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TRIPS and ICT Developments in Developing Countries: Do 'One-Size-Fits-All' Standards Work?

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Abstract: Since the introduction of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), its impacts on developing countries have been widely discussed by scholars. In this article, we focus on the impacts of stronger Intellectual Property protection, pushed by TRIPS, on Information and Communications Technology (ICT) potentials and performances of the developing countries at different stages of economic development. By comparing ICT developments of 10 countries, the paper suggests that the one-size-fits-all minimum standards of TRIPS do not fit into development demands of developing countries at various economic levels. Developing countries should be entitled more flexibilities on IP protection to let it serve their goal of technology transfer, indigenous innovations and economic development.

Key words: Developing Countries, ICT, Innovation, TRIPS

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Acronyms

GIPC	Global Intellectual Property Center
GPT	General Purpose Technology
ICT	Information and Communications Technology
IDI	ICT Development Index
IIPA	International Intellectual Property Alliance
IMF	International Monetary Fund
IPR	Intellectual Property Rights
ITU	International Telecommunication Union
LDCs	Least Developed Countries
MDGs	Millennium Development Goals
OECD	Organization for Economic Co-operation and Development
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UNECA	United Nations Economic Commission for Africa
WB	World Bank
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

‘When we talk about the new economy, we’re talking about a world in which people work with their brains instead of their hands. A world in which communications technology creates global competition – not just for running shoes and laptop computers, but also for bank loans and other services that can’t be packed into a crate and shipped. A world in which innovation is more important than mass production. A world in which investment buys new concepts or means to create them, rather than new machines. A world in which rapid change is a constant. A world at least as different from what came before it as the industrial age was from its agricultural predecessor. A world so different its emergence can only be described as a revolution.’

--Wired Magazine 1998

1 Introduction

This thesis analyzes the impacts of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement on the Information and Communications Technology (ICT) sector in various developing countries. TRIPS has been promoted as a method to encourage innovation in developing countries. In this paper, we focus on innovation performances and potentials of developing countries in the ICT sector. The analysis is based on data of indicators of ICT potential and performances of 10 selected developing countries. It focuses on two aspects: First, it looks at the rationale of a global promotion of intellectual property rights (IPRs) – TRIPS in the era of information and knowledge. Second, it analyzes how the TRIPS agreement have impacted on the penetration and innovative performances in the ICT sector among different groups of developing countries, as their levels of development are different.

In general, this paper contributes to the discussion of the impacts of TRIPS on developing countries, which belongs to the bigger topic of development issues. Progresses and stagnations in the ICT sector since the introduction of the TRIPS agreement is an interesting and relevant topic in this field. First, ICT contributes to economic development, while the economic level determines the capability of a country to absorb and innovate in ICTs. Available data of OECD countries show that ICT investment typically take up between 0.3 and 0.8 percentage points of growth in GDP per capita over the 1995 to 2001 period. (OECD, 2003) As for its importance to the economic development of developing countries, ICTs are perceived as an important catalyst to achieve the Millennium Development Goals. (Lanz, 2013) Second, the development of ICT relies on IPR, while the prevalence of IPR has been caused by ICT to a large extent. ICT has been a major driver our contemporary knowledge economy, in which ‘globalization is one of the most important issues of the day, and intellectual property is one of the most important aspects of globalization.’ (Stiglitz, 2008: 1695) Revolutions in ICT have made globalization a reality, and globalization has highlighted the significance of IPR in trade, which led to the TRIPS to reconcile conflicts of interests regarding intellectual property. Lastly, IPR allocates income between countries, between innovators and the users of innovations. The international IPR regime, represented by TRIPS, regulates the production of knowledge and the right

of access to knowledge, which is ‘at the center of how well this new economy, the knowledge economy, works and of who benefits’. (Stiglitz, 2008: 1695)

On the one hand, the TRIPS Agreement is a profound determinant of the current and prosperous economic development of countries. It is a historically unprecedented international harmonization of IPRs, as it introduced a comprehensive set of minimum protection standards of intellectual property into the World Trade Organization (WTO), the multilateral trading system, for the first time. (WTO, Intellectual Property: Protection and Enforcement) One of the main purpose of the patent system is to promote innovations, and the importance of innovations has been increasingly emphasized by countries. It is now a widespread consensus that technical progress is the major determining factor behind economic progress (Granstrand, 2005). Closely related to science and technology, innovations are perceived as the main technique for a country to boost technical, as well as economic progress. Aiming at protecting and facilitating innovative activities, the TRIPS is such a crucial international arrangement that it has been taken as a measure to eliminate barriers to worldwide trade, which are supposed to contribute to economic performances of a country. Now, the importance of innovation has been acknowledged to an extent that even the developing countries on the periphery are emphasizing the need to boost indigenous innovations. In brief, innovations are crucial to economic development, and the TRIPS Agreement is the overarching international arrangement governing trade related national innovation activities. Therefore, whether the TRIPS fits circumstances in developing countries decides whether the gap between the developed and the developing becomes wider or narrower.

On the other hand, the ICT sector is relevant in the discussion of TRIPS. TRIPS is a global regime that ensures minimum protection of IPR in all WTO member countries, and IPR is the property-like rights of knowledge. The ICT sector has transformed and will continue to transform the ways of production, accumulation and dissemination of knowledge to a large extent. How ICT or ICT related IPRs are protected globally can decide how much societies need to pay to grasp knowledge and build new ideas and innovations on this knowledge. Therefore, ICT and ICT related IPRs can determine how many benefits developing countries can enjoy from easy access to abundant knowledge provided by ICT.

Although it is clear that IP protection in the ICT sector set by the TRIPS agreement is a crucial factor of economic development of developing countries, it is not clear whether it is a positive or negative factor. Evidence supports that trade in ICT, such as in computer software, makes considerable contributions to technology transfer. Trade has played a significant role in technology convergence in industrial economies over recent decades, and it has taken up the major part of productivity gains across borders. (Coe and Helpman 1995) Theoretically, the implementation of TRIPS removes barriers to free trade in ICT between the developed and developing countries, thus it facilitates technology transfer and technology convergence, and even helps to close the economic gap between them. However, for one thing, developing countries, especially the least developed countries, lack the

necessary technological abilities. A report commissioned by the ICT, Science and Technology Division (ISTD) of the United Nations Economic Commission for Africa (UNECA) has pointed out that African countries do not have the scientific, technological and innovative capacity to effectively address the challenges that it confronts (Adia, Science, Technology and Innovation). For another, the increasing popularity of using IPRs as the method to compensate for investments of innovators in order to promote innovations has led to major expansion of IPRs, enclosing previous public domains into the private. As a result, it is costly for developing countries to take advantage of western technologies, making it even harder for them to catch-up.

Therefore, the major concern of TRIPS in this paper is that TRIPS is a one-size-fits-all arrangement regulating developed as well as developing countries. Although it takes into account needs of the developing countries by allowing them longer periods of transition, it still imposes the same protection standards to all members. Moreover, developing countries are heterogeneous, as 'developing countries have substantial differences regarding technological capacities to produce and adapt technology'. (Ghio, 2011) For example, developing countries can be divided into three groups according to their technology capabilities: countries that are technological innovators who are able to produce technology, such as Brazil, India and China; countries that are technological adapters who can localize and adapt technology, such as Argentina and South Africa; and countries that are technologically excluded from innovation, such as the vast majority of the African and Caribbean countries (Sachs, 2002). Therefore, it is relevant to research on how these same standards of TRIPS have worked on innovation activities in developing countries at different stages. Particularly, this paper focuses on how the TRIPS rules have affected different developing countries in the ICT sector.

2 Theoretical discussion: the nexus of economic developments, innovation, IPR and ICT

With developments in theories on innovations, the importance of innovation on economic developments has received growing recognition, over which process Intellectual Property Rights have been utilized as one of the main method to motivate innovative activities. In other words, the importance of IPRs in ICT originates from their nexus to economic developments through innovations, therefore, in this sector we look at theoretical constructions of this line of relation.

2.1 Importance of innovation in promoting economic development

The relation between innovation and economic performance is one of the most important topic in economic studies. First of all, to talk about innovations, we must know what an innovation refers to. According to the Oslo Manual, an innovation is 'the implementation of a new or significantly improved product (good or service), or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations'. (Oslo Manual, 2005: 46) A narrower definition of

innovation can be one that only include product and process innovations, used in previous editions of the Oslo Manual. From the definition we should remember that an innovation does not equal an invention. An innovation must have been implemented into the actual practices of business actors.

Looking at the whole history of the world economy of the human society, economists deem it undisputed that the most powerful driver of long term economic growth and job creation is improved productivity out of innovations. (Hargreaves, 2011) The achievements of our world to not only keep up, but also improve living standards with a boom of population should never be taken for granted. Scholars such as Malthus, the distinguished demographer, claimed right before the start of the industrial revolution that technology development would only lead to population growth, without real improvements in living standards. In fact, debates on whether we are able to feed all the people on the planet has never been off the table. Therefore, innovations are very crucial and relevant as it is the force dragging us out of Malthusian trap and keeping us on the track of continuously improving living standards by technology revolutions one after another.

Empirical evidence suggests that innovation plays a significant role in long term economic growth. From the steam engine, to electricity, the automobile, the computer, and to genetic engineering, 'the history of technology is filled with innovations that have transformed the world', all of which have had an almost immeasurable impact on the economy. (Verspagen, 2005: 493) The United States and Germany managed to catch up with the world economic and technological leader – the United Kingdom during the second half of the nineteenth century by developing new ways of organizing production and distribution, for example, mass production in the US, rather than merely imitating the more advanced technologies already adopted in the leading country. (Fagerberg and Godinho, 2005) An even more relevant example for the developing countries is Japan. During the first half of the twentieth century, Japan caught up rapidly to Western productivity levels out of depressed world economy after the war. Its success was associated with a number of important organizational innovations, such as the just-in-time-system, which totally transformed the global car industry. (Fagerberg and Godinho, 2005) These examples show that the adoption of innovations, either in techniques or in measures of organization, are crucial inputs for a country to develop economically and catch-up.

