

From imitation to innovation

——The optimal level of IPP in the process of building an innovation-oriented China

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An Intellectual Property Protection (IPP) system is one of the key element in a system of national innovation. Currently, the core conflict for China's IPP is its ability to protect intellectual property. Based on its position as a developing country, this paper theoretically and empirically analyzes the role that IPP plays in the process of building an innovative-oriented nation. First, we construct a duopoly model to show that, according to the strength of the innovation capability, the process of building an innovation-oriented nation can be divided into three stages: the initial stage, the transitional stage, and the advanced stage. In the initial stage, having relative weak innovative capability in overall economy, a nation blindly exerting IPP may lead the economy into a vicious cycle of "innovation traps". Corresponding to different stages, the value of optimal protection of intellectual property is various. Second, using provincial panel data from 1995 to 2008 in China, this paper empirically analyzes the optimal level of IPP. The result shows that the creative capability of China currently is more sensitive to imitation than to independent innovation, which means that China may be just in the transition stage of building an innovative-oriented nation. At last, a preliminary discussion is made to explore modes of regulating IPP in the process of building an innovative-oriented China.

Keywords: innovation-oriented nation, IPP, stage characteristics, regulating IPP

1. Introduction

An Intellectual Property Protection (IPP) system, as one of the core elements in the national innovation system, plays a crucial role in a country's innovation. Currently, China faces a grave situation in regards to IPP. On the one hand, the average possession of intellectual protection is rather little—only 4.02 patented items per invention, as the possessive quantity per ten thousand people in 2013, which is far less than developed countries like the US and Japan. On the other hand, there is a lack of core technology and international brands with independent intellectual property specific to China. Although "made in China" is a worldwide phenomenon, China

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is still weak in areas of key technologies. Third, while suffering the heavy burden of updating industry in the name of environmental protection and fewer profits, infringement proceedings on international intellectual property has become a common feature of China's economic landscape. Facing such a grave situation, we must reflect on where the crux of China's IPP lies. The author believes that in the current stage, the core conundrum is the strength of China's protective measures (Shen, 2008; Qian, 2007). With TRIPS as the background, in China's current development stage, how can policy makers promote the development of innovation with appropriate strength in IPP?

As to the degree of IPP, a widespread discussion has already been conducted. Chin and Grossman (1990), Helpman (1993), as well as Allred and Park (2007) all think that strengthening IPP will be unfavorable to innovation in developing countries. Kim (2012) discovers that patent protection has promoted economic growth in developed countries rather than developing countries. Many scholars have further discussed the causes for these negative influences. Horri and Iwaisako (2007) maintain that although strengthening IPP will reduce the chances of being imitated by new products, competition will be undermined, while monopolies will be strengthened—which will become detrimental to both innovation and economic growth. Glass and Wu (2007) point out that the aim of IPP in developing countries is main to satisfy the demand from developed countries, for the influence of IPP on innovation is closely related to the innovation models in these countries. Puga and Trifler (2010) think that abuse of intellectual property will confine free competition, hinder technological dissemination, and harm economic growth. Some other scholars believe that the influences of developing countries' strengthening IPP upon their technological innovation are uncertain. The research results of Lai (1998), as well as Chen and Puttitanun (2005), show that the effect of IPP upon the speed of technological updates is nonlinear, because this influence is highly dependent on the channels of technological transfer.

Research on IPP from the perspective of economics by Chinese scholars is still rather weak. Lin (2002), as well as Lin and Zhang (2005), have both emphasized the importance of technology input for China in its current phase. As there is a huge gap between China's technological level and that of developed countries, China's technological input will bring a spillover effect that may narrow this gap in the short-term. Yi (2007) began to pay attention to the functional mechanism between IPP and technological innovation, believing that the effect of IPP upon technological progress depends on the relative technological level and ability to imitate. Guo and Zhuang (2012) studied the issue of IPP's effect on technological innovation in developing countries, finding there is an optimal protection strength for IPP systems in developing countries, for which the optimal value relies on the technological level and the degree of competition in the developing countries' market. Dong (2012) researches the role of IPP upon economic growth and technological innovation in an economy's transformation stage, claiming that relatively weak IPP in the short run is beneficial to China's economic development in its current transformation stage.

