to regulating the use of IPRs that helps bring these poorer regions and groups more fully into the modern commercial system.

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Table 1. Substantive Requirements of the TRIPS Agreement in the WTO

<i>General Obligations</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
National Treatment	Applied for persons	Discrimination in copyright enforcement, trademark agents, and trade secrets protection	Remove discrimination
Most Favored Nation	MFN with reciprocity exemptions for copyright	Member of Berne Convention; TRIPS-compliant	
<i>Copyrights and Neighboring Rights</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Term of protection	Life + 50 years; 50 years corporate	TRIPS-compliant	
Computer software CR	Copyright	TRIPS-compliant	Discussing patents
Data compilations	Copyright	Not protected	Protect with copyright
Phonogram producer and performer rights	Right to prevent fixation, reproduction, or broadcasting for 50 years	Inconsistent with TRIPS	Clarify compensation system; strengthen rights
Broadcast rights	Right to prevent fixation, reproduction, or broadcasting for 20 years, or copyright	Inconsistent with TRIPS	Provide right of communication to public
Rental rights	Right to prohibit rental of computer programs and movies	Not protected	Provide rental rights
Discrimination in enforcement procedures	National Treatment	Foreigners could not use local copyright bureaus	Remove discrimination

Table 1. Substantive Requirements of the TRIPS Agreement in the WTO, continued

<i>Trademarks</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Well-known marks	Protected without requiring registration	No criteria for defining “well-known”; none granted to foreigners	Protect well-known marks; establish criteria
Use restrictions	Use not required for registration; import restraints cannot be used to invalidate use	Law is unclear on prior use	Comply with TRIPS
Symbols protected	Rights extend to distinguishing names, letters, numerals, colors	Certain signs are ineligible	Comply with TRIPS
<i>Geographical Indications</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Basic protection	Prevent misleading claims of origin	Not protected	Comply with TRIPS
Wines and spirits	Prevent use of such words as “style” or “like”	Not protected	Comply with TRIPS

Table 1. Substantive Requirements of the TRIPS Agreement in the WTO, continued

<i>Patents</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Eligibility	Basic exemptions	Probably TRIPS-compliant	Clarify compatibility with TRIPS
Pharmaceutical products	Covered; interim marketing rights	TRIPS-compliant	
Living organisms	Micro-organisms and biological production processes covered; “higher-order” life optional	TRIPS-compliant; plant and animal varieties excluded	Considering patents
Term of protection	20 years from filing	TRIPS-compliant	
Rights	Exclude others from production, use, or distribution	TRIPS-compliant	
Compulsory licenses	Wide scope for use with compensation and limiting conditions	TRIPS-compliant	
Burden of proof in process patent infringement	Falls on defendant	TRIPS-compliant	

<i>Industrial Designs</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Term of protection	10 years from filing	TRIPS-compliant	
Textile designs	Covered	Protected by copyright	Considering design patents
<i>Plant Varieties</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Basic protection	Plant breeders' rights to prevent commercial production or marketing of propagating material	Plant breeders' rights with farmer's privilege and research exemption (UPOV 1978)	
Stronger protection	Patents optional	No patents	
<i>Integrated Circuits</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Term of protection	10 years from filing	TRIPS-compliant	
Rights	Prevent distribution of IC's or IC-using products	TRIPS-compliant	
Exceptions	Non-voluntary license	TRIPS-compliant	
<i>Trade Secrets</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Protection from unfair disclosure	Defines boundaries of unfair practices	TRIPS-compliant	
Test data for pharmaceuticals and agricultural chemicals	Protection from disclosure for unspecified period and unfair use of undisclosed data	Unfair use not prohibited	Protection for six years from date of marketing approval

Table 1. Substantive Requirements of the TRIPS Agreement in the WTO (continued)

<i>Control of anti-competitive practices</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Compulsory licenses	Wide latitude for use subject to conditions and consultations	Weak consultation provisions	Comply with TRIPS
Exhaustion	No standard	Depends on form of IPR	
<i>Enforcement</i>	<i>TRIPS Norm</i>	<i>Pre-WTO Status of Chinese Law</i>	<i>Actions</i>
Sanctions	Civil and criminal sanctions and border measures	In existence but weak enforcement action	Enhance enforcement
Provisional measures	Preliminary injunctions and seizures	Not fully available	Comply with TRIPS
Damages	Adequate to compensate victim of infringement	Generally low or no compensation	Comply with TRIPS
Administrative actions	Enforcement may be through administrative actions	Available but costly and tends to result in small fines	Enhance enforcement
Judicial review	Must be available	Not widely available	Enhance review procedures

Table 2. An Assessment of China's IPRs System for Development Purposes

<i>Area of IPRs</i>	<i>Middle-Income Standards</i>	<i>China's post-WTO Standards</i>	<i>Commentary</i>
<i>Copyrights</i>			
Fair use exceptions	Liberal exceptions for education and research	Same	Important for research and technology access
Computer software	Copyrights with decompilation and fair use	Permit limited decompilation and fair use; considering patents	Patents may be overly protective
Market institutions	Improve collection societies and rights contracts	Weak institutions	Improvement would be beneficial
WIPO Treaties	Adopt minimum standards	Considering ratification	Could improve internet content and access
Data compilations	Copyrights with creativity requirement	Same	Avoid EU-type protection
<i>Trademarks</i>			
Well-known marks	Narrow definition of sectoral coverage	Unclear	Clarify scope and recognize well-known marks
Domain names	Protect against fraudulent registration	Same	Important for promoting internet use
<i>Confidential Information</i>			
Test data	Short period of protection from disclosure	Six years of protection	Stronger than U.S. standard
Disclosure Restraints	Limited restraints on what employees may reveal to new employers	Unclear limitation on "promise of gain"	Ambiguity may be detrimental