However, despite these rather obvious empirical indications, economic theories explaining the specific relationship between technological and organizational innovation, and long-term economic growth is far from definite. Nevertheless, we can still grasp the general idea from a review of the mainstream growth theories.

Progresses in growth theories have indicated the significance of innovations. For example, Solow model, the neoclassical growth model, treated technological change as an exogenous factor. In other words, what are left unexplained by the variables included in the model was attributed to technology. However, when Solow carried out his empirical work of 'growth accounting' later, he found that the unexplained share of long run economic growth tended be very high, suggesting that the exogenous factors,

which includes technology may actually play an important role. (Fagerberg, 2005) Now, the neoclassically inspired endogenous growth theory have included innovations as a variable. It shows that the impacts of innovations can be profound and magnificent, as technological spillovers can lead to increasing returns to scale at the aggregate level. (Verspagen, 2005)

Currently, besides the neoclassical approach, the other dominant approach to explain the relation between technology and growth is the evolutionary approach. The evolutionary approach has also emphasized 'the importance of innovation and technology for economic growth, as well as the positive role that can be played by government policy for science and technology'. (Verspagen, 2005:492) What differs the evolutionary approach from the neo-classically inspired approach is that the former emphasizes the dynamic dimension of innovation out of continuous learning process. They do not perceive economic development as jumping from one growth function to another. In other words, they do not take the evolution of innovations as independent from each other, but rather a process of accumulative progresses. In their opinion, besides creating brand new knowledge, innovations also contribute to subsequent technological progresses in their own field, to organizational improvements, as well as to the accumulation of expertise that promote spillovers of knowledge from the original field. (Hempell, 2006)

2.2 The role of IPRs in promoting innovation

Once the relation between economic development and innovations are established, the question of how to promoting economic development is transformed to the question of how to promote innovations. Intellectual property protection has been one of the main method taken by governments to encourage innovative activities, and it has received increasing popularity. Therefore, we should look through the role of IPR in promoting innovations to find the cause of its growing prevalence.

According to the definition by the World Intellectual Property Organization (WIPO), intellectual property refers to 'creations of the mind', which includes inventions, literary and artistic works, and symbols, names and images used in commerce. It can be divided into two categories: industrial property and copyright. Industrial property covers 'patents for inventions, trademarks, industrial designs and geographical indications', while copyright covers, but not limited to computer programs, databases, literary works, films, music, artistic works and architectural design'. IPR protects the creative works of innovators from unauthorized use by others for a limited period.

IPRs play a controversial role in promoting innovations. They can positively impact on innovations. First, IPRs is an orthodox way to promote innovations. Employing property-like rights to induce all kinds of innovations is perhaps 'the oldest institutional arrangement that is particular to innovation as a social phenomenon'. (Granstrand, 2005:266) As early as in 1474 when Venice introduced the first formal patent code, the 'national patent era' emerged, in which national policies were set up to attract knowledge from the outside and to stimulate orderly technical progress. (Granstrand, 2005) In 1709, the first copyright statute – the Act of Anne

came into being. (Drahos, 1995) Since then, we have gone on a track of increasing emphases on IP protection to induce innovations.

Second, IPRs provide a handy solution to the problem of finding a balance between the interests of innovators and social benefits in our market economy. More specifically, the problem lies in the contradiction between encouraging innovators by charging people for their use of knowledge, in order to compensate for the enormous investment of research and development (R&D) , and lowering the cost of knowledge to take full advantage of innovations, in order to improve efficiency and to maximize the total social benefits. The essence of this problem is that knowledge has characters of a public good. It has the character of non-rivalry in consumption, for the use by one actor does not 'restrict the ability of another actor to benefit from it as well'; and non-excludability in use, for unauthorized parties cannot be prevented from using it. (Maskus and Reichman, 2004) Thus as a kind of public good, without special arrangements, the total benefits of knowledge in the form of profits cannot be captured by its creator, but instead can be disseminated freely and be utilized by the whole society, with no compensation to the innovator. As a result, private entrepreneurs would have diminished incentives to invest in innovative researches and provide knowledge for the public.

Patents are a handy solution to encourage innovation and investment in innovation by granting the right of innovators to charge fees for a limited period of time, while encourage dissemination of innovations for the benefits of societies. To obtain a patent for innovation, the inventor has to disclose patent information, which 'accelerates the diffusion of patented technical information, and may reduce duplicate R&D, induce substitute technologies, stimulate new ideas, direct R&D efforts to opportunity-rich areas or bottleneck problems, provide a basis for bench-making and competitive intelligence, and stimulate technology exchange and cooperation'. (Granstrand, 2005, 280) In fact, the requirement of disclosure is a key rationale of IPRs. This requirement has constructed the belief that over the long term, the benefits of a society outweigh possible short term costs, as 'the creations and inventions will enter the public domain after the period of protection expires'. (WTO, Intellectual Property: Protection and Enforcement)

However, IPRs should not be considered as the only option to promote innovations.

On the one hand, an overuse of intellectual property may impede progresses in innovations. A prominent phenomenon is the new 'tragedy of the commons'. Nowadays, private market actors in sectors like pharmaceutical and computer software have managed to make the governments expand legal means of the control of access to information, in order to extract their private profit. It leads to a trend of 'over-fencing of the public knowledge commons' in science and engineering. For instance, basmati rice that have been consumed by people in India for centuries now are patented by biotech companies in the United States. (Stiglitz, 2008) This is a typical example where there is no real innovation but only unnecessary burden added to the society.

Moreover, overuse of IPRs would create obstacles on the late comers to learn technologies, thus slow down their march on innovations and generate adverse long-run consequences for future welfare gains. New innovations need to stand on the 'shoulders' of the giant of previous innovations, as there are spillovers from discoveries, inventions and the process of scientific research itself. Limiting the use of innovations would only restrict the exploration of knowledge spillovers. 'Even the greatest minds in history depend on already existent knowledge' (Schaefer et al., 2014), less advanced countries must build on the already existent technological knowledge in order to catch up. Enforcing IP protection globally makes it costly for the present economically less advanced countries to imitate advanced technologies, adding more obstacles for them to stand on the 'giants' in order to develop their own innovations from knowledge spillovers. (David, 2000) As the owner of innovations are mainly from the developed countries, IPRs make the rich richer and the poor poorer to a certain extent.

Last but not the least important, from an economic point of view, labeling knowledge – a public good with a price is not efficient. Ideally, in an optimal allocation of resources, knowledge should be distributed at the marginal cost of making copies, which are practically zero under ICT technologies, for the use of knowledge does not diminish the stock of knowledge holder and information can be transmitted almost without cost. (Maskus and Reichman, 2004)

On the other, there are other feasible ways to motivate innovative activities, including contracts, prizes, subsidies and research consortia. (Granstrand, 2005) For example, besides the patent system, entrusting public entities to provide knowledge is another method with a long tradition. Indeed, it is widely recognized that without public investment and collective action, there will be far too little research in fields that the potential commercial profitability is not proportionate to the required investment in research. (World Bank, 1999)

In summary, the use of IPRs to promote innovations has a long history, yet its role can be both positive and negative. Accordingly, 'current research provides little guidance on the potential contributions of an internationally strong patent system to the prospects of "catch-up" by the less developed countries in the contemporary world'. (Granstrand, 2005: 284) In addition, empirical evidence suggests that intellectual property rights affect economic performance of countries differently by industry. (Hassan et al., 2010) Therefore, it is necessary to look at the issue sector-specifically.

2.3 ICT as a general purpose technology for innovations and economic growth

Information and Communications technology is a broad concept that consist of a broad range of items. According to OECD, the ICT sector consists of manufacturing and services. ICT manufacturing ranges from office, accounting and computing machinery, wire and table, computer and peripheral equipment, to electronic equipment, while ICT services include wholesaling of machinery, equipment and supplies, renting of machinery

and equipment, telecommunications and computer programming and related activities. (OECD, 2002) The most widespread and prevalent application of ICT is computer and the Internet, the combination of which has gradually reached to almost every household on the planet. And ICT innovations refers to ‘finding new ways to organize production or develop new markets with the help of ICTs’. (World Bank, 2012)

ICT has been an extraordinary phenomenon of our era, where the word revolution is truly appropriate. (European Commission, 1999) It fundamentally changes the way people create, accumulate, store and transmit information and knowledge. Compared with earlier technology revolutions, IT revolution has more rapid accrual of benefits. (Bayoumi and Haacker, 2002)

The transforming capability of ICT sector makes it an important sector, and its importance is reflected in its role as a general purpose technology (GPT). As a GPT, ICT plays the role of the core technology in our age of knowledge and information, it involves not only product innovations, but also process innovations. Bresnahan and Trajtemberg defines GPTs by three key characteristics: pervasiveness, inherent potential for technical improvements and innovational complementarities, ‘giving rise to increasing returns of scale’. (Bresnahan and Trajtenberg, 1995)

First, the ICT sector has the character of pervasiveness, as its technologies are used in a wide range of sectors throughout the economy. Moreover, the Internet continues to penetrate into everyday activities of firms, making it increasingly inevitable to resort to the Internet to communicate with clients and suppliers. In addition, the functions of ICTs are also expanding continuously, developing from basic calculation tasks to a wide variety of use, covering communication, measurement devices, and control units in companies and households. (Hempell, 2006) In fact, ‘the most pervasive technological change of this era has been the widespread computerization of many companies’. (Yang and Brynjolfsson, 2001:1)

Second, ICTs have shown their magnificent potential for technical improvements. From the 1970s to 1990s, we have witnessed crucial innovations in ICT sector from the first database management system, to the birth of personal computer and Local Area Networks (LANS), and to the Internet and the World Wide Web. (European Commission, 1999) Taking the progresses on computer as a specific example, since its introduction in 1976, personal computers have leaped from several kilobytes (KB) of random access memory (RAM), no hard disk and processing speed of less than 1 MHz, to megabytes (MB) or RAM, gigabytes (GB) of hard disk memory, and processing speed exceeding 1, 000 MHz. Meanwhile, the price of personal computer has dropped from several thousand dollars to less than one thousand dollars. (Berndt et al, 2001) The extraordinarily high speed of development in ICT has been typically summarized as Moore’s law, estimating that the computing power of integrated circuit has been doubling every 18 months since 1960s. (Jovanovic and Rousseau, 2002)