We can see from the above mentioned literature that although scholars have

discussed in detail the effect of IPP upon developing countries in terms of technological innovation and economic growth, these research has not discussed in-depth the evolution of IPP strength for each phase in building an innovation-oriented country, nor identified which intellectual property protection strategy is favorable for China to improve its overall innovative capability in its current phase. This is the core aim of this paper—to explore, from a theoretical perspective, what the optimal IPP strength in different phases in an innovation-oriented country is, and, furthermore, how to achieve it. By doing so, a suitable approach for optimizing China's intellectual property protection in its current situation will be identified.

2. Analysis on the model reflecting the effect of IPP upon the interests of enterprises and consumers

Innovation-oriented countries refer to those countries treating technological innovation as the core driving for economic and societal development. When measuring whether a country is an innovation-oriented one or not, its innovative capability is a key element, which determines the contribution rate of its international technological competitiveness, scientific advancement, and technological innovation to its economic development. Globally recognized innovation-oriented countries like the US, Japan, Finland, and South Korea, have the common trait that their comprehensive innovation index are obviously higher than other countries! For instance, these countries' technological contribution rates are all over 70%. This paper, according to the power of innovation, divides the building process of an innovation-oriented country into several phases and attempts to analyze the optimal strength for IPP in different phases. The analysis steps are as follows. First, build a duopoly model; second, based on the changes in the innovative capability, the building process should be classified into the initial phase, transitional phase, and advanced phase; third, with the precondition of maximum social welfare, a discussion on how to adjust the IPP strength according to the changes in innovative capability in different phases will be conducted. This means finding the optimal degree of IPP for the improvement of innovative capability. Excessively strong IPP, though favorable for technological innovation, will also limit technological imitation. By comparison, too weak IPP, though favorable for technological imitation, is detrimental to technological innovation. With certain innovative capabilities, we should seek the optimal IPP that is favorable for the improvement of innovation capability. Through analysis, we aim to answer the question of what is the optimal IPP strength in China within its current development stage. Following this analysis, the author believes that a country should implement the optimal IPP policy in different stages and establish

an adjustment mechanism on IPP on the basis of their differentiated innovation capability.¹

2.1. Basic hypotheses

Hypothesis 1: There exist two enterprises in one country's market—one is the innovation-oriented enterprise, and the other is the imitation-oriented enterprise. Innovation-oriented enterprises conduct cost-reducing innovation, while imitation-oriented enterprises have no innovative behavior and reduce costs by incorporating and imitating research products from innovation-oriented enterprises. IPP strength influences the production cost of imitation-oriented enterprises by exerting impact on technological spillover.

Hypothesis 2: There is linear duopoly competition between two enterprises. Suppose the inverse demand function in the market as $P=a-q$. a represents the scale of the market in the country. In $q=q_1+q_2$, q_1 and q_2 represent the production of innovation-oriented enterprises and imitation-oriented enterprises, respectively.

Hypothesis 3: There are two steps in the process of making decisions for an enterprise. First, innovation-oriented enterprises conduct the optimal decision for research and development. Second, innovation-oriented and imitation-oriented enterprises make decisions for the optimal production simultaneously on the products market.

Hypothesis 4: The key variant influencing the research and development of an innovation-oriented enterprise is the difficulty and efficiency of research and development. That is to say, to acquire a similar technological level, the higher the difficulty is, the more investment into research and development will be; the higher the efficiency of research and development is, the less the input into research and development will be.

2.2. Effects of enterprises' decisions on research and IPP

The R&D function of an innovation-oriented enterprise: $x=(\lambda_0 R)^{1/2}$

¹ Three points must be noted. First, because there is an intrinsic rule for a country's development for innovation, it is necessary to seize the main element influencing development for innovation regardless of the influence on the country by other countries. By establishing a model to reflect the rule of a country's development for innovation, we will further inspect the optimal IPP in different phases. Under the conditions of openness, such a goal can be achieved by the extending a country's model, which will not exert substantive influence on the research conclusions. Because of this, the author only considers the economy of a country without considering the influence of other countries. Second, the author employs a static partial equilibrium model without considering the element of time. The main reason is that this thesis aims to reflect the IPP system in different phases objectively. The difference in innovation capability is not all related to time, which means the innovation capability will not increase with the passing of time. Thus, this thesis introduces a model. Third, this paper has not incorporated consumer behavior into the model as the main object of analysis. The reason is that the key element in embodying a country's innovation capability is enterprises instead of consumers. In this model, the analysis on consumer surplus has actually implied the consideration of the benefits that innovation would bring to consumers.