Table 2. An Assessment of China's IPRs System for Development Purposes, continued

<i>Area of IPRs</i>	<i>Middle-Income Standards</i>	<i>China's Post-WTO Standards</i>	<i>Commentary</i>
<i>Patents</i>			
Exemptions from eligibility	Exemptions for discoveries, algorithms, medical treatment methods, plants and animals	Same	Appropriate to retain exemptions
Novelty	Consider oral prior art	Oral prior art in China	Scope could be widened
Inventiveness	High step	Notable progress	Unclear
Scope of claims	Narrow claims and narrow doctrine of equivalents	Single claim; scope unspecified	Depends on examiners
Experimental use	Permit experimental use	Not permitted	May be overly strong
Exhaustion	International exhaustion	National exhaustion	Strong protection
Government use	For clear public interest	Same	Appropriate
Compulsory licenses	Permitted under TRIPS conditions	Same	Appropriate
Utility models and designs	Short duration, low inventiveness	Ten-year duration, same	Appropriate
<i>Plant Varieties</i>			
Farmers' privilege	Recognize farmers' privilege	Recognized	Appropriate
Breeders' Exemption	Use for breeding and scientific research permitted	Permitted	Appropriate

Table 3a. Patent Applications by Type and Nationality, 1994-2000

	Invention Patents		Utility Models		Design Patents		Total Patents	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
1994	11191	7876	45188	323	11428	1729	67807	9928
1995	10018	11618	43429	312	15433	2235	68880	14165
1996	11471	17046	49341	263	21395	3219	82207	20528
1997	12713	20953	49902	227	27456	2957	90071	24137
1998	13726	22234	51220	177	31287	3345	96233	25756
1999	15596	21098	57214	278	37148	2905	109958	24281
2000	25346	26401	68461	354	46532	3588	140339	30343
Growth	126.50%	235.20%	51.50%	9.60%	307.20%	107.50%	107.00%	205.60%
Total	100061	127226	364755	1934	190679	19978	655495	149138

Table 3b. Patent Grants by Type and Nationality, 1994-2000

	Invention Patents		Utility Models		Design Patents		Total Patents	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
1994	1659	2224	32611	208	5507	1088	39877	3520
1995	1530	1863	30195	276	9523	1677	41248	3816
1996	1383	1593	26961	210	11381	2252	39725	4055
1997	1532	1962	27185	153	17672	2488	46389	4603
1998	1655	3078	33717	185	26006	3248	61378	6511
1999	3097	4540	56094	274	32910	3241	92101	8055
2000	6177	6506	54407	336	34652	3267	95236	10109
Growth	272.30%	192.50%	66.80%	61.50%	529.20%	200.20%	138.80%	187.20%
Total	17033	21766	261170	1642	137651	17261	415954	40669

Grants Ratio	17.00%	17.10%	71.60%	84.90%	72.20%	86.40%	63.50%	27.30%
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Source: State Intellectual Property Office of The People's Republic of China, *2000 Annual Report*

Table 4a. Bilateral Invention Patent Applications, 1994-98

Country	1994		1996		1998		
	by China in foreign	in China by foreign	by China in foreign	in China by foreign	by China in foreign	in China by foreign	
USA		190	8105	246	14892	436	25634
Japan		137	3742	145	7212	373	11301
Germany		172	2094	210	3631	624	6599
UK		188	2028	224	2656	627	4216
Australia		87	692	101	746	295	1067
R. of Korea		84	569	97	1645	309	2076
Brazil		85	20	100	39	290	104
India		21	8	54	6	15	21

Table 4b. Bilateral Invention Patent Grants, 1994-98

Country	1994		1996		1998		
	to China by foreign	by China to foreign	to China by foreign	by China to foreign	to China by foreign	by China to foreign	
USA		48	701	46	449	72	785
Japan		5	579	29	445	7	927
Germany		16	213	15	148	7	318
UK		21	94	29	66	12	133
Australia		4	24	5	20	14	36
R. of Korea		0	48	0	49	2	149
Brazil		2	4	0	1	5	2
India		5	2	1	0	0	3

Note: data include applications under Patent Cooperation Treaty. Source: World Intellectual Property Organization, *Industrial Property Statistics*, various years

Table 5. Patenting Indicators for Top Patenting Regions, 1985-96 and 2000

Region	Applications 1985-96	2000	2000 GDP per capita, yuan	2000 Applications per million of population	2000 Applications per million yuan of GDP
Guangdong	42159	21123	11180.55	487.84	436.33
Shanghai	21758	11337	27187.57	1299.76	478.07
Beijing	54348	10344	17936.32	3932.56	2192.51
Zhejiang	29197	10316	12906.56	624.27	483.68
Shandong	37082	10019	9408.97	408.44	434.09
Jiangsu	34983	8211	11538.99	470.33	407.60
Liaoning	38768	7151	11017.23	914.77	830.31
Sichuan	27046	4496	4814.86	324.72	674.41
Fujian	11027	4211	11293.86	317.69	281.29
Hunan	26400	4117	5732.76	409.94	715.08
Hebei	20584	3848	7545.91	305.22	404.48
Correlation with GDP per capita				0.54	0.78

Sources: The Patent Office of the People's Republic of China, *Annual Report, 2000* and State Statistical Bureau, *China Statistical Yearbook 2000*, Author's Calculations