Lastly, ICTs complement innovation activities in other sectors, and these innovational complementarities is the main source of the enabling character of ICTs. Bresnahan and Trajtenberg has pointed out that ‘most

GPTs play the role of "enabling technologies", opening up new opportunities rather than offering complete, final solutions'. (Bresnahan and Trajtenberg 1995, p. 84) In other words, ICTs not only facilitate technological developments in its own sector, but also spill over to its vast downstream sectors. 'Over the long run, total factor productivity rises economy-wide owing to a reorganization of production based on use of' ICT goods by other producers. (Bayoumi and Haacker, 2002)

More specifically, for its support to other sectors, ICTs have been used to 're-engineer and coordinate production processes, work practices as well as to explore completely new economic fields'. (Hempell, 2006) Prior to the ICT era, different fields of knowledge creation were kept largely apart. ICT thus expanded the possibilities for potential innovation by coordinating previously separate fields of innovation activities, which increases the scope of wider innovation. (Cantwell, 2005:562) For instance, the rapid advances in biotechnology would not have been possible without the computing and storing facilities provided by ICT. The application of ICT technology has penetrated into our daily life, from microcomputers on cars and domestic appliances to help with control operations of components, to intelligent devices used by firms to improve their existing products and services, such as online banking, e-commerce. (Hempell, 2006)

The last feature of the ICT sector is an important one. It implies merely a spread of ICT to the developing countries may lead to a whole package of upgrading in production. The rapid technical advances and fierce competition in the ICT sector have led to major fall of prices of ICT goods and some services over the last decades. Bayoumi and Haacker found that 'welfare benefits mainly accrue to users of IT, not their producers, because of falling relative prices…for example, some of the major producers of IT goods (Malaysia, Ireland) experience only average gains in terms of the growth rate of real domestic demand, while Austrilia, with little production of IT-related goods, is among the principle gainers'. (Bayoumi and Haacker, 2002)

In general, as a GPT, the main feature of ICTs is that they lead to 'fundamental changes in the production process of those using the new invention'. (Basu and Fernald, 2008) The network effects of ICT, including lower transaction costs and more rapid innovations, improve the overall efficiency of an economy. (OECD, 2003) This forms a magnificent increase in social welfare, as the unprecedented productivity gains achieved in the ICT sector have largely been passed to downstream sector and consumers.

However, lower cost of technology to provide access to the large pool of knowledge does not necessarily leads to lower cost of less advanced countries to take advantage of that knowledge, which can be explained by the nexus of ICT and IPR.

2.4 The nexus of ICT and IPR

The relation between ICT and IPR is interdependent. On the one hand, IPR plays a significant role in the ICT sector, as WIPO points out, without copyright protection, software industries would not exist. On the other, to some extent ICT has determined the trend of IPR developments. Rapid

changes in ICT, especially in the Internet and the computer software industry forms ‘the most interesting and important contemporary challenges to previous intellectual property practices’. (May, 2000)

ICT relies on IPR. In our capital market economy, to profit in ICT relies on enclosure of knowledge in ICT as property by transformed IPR regimes. ‘Given the organization of capitalism is firmly rooted in the recognition of property rights, those areas of social life that capitalists wish to profit from must be rendered as property’. (May, 2000) Growing easiness to obtain knowledge, to imitate and pirate, as well as globalization of information, has led to noticeable trend of strengthening the legal protection of intellectual property worldwide. More specifically, the field of information technologies and telecommunication network services are characterized by ‘the combination of high fixed costs of development with very low unit costs of reproduction’, impelling innovators in such sector to find more effective mechanisms of protection of their technologies. (David, 2000:9) As a result, ICTs have become a key driving force for the emergence of ‘intellectual capitalism’. (Granstrand, 2005, 277)

Widespread of knowledge associated to ICT challenges the foundation of IPR. This widespread of ICT and the digital revolution undercuts the foundation of intellectual property, as a ‘property’ requires scarcity. The emergence of new, high-bandwidth digital networks is continuously lowering the marginal costs of information goods and creating faster and easier access to knowledge, making ‘scarcity’ of knowledge almost an illusion. It is a revolution that ‘touches everything from the availability of electronic working papers and journal publications, and specialized dynamic database services, to the prospective growth of an upgraded Internet that will support enhanced information search, filtering and retrieval services, virtual laboratory environments, and remote shared access to large experimental research facilities’. (David, 2000:1) May even argues that information and knowledge will become so diffused that intellectual property will not be able to govern them effectively. (May, 2000) In other words, ‘information wants to be free’ to flow worldwide. (May, 1998) There is no natural boundary between what is intellectual protectable or not. The history of intellectual property is rather a process of enclosure of leading technologies and knowledge into previous IP regime.

IP protection of computer software is one typical example of abrupt enclosure of ICT. Software is written in a form of language, which are not a material process or product that is patentable, therefore, software is protected under copyright after TRIPS. However, the protection period under copyright is lifetime-plus, which is extremely long for technology product-like software that transforms rapidly. This may add to the problem of the anti-commons, as innovations in software can be facilitated with access to copyrighted inputs. Moreover, as developed countries are much capable to develop new substitute software, this IP arrangement is a way to prolong life cycle of outdated products from developed countries by selling them in the developing countries, who lack innovative abilities.

2.5 TRIPS as the playing field of the nexus of IPR, innovation and economic development

Since the coming into being of the TRIPS, empirical literature on the impacts of strengthening IPRs in developing countries has grown substantially. However, the bulk of the empirical literature either focus on periods before the TRIPS, or only analyzes the impacts of TRIPS generally by econometric model across countries, without differing between different groups of developing countries (eg, high, middle and low income developing countries). In addition, the most discussed fields are pharmaceuticals and traditional knowledge, with few researches focusing on the impacts of TRIPS on development of ICT in developing countries.

Nevertheless, a review of previous literature can shed lights upon the discussion in this paper, as the disputes over possible impacts of enforcing IPR internationally summarize both potential positive and negative influence of TRIPS.

Developing countries have criticized the TRIPS Agreement from the negotiation process to the final arrangements. The TRIPS negotiations were initiated by the United States, who was supported by the European Commission and the Japanese government. (Gervais, 2009) The high levels of IPR have been set up in the developed countries over decades, but were imposed to developing countries at once, although the latter lacks necessary institutions, experts and fund to build from scratch. Developing countries were made to accept GATS and TRIPS in the Uruguay Round in exchange for agriculture product and textiles. More specifically, developing countries needed to accept practically the full range of pre-existing GATT law, the Tokyo Round codes, which had been previously negotiated among developed countries. (Gervais, 2009)

As for the final arrangements of TRIPS, it is without doubt that at least in the short term, TRIPS benefits developed countries most. The majority of IP holders are from the developed countries, thus after the enforcement of IPR, developing countries can no longer take advantage of new foreign technologies without paying to IP holders. (Michaels, 2009) Price of local product may be increased to pay the compensation fee of IP holder, and job losses will occur in the already established industries of imitation.

There are also arguments in favor of TRIPS. The main support of TRIPS is the assumption that the long term benefit of TRIPS. For example, one such benefit that are frequently talked about is IPR's importance to attract Foreign Direct Investment (FDI). More FDI has been believed to accelerate the recipient economy's innovation via technology transfer, as stronger IP protection should eliminate concerns of imitation of multinational companies and thus they would invest more in the emerging economies. TRIPS has also been argued to encourage domestic innovative activities of firms. Relying on panel data on Indian firms from 1989 to 2005, Dutta and Sharma (2008) find strong evidence that in innovation-intensive industries, firms increased R&D expenditure after TRIPS. (Hassan et al, 2010)

Empirical analysis based on econometric data are consist with the disputes, as they form a mixed picture of the impacts of TRIPS on developing countries. Some scholars find no positive relation between strengths of IP protection and amount of FDI (Fink and Maskus, 2005),

some finds a positive relationship between trade and strong IP protection (Maskus and Penubarti, 1995; Smith, 1999), some finds that strong IPRs are only crucial to certain IP-sensitive sectors, such as chemicals, software and pharmaceuticals (eg. Javorcik, 2005), others find that the impacts of TRIPS are conditional: they are dependent on economic level of a country, or on human endowments, technological infrastructure and absorptive capacity of a country. (eg. Hoekman et al, 2002; Michaels, 2009; Watson, 2011; Lall, 2003)

In summary, similar to the potential general impacts of IPRs on developing countries, strengthened protection in the ICT sector are possible to generate negative or positive influences on the developing economies, depending on the endowments of a country. Meanwhile, the outcome of the spread of information and communications technologies can also be positive or negative: it may eliminate inequality by bringing access to worldwide information resources to millions who had little or no prior access, or it may deepen the gap between the information 'haves' and 'have-nots'. (National Research Council, 2000) The combination of these two sets of possibilities, namely developments of IPR and ICT on developing countries, are thus a relevant research question of development issues, and will be discussed in the empirical analysis of this paper.

3 Methods and Data

To research on how the TRIPS agreement have impacted on the innovative potentials and performances in the ICT sector in developing countries at different levels of development, this paper focuses on data from 10 countries: Burkina Faso, China, Ghana, India. Kenya, Nepal, Nigeria, Singapore, South Africa, and South Korea. Using a small sample of 10 countries of various economic situations have the benefit of a thorough discussion of detailed information, which are often hidden in the highly condensed econometric models. In addition, with regard to innovation, it is difficult to construct one proper measure or indicator of innovation activities, which questions the reliability of an econometric model. Therefore, this paper rather relies on detailed data and analysis of these 10 countries. The shortcoming of focusing on a small group of countries is that they cannot build a general correlation between implementing TRIPS and economic impacts as econometric models do.