The cost function of the two enterprises: $\begin{cases} C_1 = (c - x)q_1 \\ C_2 = (c - \theta x)q_2 \end{cases}$

The profit functions of the two enterprises: $\begin{cases} \pi_1 = (a - q_1 - q_2)q_1 - (c - (\lambda_0 R)^{1/2})q_1 - R \\ \pi_2 = (a - q_1 - q_2)q_2 - (c - \theta(\lambda_0 R)^{1/2})q_2 \end{cases}$

Among theses, x represents the technology level, that is the amount of marginal cost saved due to innovation; R represents the investment into R&D; $\lambda_0 = \sigma/\gamma$ represents the innovation capability of a country, σ represents the efficiency of R&D, and γ represents the research difficulty. If the research difficulty increases while research efficiency decreases, which means an increasingly smaller λ_0 , the overall innovative capability of research and development will become weaker and weaker. The opposite means the overall capability in R&D is getting stronger and stronger. C_1 represents the cost function of an innovation-oriented enterprise, while C_2 is the cost function of an imitation-oriented enterprise. c represents marginal costs and θx is the technological level that an imitation-oriented enterprise learns to reach, which is the cost for each unit in an innovation-oriented enterprise when the enterprise has come up with technology at a level of x . This figure is less than x . $\theta \in [0, 1]$ represents the degree of spillover for an innovation-oriented enterprise, which indirectly reflects the strength of IPP in a country. The more protection, the less the technology spillover will be; the less protection, the more spillover will be. When $\theta=0$, the IPP reaches its top level, signifying total protection. When $\theta=1$, the IPP reaches its lowest point, meaning intellectual property totally without protection; π_1 is the profit function for an innovation-oriented enterprise; π_2 means the profit function of an imitation-oriented function (Yang, 2006).

With a duopoly market structure, the optimal equation for production competition is:

$$\begin{cases} \max_{q_1} \pi_1 = (a - q_1 - q_2)q_1 - (c - (\lambda_0 R)^{1/2})q_1 - R \\ \max_{q_2} \pi_2 = (a - q_1 - q_2)q_2 - (c - \theta(\lambda_0 R)^{1/2})q_2 \end{cases}$$

s. t. $\pi_1 \geq \pi_2 \geq 0$

According to $\partial \pi_1 / \partial q_1 = 0$, $\partial \pi_2 / \partial q_2 = 0$, the balance of duopoly production competition can be explained as:

$$q_1^* = \frac{a + (2 - \theta)(\lambda_0 R)^{1/2} - c}{3}; \quad q_2^* = \frac{a + (2\theta - 1)(\lambda_0 R)^{1/2} - c}{3}$$

When this equation is substituted into the profit function, we can get the optimal profit for innovation-oriented enterprises and imitation-oriented enterprises:

$$\pi_1^* = \frac{(a + (2 - \theta)(\lambda_0 R)^{1/2} - c)^2}{9} - R; \quad \pi_2^* = \frac{(a + (2\theta - 1)(\lambda_0 R)^{1/2} - c)^2}{9}$$

Innovation-oriented enterprises, on the basis of maximum profit, make decisions on R&D. From $\partial \pi_1^* / \partial R = 0$, the optimal input into R&D and the optimal technological level of an innovation-oriented enterprise are:

$$R^* = \frac{\lambda_0(2-\theta)^2(a-c)^2}{(9-\lambda_0(2-\theta)^2)^2}; x^* = (\lambda_0 R)^{1/2} = \frac{\lambda_0(2-\theta)(a-c)}{9-\lambda_0(2-\theta)^2}$$

The technological level of imitation-oriented enterprises is:

$$\theta x^* = \theta(\lambda_0 R)^{1/2} = \frac{\lambda_0 \theta(2-\theta)(a-c)}{9-\lambda_0(2-\theta)^2}$$

The profits of an innovation-oriented enterprises and imitation-oriented enterprises are:

$$\pi_1^{**} = \frac{(a-c)^2}{9-\lambda_0(2-\theta)^2}; \pi_2^{**} = \frac{(a-c)^2(3-\lambda_0(2-\theta)(1-\theta))^2}{(9-\lambda_0(2-\theta)^2)^2}$$

In order to satisfy the duopoly market structure, we should guarantee the output of the two enterprises be positive with the following constraint condition:

$$9-\lambda_0(2-\theta)^2 > 0; [3-\lambda_0(2-\theta)(1-\theta)] > 0$$

The consumer surplus is:

$$CS^{**} = \frac{(q_1^{**} + q_2^{**})^2}{2} = \frac{(a-c)^2(6-\lambda_0(2-\theta)(1-\theta))^2}{2(9-\lambda_0(2-\theta)^2)^2}$$

Social welfare is equal to the sum of the consumer surplus and the profit of two enterprises:

$$W^{**} = \pi_1^{**} + \pi_2^{**} + CS^{**} \quad (1)$$

The IPP's effect on the optimal profits of an innovation-oriented enterprise is:

$$\frac{\partial \pi_1^{**}}{\partial \theta} = \frac{2\lambda_0(\theta-2)(a-c)^2}{(9-\lambda_0(2-\theta)^2)^2} < 0 \quad (2)$$

The IPP's effect on the optimal profit of an imitation-oriented enterprise is:

$$\frac{\partial \pi_2^{**}}{\partial \theta} = \frac{2\lambda_0(a-c)^2(3-\lambda_0(1-\theta)(2-\theta))(3(5-4\theta)-\lambda_0(2-\theta)^2)}{(9-\lambda_0(2-\theta)^2)^3} \quad (3)$$

The effect of IPP on the consumer surplus is as follows:

$$\frac{\partial CS^{**}}{\partial \theta} = \frac{\lambda_0(a-c)^2(6-\lambda_0(\theta-1)(\theta-2))(3(1-2\theta)-\lambda_0(2-\theta)^2)}{(9-\lambda_0(2-\theta)^2)^3} \quad (4)$$

The influence of IPP on social welfare is as follows:

$$\frac{\partial W^{**}}{\partial \theta} = \frac{\partial \pi_1^{**}}{\partial \theta} + \frac{\partial \pi_2^{**}}{\partial \theta} + \frac{\partial CS^{**}}{\partial \theta} \quad (5)$$

2.3. Analysis of IPP's effect on the interests of innovation-oriented enterprises, imitation-oriented enterprises, and consumers

At different values of λ_0 , the effect of θ on the interests of innovation-oriented enterprises, imitation-oriented enterprises, and consumers can draw the following conclusions.

First, for an innovation-oriented enterprise, a profit of $\partial \pi_1^{**}/\partial \theta < 0$ will increase with strengthening IPP. Second, for an imitation-oriented enterprise, there are two approaches for the IPP strength to exert its effect on profits. One is a direct approach, with strengthening IPP (decreasing θ), less technology can be imitated, causing costs to increase and profits to decrease. The other is an indirect approach. By strengthening IPP, innovation-oriented enterprises are stimulated to raise input into R&D and achieve technological progress. With a certain protection strength, there will be a greater supply of technology for imitation, with decreased costs and increased profits. When the indirect influence of IPP on the profits of imitation-oriented enterprises is greater than the direct one, $\lambda_0 > 3(5-4\theta)/(\theta-2)^2$, there will be $\partial \pi_2^{**}/\partial \theta < 0$, which means with strengthening IPP, profits will increase. When the indirect influence of IPP on imitation-oriented enterprises is less than the direct one, $\lambda_0 < 3(5-4\theta)/(\theta-2)^2$, there will be $\partial \pi_2^{**}/\partial \theta > 0$, which means that with strengthening IPP, profits may be less instead. Third, for consumers, the IPP's influence on consumer surplus is quite complex. When the initial IPP strength is weak, $1/2 < \theta < 1$, we will have $\partial CS^{**}/\partial \theta < 0$. This means that with the strengthening of IPP, consumer surplus will increase. However, when the initial IPP strength is strong, $0 < \theta < 1/2$, the influence of IPP strength on consumer surplus is related to the country's innovative capability. When the innovative capability is relatively strong, $\lambda_0 > 3(1-2\theta)/(\theta-2)^2$, there will be $\partial CS^{**}/\partial \theta < 0$, which means that with strengthening IPP, consumer surplus will increase. When the innovative capability is weak, $\lambda_0 < 3(1-2\theta)/(\theta-2)^2$, there will be $\partial CS^{**}/\partial \theta > 0$, meaning the consumer surplus will decrease with a strengthening IPP.