The 10 countries well represent different groups of developing countries. Burkina Faso, Ghana, Kenya, Nigeria and South Africa are 5 African countries, while China, India, Nepal, Singapore and South Korea are 5 Asian countries. According to the 2013 release of UN M49 country classification of the United Nations, Burkina Faso and Nepal are least developed countries. Kenya, Ghana, India and Nigeria are less developed countries with either low-income or lower-middle income according to per capita GNI in 2012. South Africa, China, South Korea and Singapore are better developed countries with either upper-middle income or high-income. In addition, South Africa and China are of the 'BRICS' countries, while South Korea and Singapore are of the 'Four Asian Tigers'. Therefore, a comparison between current situation of the countries, together with a

comparison between historical strengths of IP protection and current potentials and performances in ICT, can demonstrate whether TRIPS positively impacts on ICT outcomes, and more importantly, whether economic developments induces the needs of IP protection or whether IP protection induces innovations.

To figure out the impacts of TRIPS on development in the ICT sector, the paper uses index of IP protection and indicators of ICT potentials and performances. The intellectual property protection score of the World Economic Forum (WEF)'s Global Competitiveness Index are used, of which 7 represents strongest protection of IPR, while 1 represents the weakest. To have a historical perspective, the paper also refer to GP-Index of Patent Rights developed by Ginarte and Park. GP-index is used as a proxy of general strengths of IP protection, of which a score 5 is strongest protection, while 0 weakest. (Ginarte and Park, 1997; Park, 2008)

As for indicators for potential and social economic benefits of ICT, the paper uses data on ICT Development Index (IDI) (with a range of 0 to 10), the Internet penetration rate, computer penetration rate measured by percentage of households with computer, and fixed-broadband prices as % of GNI per cent. IDI builds a broad picture of ICT development in a country, as it combines information about ICT access, ICT use and ICT skills. The Internet and computer penetration reflects penetration of ICT in a country. And the remaining indicator tells the affordability of ICT to people. The affordability threshold for fixed-broadband prices are 5 percent of GNI p.c.. Lower fixed-broadband prices as % of GNI per cent represents easier access of ICT.

European Patent Office data on numbers of patents in ICT by country, and exports in ICT products and services are used as indicators of innovative capabilities in ICT. Although patents cannot cover all innovative activities, it is a reliable indicator of innovative capability. In addition, for developing countries, exports and international trade is an important instrument to promote their economy, as exports help develop productive capacities and expand employment opportunities. (Hassan et al, 2010) In addition, although gross exports in ICT cannot accurately reflect how much value-added a country achieve in the international value chain, it still tells the extent of technology transfer, which is a clearly stated goal of TRIPS. (Lanz, 2013)

To test the research question, namely impacts of TRIPS implementation on ICT potentials and performances in developing countries at different economic level, countries are placed in a sequence of growing GNI per capita. Each figure combines one ICT indicator with IP protection level of two periods: 2006 to 2009 and 2010 to 2013. Average scores of IP protection of the two periods shows a general trend of the strengths of protection. If better ICT performance in the second period correlates with stronger IP protection in the second period, it supports that improving IP protection motivates ICT development in the country. In addition, by comparing patterns of correlation in the groups of least-developed, lower income and higher income countries, we can test whether the impacts of IPR on ICT development is U-shaped in accordance with economic level.

4 The interaction between TRIPS and ICT

From the theoretical discussions we can see that the transformation brought by the ICT sector is that it is now possible for the owners of innovations to chase profit globally, which involves trade. The importance of knowledge as an economic input keeps increasing, which now allows intellectual property to take on international commodity status. Integrating IPRs into the global trade system would thus facilitate global profit chasing. As a result, the TRIPS negotiations was pushed by the developed countries, especially by the United States under this background. TRIPS has integrated knowledge into our global economy through institution of intellectual property, which harmonizes international laws, and expand into the new area of ICTs, such as computer software. (May, 2000) From this angle, TRIPS is a milestone in the history of IPR, as it contributed to 'the emergence of intellectual property and its protection as a major trade issues'. (May, 2000: ix)

TRIPS was negotiated in the 1986-94 Uruguay Round in World Trade Organization (WTO), which was the first time that intellectual property rules were introduced into WTO. The final products of the Uruguay Round negotiations created the World Trade Organization and its rules, including TRIPS, which took effect on January 1st, 1995. The multilateral trading institution (WTO) supersedes member countries' internal laws and regulations, thus members of WTO has to follow the minimum standards for the protection of intellectual property set by TRIPS agreement. (Ghio, 2011) The protection required by WTO covers a variety of IPRs, including copyright, patents, trademarks, industrial designs, geographical indications, semiconductor topographies and undisclosed information. (UK commission, 2002) The TRIPS requires all member countries, regardless of their level of development, to apply the same standards after certain transitional periods, which are longer for the less developed countries. (Giray, 2013) More specifically, developed countries were given 1 year to conform their domestic laws and practices to TRIPS. Developing countries were given 5 years till 1 January 2000, while least-developed countries were given 11 years till 1 January 2006, which has generally been extended to 2013, and to 2016 for pharmaceutical patents and undisclosed information. (WTO)

As for TRIPS arrangements related to ICT, the most important one is Article 10 of TRIPS. Compared to the Berne Convention, one of the predecessor of TRIPS, the TRIPS expanded coverage of copyright to include computer programs. Under TRIPS, computer programs, whether in source or object code, are protected as literary works under the Berne Convention. (GATT 1994, A1C: 6) The second clause of Article 10 also include compilations of data or other material, whether in machine readable or other form under the protection of copyright. (GATT 1994, A1C: 6)

Article 10 implies that after TRIPS, computer programs and other materials readable by computers enjoy the longest period of protection in all kinds of intellectual properties. It raises the price of information as it increases duration of protection for IPRs of electronically stored and transferred knowledge. (Drahos, 1995) In addition, the conditions to get copyright is considerably less stringent than other sorts of manufacturing or

industrial processes covered by patents, which favors owners over possible users to a large extent. Therefore, although TRIPS sets up ‘minimum’ standards of IP protection to all members, the standards themselves are not ‘minimum’ but rather higher and more stringent than previous international IP regimes. As a result, the developing countries can no longer be ‘free rider’ of computer software, databases and all kinds of other knowledge that can be transferred easily and fast.

Regulations of TRIPS thus show that the one-size-fits-all problem of TRIPS are two fold regarding ICT. First, it treats all ‘digital products’ as the same, without paying attention to features of each product. Some ICT products requires abundant investments, have lasting value, but can be copied easily almost without cost. Others do not require much research and development efforts precisely because of their digital nature, or they can be protected and financially supported by means other than copyright, such as charging for access or paid advertising. (Boyle, 1997) For the former kinds of products, IPR are necessary to provide enough incentives for innovation. However, for the latter ones, IPRs only serve as one way for IP holders to make a fortune, blocking the have-nots from benefiting from knowledge that are supposed to come without much cost.

Second and more importantly, it treats all countries, regardless of their innovative and technological abilities or absorptive capabilities, as the same. In the information age, it is intellectual property that acts as ‘the key to the distribution of wealth, power, and access in the information society’. (Boyle, 1997: 89) TRIPS as the key is inclined to the developed countries. As discussed in the theoretical section, profit in ICT relies on enclosure of knowledge in ICT as property, profit in ICT globally thus relies on global enclosure of knowledge in ICT as property. It is obvious that the US corporations like IBM and Microsoft, who have large intellectual property portfolios, will benefit from TRIPS as it punish piracy of their products. (Drahos, 1995) In contrast, the least developed countries, who might benefit most from the ICT’s informational potential, are least likely to have the tools to use it, or the educational background to take advantage of it. (Barber 1997) TRIPS only makes it even more difficult and expensive for them to have access to it. Counterfeit products that were affordable for them have been no longer legitimate.

It is not deniable that stronger IPRs serve the interest of developed countries to expand to the developing markets, the relevant question is actually whether the developing countries also benefits from this process, whether technology has been transferred and endogenous innovations are motivated. It is not wrong of the developed countries to protect their interests, but it is problematic if they are the only beneficiaries.

Without enforcing IPRs, life for the developing countries could have been cheaper and easier thanks to ICTs. They have been told by the IP holders to improve IP protection in exchange for advanced technologies and better environment for innovations. With all efforts in time, human capital, investment and judicial structure building, they should be paid off by better potential or even better performances in ICT. The next section thus examines whether their efforts are worthy and whether imposing same standards on countries at different stages are appropriate.

5 Empirical Analysis: A comparison between developing countries at different economic level

The ICT sector has been going through rapid growth over the last decades. 'Over the past 15 years the ICT revolution has driven global development in an unprecedented way. Technological progress, infrastructure deployment, and falling prices have brought unexpected growth in ICT access and connectivity to billions of people around the world.' (ITU 2015:1) More specifically, according to statistics of International Telecommunication Union, there are more than 7 billion mobile cellular subscriptions, which is a 97% increase from 738 million in 2000. The spread of Internet is even more rapid: between 2000 and 2015, global Internet penetration grew 7 fold from 6.5 % to 43%. (ITU 2015)

This wave also involves developing countries. In the recent decades, the developing countries have achieved unprecedented developments in ICT. For instance, in spite of traditional 'Factory Asia' countries, emerging economies including Mexico and South Africa are now home to some of the world's largest electronic manufacturers and multinational telecommunication operators. (Lanz, 2013) The ICT sector has played a significant role in major examples of successful catch-up in Asia: Korea, Japan and China, who are now the largest producers of ICT goods. These Asian example supports the positive impacts of ICT developments and the possibility of achieving rapid development of ICT in a short period. How is the situation in other developing countries besides the frequently mentioned 'benchmark' models? How different is the situation of ICT development among developing countries?