To sum up, in different phases of changing innovative capability λ_0 , strengthening IPP will exert different influences on innovation-oriented enterprises, imitation-oriented enterprises, and consumer surplus. With diverse maximum values of social welfare, the optimal solution for a country's IPP depends on its stage of development. It can be certain that the value of $\partial W^{**}/\partial \theta$ should be determined by the equations from (2) to (4). When the innovative capability is strong, $\lambda_0 > 3(5-4\theta)/(\theta-2)^2 > 3(1-2\theta)/(\theta-2)^2$, we will have $\partial W^{**}/\partial \theta < 0$, which means that with strengthening IPP, social welfare will be greater. When $\lambda_0 < 3(1-2\theta)/(\theta-2)^2$ and $0 < \theta < 1/2$, the innovative capability is quite weak and is strongly protected, it can be calculated that $\partial W^{**}/\partial \theta > 0$. With greater IPP strength, social welfare will decrease, so only when the intellectual property tends to be as weak as $\theta = 1/2$ can the social welfare increase. Under the conditions of $\lambda_0 < 3(1-$

$2\theta)/(\theta-2)^2, 1/2 < \theta < 1$ and $3(5-4\theta)/(\theta-2)^2 > \lambda_0 > 3(1-2\theta)/(\theta-2)^2$, the $\partial W^{**}/\partial \theta$ is not certain. As the condition of $\theta=1/2$ and $\theta=1$, $\partial W^{**}/\partial \theta$ represents different signs, and this function is a continuous one, so we can judge that when $\lambda_0 < 3(1-2\theta)/(\theta-2)^2$ and $1/2 < \theta < 1$, as well as $3(5-4\theta)/(\theta-2)^2 > \lambda_0 > 3(1-2\theta)/(\theta-2)^2$, there exists the scenario of $\partial W^{**}/\partial \theta=0$, which means there is an extreme value for W .

3. The characteristics of building an innovation-oriented country and the optimal intellectual property protection

According to the changing economic effects of IPP, due to different innovation capabilities in a country, we can divide the process of building an innovation-oriented country into four phases from the perspective of maximum social welfare. In each phase, the country should cautiously select the appropriate interval for its IPP to correspond to its national innovation power.

3.1. The initial phase of building an innovation-oriented country

When $\lambda_0 < 3(1-2\theta)/(\theta-2)^2 < 3(5-4\theta)/(\theta-2)^2$, the overall economic innovative capability is quite weak, that is, when IPP stays at an interval of a lower level of $1/2 < \theta < 1$, strengthening IPP appropriately will promote market demand, which will encourage innovation and curb imitation. This means that strengthened IPP is favorable to innovation-oriented enterprises, but detrimental to imitation-oriented enterprises. Specifically, when $\partial \pi_1^{**}/\partial \theta < 0$, $\partial CS^{**}/\partial \theta < 0$, there will be $\partial \pi_2^{**}/\partial \theta > 0$. When initial IPP strength is low, imitation-oriented enterprises will enjoy tremendous convenience when innovation is curbed, causing the market to be filled with fake products, and consumers will benefit as long as there are new products. Under this circumstance, strengthening IPP appropriately, with θ ranging from $1/2$ to 1 , and increasing interests of innovation-oriented enterprises will cause consumers' utility to rise until the three figures reach the same level. The imitation-oriented enterprises will incur a loss of interests. This means when $\partial W^{**}/\partial \theta=0$ in the equation (5), the optimal IPP value of θ^{**} will be reached. In reality, people show tremendous enthusiasm towards innovative products in the initial period of reform and opening up. New fashions lead the popular dressing and new films attract amounts of audiences. When products such as TVs and fridges enter the market, families that can afford them will eagerly buy them. But under the economic situation of inadequate innovation capabilities, people yearn for the appearance of new products, and once that occurs they will be bought enthusiastically by buyers, showing the basic characteristics of a country in its initial phase of building an innovation-oriented country.