A global comparison may help build a general view of where the less developed countries stand. In 2015, about 83% people in the developed countries are using the Internet, and about one third of the population in the developing countries have access to the Internet. However, in the least developed countries, of the 940 million people living there, only 89 million use the Internet, corresponding to a penetration rate of less than one ninth. (ITU 2015) WTO report concludes that least developed countries (LDCs) and low- and middle- income countries (LNICs) are generally of marginal importance for production and trade in the ICT sector. (Lanz, 2013) Obviously, countries like China and India are successful exceptions. Do these exceptions, become 'exceptions' through introducing better implementation of IP protection or other reasons? Do the LDCs left behind in enforcing IPRs required by TRIPS?

5.1 Implementation of TRIPS in countries at different economic level

After over fifteen years since the TRIPS Agreement entered into force, it is now feasible to review how and to what extent the principles have been complied by the developing countries.

As shown in the table below, after the TRIPS agreement, there has been a general trend of stronger protection on intellectual property over the years. Although GP Index of Patent Rights and the IPR score of World Economic Forum International Property Right Index are two distinct IPR indicators, we can still tell the trend of IPR in these countries. South Korea,

South Africa and Singapore has kept being the three countries with strongest IPR among the countries. Among the rest of the countries, Ghana, China, India, and Burkina Faso have similar level of IP protection according to the index. Kenya, Nepal and Nigeria have poorest level of IP protection. While Kenya and Nepal have a trend of stronger protection, Nigeria has a trend of decreasing score in IPR. Burkina Faso, as a least developed countries with limited resources to transform its IP system in accordance with TRIPS requirements, has managed to join the group with medium protection of IPRs.

countries	per capita GNI 2012	country classification	GP Index of patent rights			
			60-90	1995	2000	2005
Nepal	low-income	least developed &landlocked	1.79	1.79	1.79	2.19
Burkina Faso	low-income	least developed	1.62	1.98	2.1	2.93
Kenya	low-income	developing	1.55	2.43	2.88	3.22
Ghana	lower-middle	Heavily indebted	1.47	2.83	3.15	3.35
India	lower-middle	developing	1.03	1.23	2.27	3.76
Nigeria	lower-middle	fuel exporting	2.5	2.86	2.86	3.18
South Africa	upper-middle	developing	2.94	3.39	4.25	4.25
China	upper-middle	developing	1.33	2.12	3.09	4.08
South Korea	High-income	developing	2.55	3.89	4.13	4.33
Singapore	High-income	developing	1.64	3.88	4.01	4.21

Table 1 GP index of patent rights
Source: UN M49 Country Classification released in 2013; Park, 2008

Countries	World Economic Forum IPR Index							
	2014	2013	2012	2011	2009	2008	2007	2006
Nepal	2.928575	2.854457	2.782714	2.645617	2.585264	2.555323	2.262483	2.291667
Burkina Faso	3.421976	3.40516	3.585948	3.167313	3.284792	3.498337	3.841241	3.913043
Kenya	3.692819	3.44724	3.124451	2.924985	3.084968	3.082341	3.013841	2.959566
Ghana	4.085306	3.885124	3.148433	3.146397	3.153827	3.2645		
India	3.718591	3.678587	3.674574	3.523963	3.648265	3.702684	3.994208	4.221486
Nigeria	2.686838	2.789705	2.885296	2.778052	3.084236	2.938434	2.941158	2.958533
South Africa	5.30002	5.457896	5.308457	4.972681	5.222717	5.335612	5.203681	5.062125
China	3.952852	3.943955	3.940938	4.013536	4.02367	3.882581	3.420311	3.241482
South Korea	3.705182	4.025284	4.331084	4.071846	4.197293	4.976736	5.36842	4.524404
Singapore	6.151738	6.121031	6.086865	6.096157	6.208658	6.277703	6.171764	6.031952

Table 2 World Economic Forum IPR Index
Source: World Economic Forum – The Global Competitiveness Index Historical Dataset

The timing of implementing TRIPS varies among the countries. Using shorter term than required by TRIPS can reflect a country's determination to comply with TRIPS. Among these 10 countries, Burkina Faso and Nepal are LDC members of WTO that implemented major legislative reforms in advance of their general mid-2013 TRIPS deadline; India, South Korea, Singapore are developing countries who have completed major TRIPS-related legislative reforms in advance of 2000 deadline; Nigeria, Kenya, Ghana are developing countries who have significant legislative reforms left to be carried out when their deadlines for TRIPS implementation expired in 2000. (Deere, 2009)

As for copyright protection that covers software and databases under TRIPS, standards adopted by countries also varies. TRIPS minimum requirement of copyright term is life of the holder plus 50 years. Nepal,

Kenya, China, South Africa and South Korea meet the requirement by granting holders 50 years plus life of copyright. India exceed requirement of the standards by granting 60 years plus, while Burkina Faso, Nigeria, Ghana, and Singapore by granting 70 years plus. (Deere, 2009)

Contrary to our common expectations, the least developed countries in Africa actually adopt pro-IP attitudes. For Example, the head of Burkina Faso's IP office stated that countries 'must make the necessary arrangements and adjustments, because globalization is here. We cannot afford to marginalize ourselves'. (Deere, 2009:171) Burkina Faso, Nepal, South Korea and Singapore take the least advantage of TRIPS flexibilities and include a broad range of TRIPS-plus provisions in their national laws. China, Ghana, India, Kenya, Nigeria, South Africa adopt TRIPS-plus, -minimum and/or minus IP standards and made mixed use of TRIPS flexibilities, therefore are weaker on IP protection and less consistent with TRIPS agreement than the first group. (Deere, 2009)

Here we choose four out of the ten countries: South Africa, Nigeria, South Korea and India as examples with a focus on ICT related amendments to national laws. The four countries are chosen as one Asian country with strong IPR, and the other with weak IPR; one African country with strong IPR, and the other with weak IPR.

South Africa

Different from most of the developing countries attitudes toward TRIPS in the negotiation period, South Africa was supportive of TRIPS as it had a long history of IP protection and enforcement. In addition, dissimilar to other African countries, it had sophisticated legal system to deal with IP issues. (Fasan, 2012)

In 1997, only two years after TRIPS entry into effect on 1 January 1995, South Africa introduced the Intellectual Property Laws Amendment Act, its first major adaptation to TRIPS regime. There were several important change regarding ICT in this act. The definition of 'literary works' has been expanded to cover 'tables and compilations, including table and compilations of data stored or embodied in a computer' (section 1(1)(g) of the Act); computer programs have been provided 50 years of protection, which is compatible to TRIPS requirement; and the scope of copyright in computer programs has been broadened to cover exclusive rights to do or authorize 'the letting of offering or exposing for hire by way of trade, directly or indirectly, a copy of computer program' (section 11B(h)). The amendments 'appears' to grant rental rights to authors of computer programs. (Fasan, 2012)

Nigeria

Contrary to our expectation, Nigeria had a copyright law largely in consistent with TRIPS requirements even before 1995. As required by TRIPS, Nigeria's Copyright Act 1990 protect computer programs and compilation of data as literary works. And the protection is 70 years, while article 12 of TRIPS only requires 50 years. (Fasan, 2012) Therefore, literally Nigeria's law of computer program is in more accordance with TRIPS than South Africa.

However in reality, software piracy is a significant phenomenon in Nigeria. The piracy rate in the business software industry, including hard-disk loading of pirate software and unauthorized use of software, is 82%. (IIPA, 2007) The problem has been more prevalent over the years, as the nascent but growing Internet presence in Nigeria has added digital piracy. (IIPA Nigeria, 2009)

South Korea

In 1998, as response to TRIPS, Korea released an amendment to its Computer Programs Protection Act. It provides fifty years of protection of copyright for computer programs. (Amended by Act No. 4996, Dec. 6,1995) In 2007 and 2008, following negotiation of the Korus FTA, Korea has released two amendments in order to upgrade its Computer Program Protection Act to better govern computer software copyrights, and to strengthen administrative enforcement and sanctions against only copyright infringement. (IIPA, 2009)

Piracy is also an issues in Korea, but it has been taken much more seriously by the Korean government, as they have taken relevant legal preparations as mentioned above. In 2009, 41% of software installed on personal computers in the country was pirated, corresponding to a commercial value of $575 million. (CP, 2010) Compared to India and Nigeria, computer piracy is much less severe in Korea.

India

In accordance with TRIPS, India law included computer programs, together with books, articles, poems, tables and databases, in literary work. And term of copyright is 60 years, which is also longer than the required period of TRIPS, similar with Nigeria. (Department of Electronics & Information Technology)

India is a special case. After 2005, during the initial period of transition and implementation of important aspects of TRIPS, India's national IP protection has been 'deteriorated markedly' since the end of 2000s, making it an 'outlier' in international community regarding IPR now. (GIPC, 2013) The Global Intellectual Property Center (GIPC) report on India criticizes the country's protection on IP severely by pointing out that compared with other emerging markets, 'India's IP environment is underdeveloped, with significant weaknesses in both the availability of IP protection as well as enforcement through administrative and judicial redress'. (GIPC, 2013:3)

The evident worldwide image of India is a country of cheap counterfeiting products. For many years, India has been on United States Trade Representative's (USTR) Special 301 Report Priority Watch List as a notorious market for IP infringement. (GIPC, 2013) The value of India's counterfeit market in 2011 is estimated to be well above $5 billion. （APAA, 2011） Right after drug piracy, electronic and software counterfeits ranks second on the global counterfeit goods list. Software piracy is prevalent in India, for instance, it is estimated that 64% of PC software deployed in India in 2010 was unlicensed, 'with the commercial value of such pirated software for U.S. vendors amounting to more thanUS$1.05 billion'. (IIPA, 2011) In other words, nearly two out of three

software application is unlicensed. Compared to the PC software piracy rate of 69% in 2007, it has been only marginal progress. (IIPA, 2011)

5.2 Economic potential based on ICT penetration

As discussed in the theoretical chapter, productivity improvements has been largely resulted in price falls of ICT goods, with most of the social benefit going to user side. Therefore, penetration of ICT products and services can be a feasible indicator of technology transfer and innovative potentials, as well as potential economic gains led by ICT.

The IDI score draws a broad picture of developments in ICT across countries. Among the sample countries, Korea has been remained top 10 of the world regarding ICT access, use and skills. Singapore's ICT developments are similar to that of Korea. India, Nepal, Burkina Faso and Nigeria belong to the so-called 'least-connected countries', whose IDI score is below 2.78. Burkina Faso, whose IPR protection is at the same level of India, ranks 156 of 166 countries who are scored. (ITU, 2014) As the IDI index combines indicators of ICT access, ICT use and ICT skills, generally these four countries are with the least technological capability and potential regarding ICT.

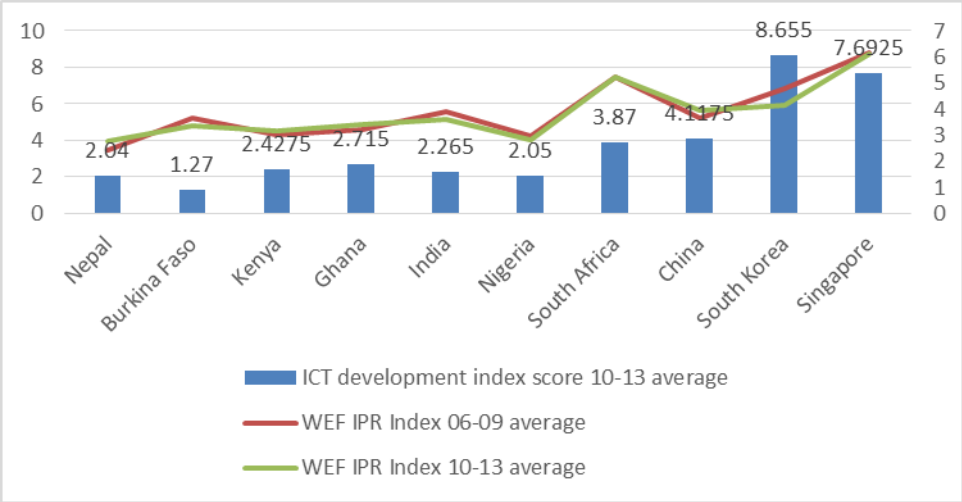

Figure 1 ICT development index (IDI) score
Source: Author's calculation based on International Telecommunication Union – Measuring the Information Society Report 2011-2014; author's calculation based on WEF IPR Index

For the group of the least-developed of the ten countries, which include Nepal and Burkina Faso, although IPR are better protected in Burkina Faso, all the indicators suggest ICTs have been spread deeper in Nepal. While the percentage of individuals using the internet and the percentage of households with computer of Nepal are about 3 times and 2 times of Burkina Faso respectively, the fixed-broadband price as % of GNI of Burkina Faso is almost 3 times of Nepal. Therefore, the data suggests for the LDCs, stronger IPRs comes with significantly less penetration of ICT and poorer potential of ICT. Compared with other countries, although Nepal and Burkina Faso have been active in transforming their domestic structure to

comply with TRIPS requirements, they are still of particularly low technological development.

The second group formed by low-income and lower-middle income countries, namely Kenya, Ghana, India, and Nigeria, shows a mixed picture. It appears to be an inversely correlated relation between IPR protection and Internet penetration. In contrast, affordability of broadband and computer penetration are positively correlated to protection of IPRs, except the extremely high coverage of computer in households in Ghana. Therefore, although the last two indicators here supports a positive correlation between IPRs and potential in ICT, it is difficult to tell the general trend, as Internet penetration tells how a country is connected to information of the outside world.

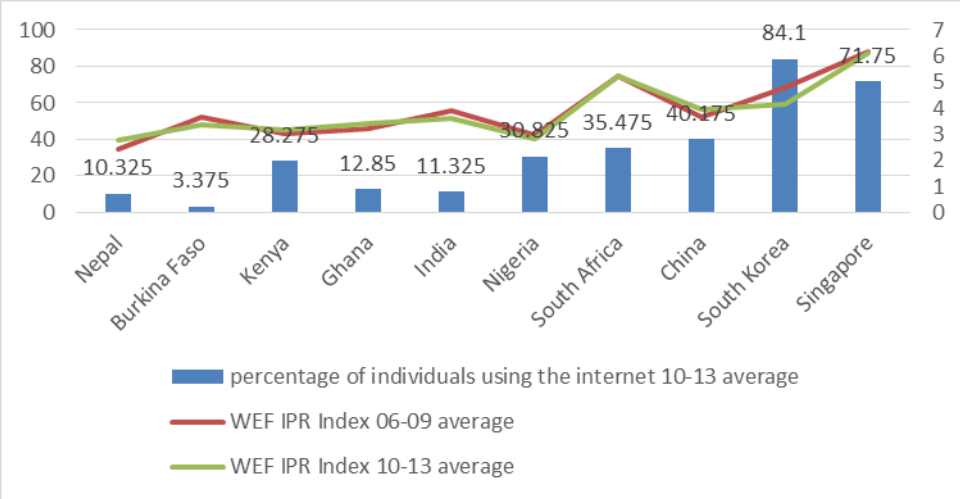

Figure 2 Internet penetration rate
Source: Author's calculation based on International Telecommunication Union – Measuring the Information Society Report 2011-2014; author's calculation based on WEF IPR Index

As for the last group of upper-middle and high-income countries, it seems that generally better protection of IPR comes with better access and broader coverage of ICT. However, putting the current picture into a historical background, it appears that economic development introduces needs of IPR protection, not the other way around. During the catching-up period of Singapore and South Korea from 1960s to 1990s, IPRs are weak according to the Ginarte-Park index of patent rights. More specifically, IPRs are weaker in South Korea than South Africa, while the situation in Singapore is even worse than countries like Nepal and Nigeria during this period. It is after their catch-up efforts succeeded that South Korea and Singapore strengthened their IPR protection to a large extent. The current situation in China and South Africa further supports that economic development comes before IPR improvements. Although South Africa has significantly stronger protection of IPR, with a much larger population, penetration of ICTs in China are considerably higher than in South Africa, while affordability of fixed-broadband is almost the same.

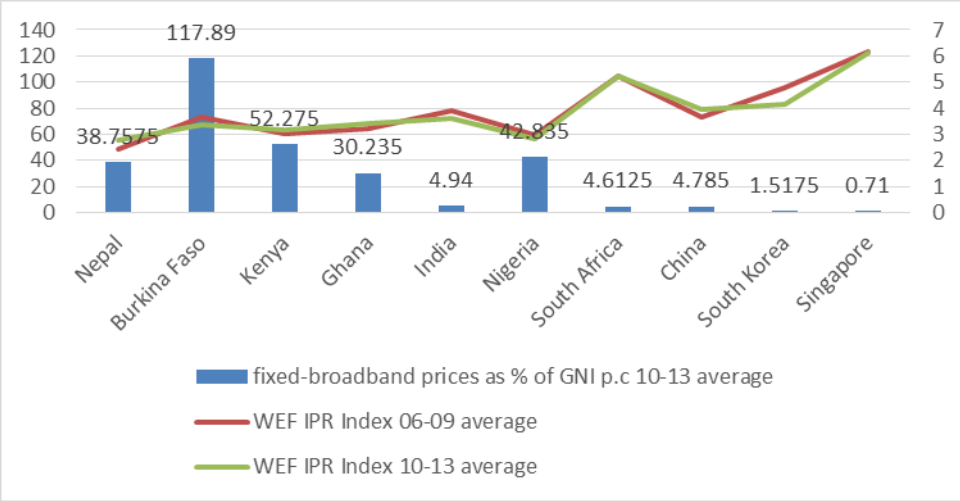

Figure 3 Fixed-broadband affordability
Source: Author's calculation based on International Telecommunication Union – Measuring the Information Society Report 2011-2014; author's calculation based on WEF IPR Index

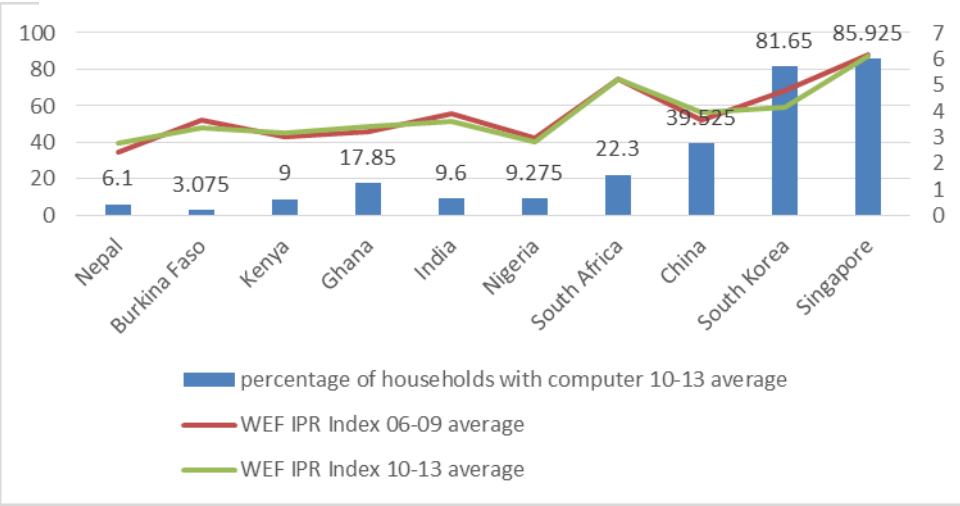

Figure 4 Computer penetration rate
Source: Author's calculation based on International Telecommunication Union – Measuring the Information Society Report 2011-2014; author's calculation based on WEF IPR Index

To summarize, theoretically, if the chain of relation from IPR to technology transfer stands, protection of IPR are supposed to be the main concern for multinational companies to introduce their technology into markets in developing countries, as they face tremendous amount of market loss to introduce ICT products and service into a country with poor IP protection. Despite the mixed picture of the second group of countries, both the experience of the high-income developing countries and current situation in the least develop countries suggests that catch-up in a weak IPR regime comes first. IPRs are not the decisive factor of ICT technology transfer and penetration.

5.3 Performance in ICT

Before looking into the ICT-specific performances of the countries, we first present a general view of the relation between IPR and macroeconomic indicators.

If stronger IPR regime guarantees more FDI inflows, which has been the main source of economic growth for developing countries to catch-up, countries should generally form a positive line in the two scatter graphs. However, there appears to be no such simple correlation. South Africa and China have better IPR protection than South Korea in 2014, but their GDP per capita in the same year is less than half of the amount in Korea. Considering the possible lag for changes in IP protection to take effect, Figure 6 uses data of IPR protection level between 2006 and 2009. Despite the comparatively weak IPR protection, the amount of FDI that China attracts is more than 10 times of its counterpart developing countries such as India and South Africa. The difference between FDI in China and other countries are so huge that it can barely be explained by strengths of IP protection. It thus suggests that other factors, including the size of market, are more significant determinants of FDI rather than threats of imitation. After all, China is both with the vast capability and a reputation of counterfeiting products, yet still absorbs abundant inflows of FDI.

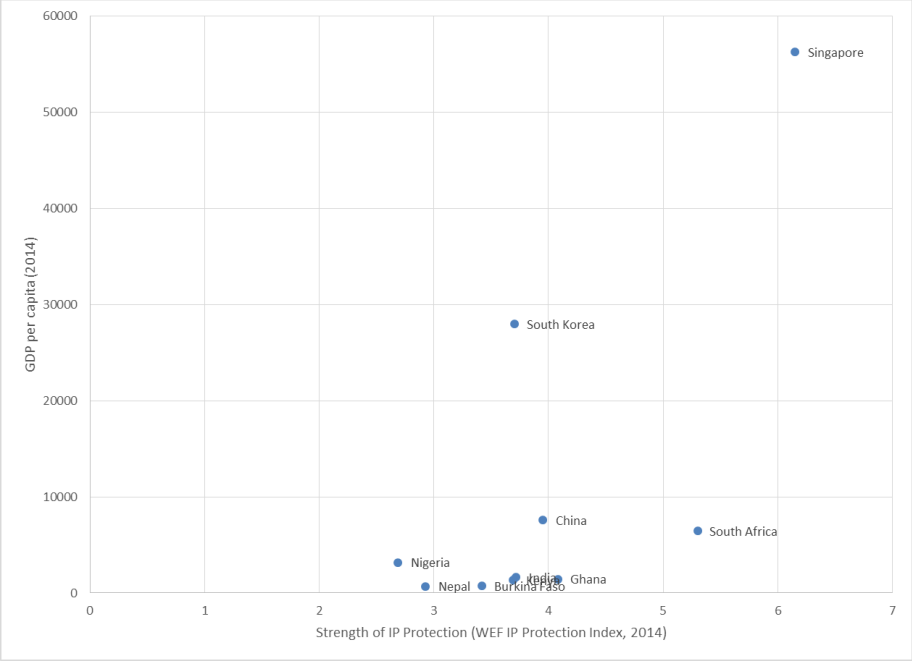

Figure 5 Variation in GDP per capita in 2014 by IP protection
Source: The World Bank

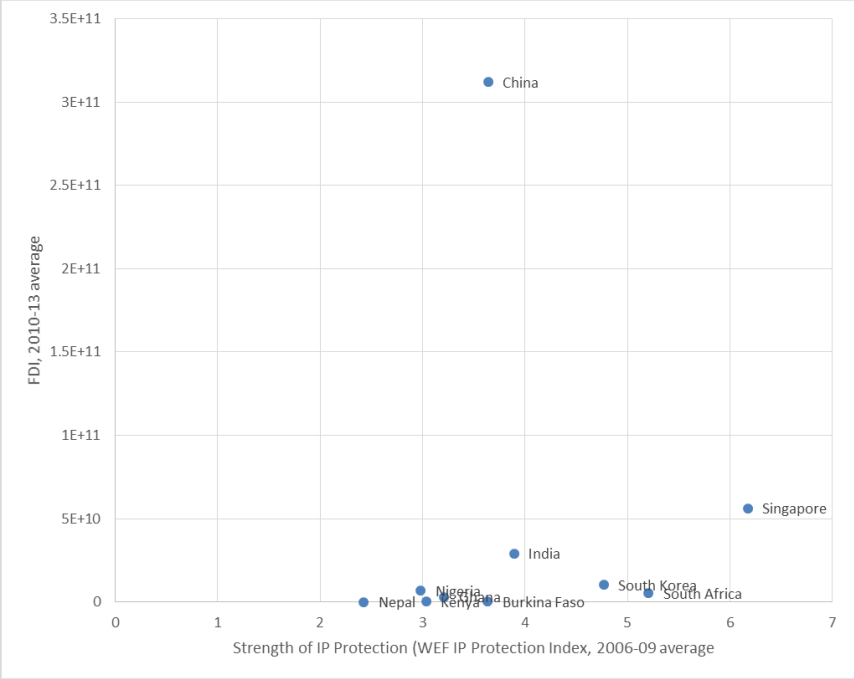

Figure 6 Variation in FDI between 2010 and 2013 by IP protection between 2006 and 2009
Source: Author's calculation based on FDI data of the World Bank

The flowing analysis focus on indicators of ICT performances. Generally speaking, ICT technologies and productivities are highly concentrated in a small group of developing countries, which can be supported by the distribution of big ICT companies. The OECD Internet Economy Outlook 2012 released data about the top 250 ICT firms in the world, covering both manufacture and service sectors in ICT. Out of the top 250 firms, 201 are registered in OECD, 5 of which are in South Korea. Only 3 of them are registered in mainland China, 4 in India, and 3 in South Africa. (OECD, 2012) This figure reflects characteristic of the spread of resources in ICT: they are highly concentrated in a fairly small group of countries, with little correlation to IPRs. For example, although Burkina Faso and Ghana has been better in IP protection than China over the 1960 to 1990 periods, and always have had similar level of IP protection with China, there is no top 250 firm in these two countries.

Numbers of Patents have been used as a mainstream indicator of innovation activities of a country. Surprisingly enough, even for the high-income and upper-middle income countries, stronger IPRs comes with less patents. Singapore, with the strongest IPR protection, has fewest patents in this group of countries. In addition, both as 'BRICS' countries, though South Africa has stronger IPRs, its patents are significantly fewer than China. For the low income developing countries, it seems that better innovative performances come with stronger IPR protection.

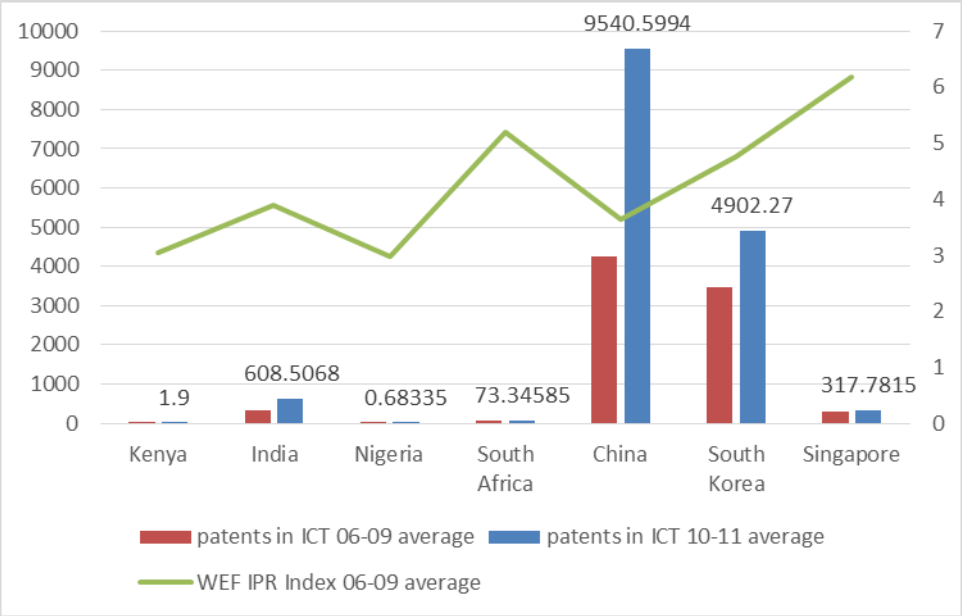

Figure 7 Average number of patents in ICT in selected periods
Source: Author's calculation based on European Patent Office (EPO) total count of patents in ICT by country

With regards to exports in ICT products and services, China has incomparably largest amount in product exports, while India in service export. For China, its IPR protection are stronger in the second period, with a growth in both ICT product and service export. Therefore, advances in IP protection indeed come with better performances in innovation in China. In contrast, IPRs are weaker in India over the latter periods, consistent with its status as an 'outlier' of international IPR protection. Although its export in ICT products is low, suggesting a weak manufacturing capability, its average export in ICT services between 2010 and 2013 are more than 1.5 times more than it was between 2006 and 2009. Regression in IPR in India has witnessed progress in its ICT service technological capabilities over the periods.

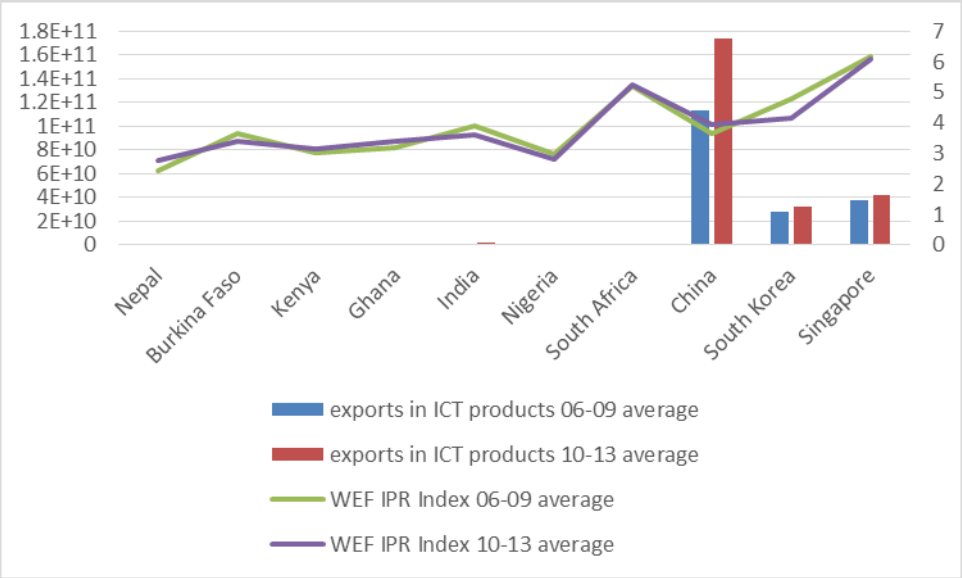

Figure 8 Average exports in ICT products in selected periods
Source: Author's calculation based on time series on international trade database of the Word Trade Organization (WTO)

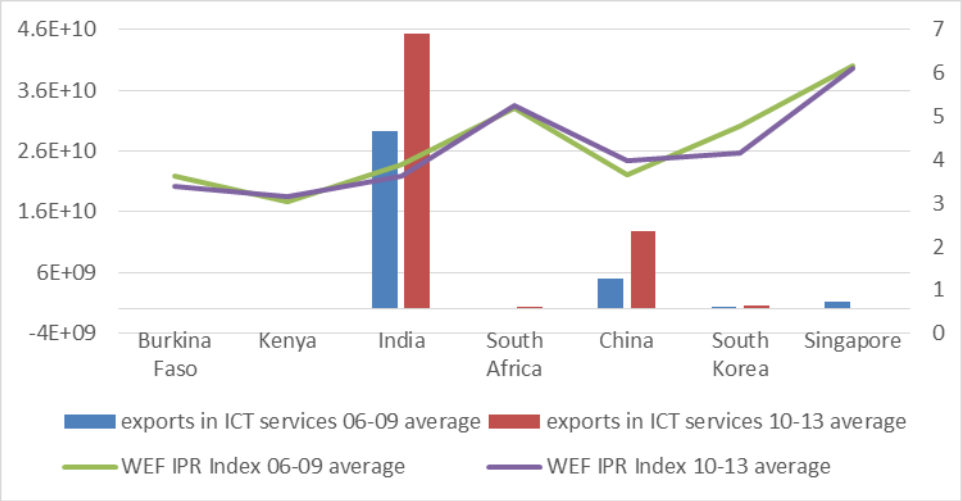

Figure 9 Average exports in ICT services in selected periods
Source: Author's calculation based on time series on international trade database of the Word Trade Organization (WTO)

Despite a worldwide image of counterfeiting, China and India has been successful in ICT. With only moderate protection of intellectual property, China still has achieved unchallenged increase in ICT patents and exports in manufactured goods. As early as 2003, China overtook the United States in ICT goods exports. In 2013, China's ICT exports, as the largest exporter of ICT goods, accounted for 37% of world amount. (Lanz, 2013) India is another 'miracle' economically, even with an 'outlier' status in the global IP system. Regarding the ICT sector, India is even more successful than China, as its focus is on ICT service, which has much more value added than manufacturing. WTO report has referred to India as the representative of

‘the most prominent success story of a developing country successfully integrating into ICT value chain by developing export-oriented software service industry’. (Lanz, 2013:14) India alone takes up 60% of the global market for IT services offshoring and about 20% of world exports in computer services. (Lanz, 2013) However, South Africa as a counterpart of these two countries, who are also one of the BRICS countries, have much poorer performance in ICT patents and exports, although it has much better protection of IP than the other two over decades.

Moreover, the least developed countries Burkina Faso and Nepal have not benefit from their efforts on strengthening IP protection. With a cooperative attitude to finish implementation of TRIPS requirements in advance, efforts to build the necessary structures from scratch with extremely limited resources and low-income, they still have the lowest penetration rate of the Internet and computers, the highest price of access to the Internet, and negligible or even no patents or exports in ICT. In brief, the results show that for low income countries with a weak scientific and technological capabilities, stronger IP protection has little effect on their performance in the ICT sector.

The results are not surprising. On the one hand, ICTs as high-tech products are difficult for the low-income countries to imitate, thus IPR is not an important determinants of technology transfer to these countries. On the other, there are other more crucial factors. The WTO report has pinpointed a crucial element in the success of ICT developments: ‘the potential for a developing country to successfully integrate into ICT manufacturing value chains depends on, among other things, its closeness to a big market or to regional production networks’. (Lanz, 2013: 13) Besides geographical advantages, a sound business environment and transparent regulatory environment are the most important factors influencing the establishment of commercial presence of leading companies in developing countries. (Lanz, 2013) In addition, physical infrastructures, including power supply, telecommunications and transport infrastructure are also in consideration of firms investing abroad. Especially for the low income countries, these other conditions, together with factors like finance and skills can be much more important to investment decisions than strengths of IP protection. (Hargreaves, 2011) Therefore, IP protection may only have secondary impacts on ICT, if there are any.

What is clear from past experience is that systematic IP protection alone provides neither the necessary nor sufficient incentives for FDIs in particular countries. Many East Asian and Latin American economies, though with weak IPR regimes, have received the bulk of foreign investment inflows in the past and even now, after the worldwide promotion of IP protection by TRIPS. For instance, between 1960 and 1980, both Taiwan and South Korea emphasized the importance of imitation and reverse engineering, and adopted weak forms of IP regime. Their indigenous technological and innovative capacity was built, during which period their economy leaped. (UK commission, 2002) However, with the introduction of TRIPS, developing countries who are WTO members are no longer free to tailor the extent of IP protection to serve their economic needs.

Actually, a rather weak IP regime to serve the goal of rapid catch-up

were also apparent in the nineteenth century United States and Japan of the 1950-80 period. In this context, 'TRIPS may be seen as an attempt by leading countries and companies to increase the economic payoffs of their R&D, making it more costly for developing countries to catch-up'. (Granstrand, 2005: 284)

The important lesson from the comparison is that IPR alone is far from enough. Developing countries aim to learn from economic success of the developed, thus they adopted IPRs. However, even for the developed economies, production requires both traditional tangible assets such as capital and labor, and intangible assets, including skills, organizational structures and processes, culture. (Brynjolfsson et al, 2002) The comparison between these 10 countries reflect that IPRs are not a powerful explaining variable for the differences of their potentials and performances in ICT. In other words, the portfolio of tangible and intangible assets are more important for the seed of innovation to grow. The most urgent issue for the developing countries is development, not adopting stringent IPR regime to limit their possible paths of development.

The exceptions of developing countries have become 'exceptions' without introducing better implementation of IP protection for a long term. And the least developed countries have been left out by the wave of ICT revolution without lagging behind regarding IPR protection. Stiglitz says that 'what separates developed and developing countries is not just the disparity, the gap, in resources, but also the disparity in knowledge, and closing that gap in knowledge is an essential part of successful development. We had become concerned that TRIPS might make access to knowledge more difficult—and thus make closing the knowledge gap, and development more generally, more difficult'. (Stiglitz, 2008: 1694) Least developed countries like Burkina Faso and Nepal have more urgent task to economically develop, why do we have to make the process even slower and more difficult by bothering them with IPR protection? Even though better off country such as China appears to be benefiting from stronger IPRs currently, their technological capabilities and qualifications to attract technological transfer are totally different from the least developed and low income countries, why do we have to impose the same minimum standards, which are not 'minimum', to all the countries regardless of their specific needs, focusing on the needs of multinational conglomerates?

6 Conclusions

The paper has reviewed the rationale under the TRIPS to promote intellectual property rights globally in the era of information and technology. It also presents distribution of ICT penetration and potentials, and analyzes the relation between implementing IP protection and ICT outcome. The data suggests for the least developed and low-income countries, stronger IPR protection are not a significant determinant in ICT developments. Especially for the least developed countries, stronger IPR protection even hinders developments in ICT penetration and affordability. As for the better-off countries, their routes of developments suggest that economic development comes first, and IPRs need to serve this goal, not to be set as the goal. In

other words, an international minimum standards regardless of specific development requirements of each country is not feasible. A theory from IPR protection to innovation and to economic development is simple, yet reality is far more complicated, and we cannot deal with this complexity simply by differences in length of transition periods.

History tells us to learn from successful stories. Compared to other countries, the size of increase in ICT products and service accomplished by China and India respectively has been tremendous. However, what deserves our attention is that both countries have a poor reputation regarding IPR, as they are both ‘notorious’ sources of cheap counterfeit products costing huge loss of profits of the lead companies in the developed countries. If intellectual property rights are such a crucial factor in attracting FDI and technology transfer, in encouraging indigenous innovations for sustainable economic growth, then why has flows of FDI flushed to China and India, with their poor image of counterfeiting well spread worldwide? Why have countries like the United States, and South Korea and Singapore caught-up with world economic leader in their time with a fairly loose regime of IP protection?

The intention of the paper is not to deny the effects of IPRs, but rather to question the ‘one-size-fits-all’ arrangements of TRIPS. IPRs encourage technology transfer and indigenous innovations at higher level of development. Countries like South Korea have established rather complete system of IPR regime for years, and it comes with steady developments in ICT penetration and innovation indicators such as patents. In addition, over the last decade, stronger IPRs correlate with better ICT performances in China. However, developing countries with weak absorptive capacity are already over-burdened with their primary needs to feed their population, knowledge with a high price tagged by IP arrangements may only severe their current situation, especially restrict the least developed and the least connected countries. More flexibility should be given to the developing countries to allow IPRs to serve their mission of inducing development.

ICT is a general purpose technology with unprecedented power to transform life of people, hopefully also life of poor people. The greatness of ICT is easiness and marginal cost for knowledge to spread to anybody, which finally offers the poor opportunities to benefits from knowledge. Trade is the main driver for economic development, and TRIPS performs as a crucial regulation on trade. TRIPS thus influences how much the poor can benefit from the wave of ICT, and it deserves more thorough considerations.

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