3.2. The "innovation-gap" in building an innovation-oriented country

Such a gap is a unique situation in initial phases of market development. When the overall innovation capability of an economy is weak, blindly placing IPP strength at an interval of a higher level will cause the economy to be trapped into

the vicious cycle of an “innovation trap”, which will curb innovative capabilities. Specifically, when $\lambda_0 < 3(1-2\theta)/(\theta-2)^2 < 3(5-4\theta)/(\theta-2)^2$ and $0 < \theta < 1/2$, we will have $\partial \pi_1^{**}/\partial \theta < 0$, $\partial CS^{**}/\partial \theta > 0$ and $\partial W^{**}/\partial \theta > 0$. The final result depends on whether the last equation is $\partial W^{**}/\partial \theta > 0$, which means strengthening IPP will cause less social welfare. We can attempt to explain this as follows. Although strengthening IPP bring benefits to innovation-oriented enterprises, the interests of imitation-oriented enterprises and consumers will be harmed. As consumers represent market demand, damaging consumer interests will mean the market environment discourages innovation and supports imitation, causing innovators to become unable to cover their costs of R&D. With dampening enthusiasm for innovation, and decreasing λ_0 , the overall innovative capability of an economy will become even weaker. Continuing to strengthen IPP would cause more loss for consumers, causing the market to discard innovation, leading the economy to become trapped once again in an innovation trap. Of course, an innovation trap is not an inevitable path when building an innovation-oriented country. If we can proceed from the actual situation of innovative capability, cautiously select the adjustment interval for IPP, an innovation trap will be avoided effectively. Currently, there are a great number of countries in this interval, including Argentina and other South American countries. These economies leave technological development and structural upgrades to be dominated by the market, but do not recognize the needs of appropriate intervention by countries in terms of knowledge production and technological incorporation. Under the condition of low innovation capabilities and strict IPP, the absolute advantages of the new technology products from foreign countries in the market cause technological innovation to be curbed due to the lack of market competition. Meanwhile, strengthened IPP will curb imitation of enterprises developing new technology, leading IPP to protect only new technology from abroad, which is not favorable for the promotion of a country's innovative capability. It can be seen that under the condition of weak innovative capabilities and a lack of market competition, relatively weak IPP policy is better than strong IPP policy.

3.3. The transitional phase of an innovation-oriented country from initial phase to a higher phase

When $3(5-4\theta)/(\theta-2)^2 > \lambda_0 > 3(1-2\theta)/(\theta-2)^2$, the economy enters a transitional phase in which overall innovative capability is weak and is in the process of transferring to a new phase with higher overall innovative capabilities. Appropriate IPP strength correspondingly changes from a low level interval to a higher one. In this phase, it is not likely to remain in the interval of $1/2 < \theta < 1$, with weak intellectual property protection strength, because we know from the model that if relevant departments continue to adopt a lower IPP strength, that is $1/2 < \theta < 1$, the innovative capability λ would decrease at the level of $\lambda_0 < 3(1-2\theta)/(\theta-2)^2$. When back to the initial phase, the building of an innovation-oriented country is not favored. Thus, the IPP strength in this phase can only fall in the interval of $0 < \theta < 1/2$, in which there is $\partial \pi_1^{**}/\partial \theta < 0$ and $\partial CS^{**}/\partial \theta < 0$. But when $\partial \pi_2^{**}/\partial \theta > 0$, strengthening IPP will increase the interests of innovation-oriented enterprises and consumers and cause imitation-oriented

enterprises to incur a loss. When the increment of innovation-oriented enterprises and consumer interests is equal to the loss of the imitation-oriented enterprises, the optimal value of IPP θ^{**} will be achieved. As IPP both protects innovators and allows for consumers to benefit, market demand is stimulated. Such demand for innovative products will further stimulate innovation in the market and force those imitation-oriented enterprises to curb their imitation behaviors and participate in innovative activities. The overall economy will enter a process of healthy development in which innovation is stimulated, and the overall innovative capability of the economy will be in a benign state with gradual development. Judging from the actual situation, ever since China's reform and opening up, the strengthening of IPP has given a big push to China's innovative capability and economic upgrade. Base on the time series data of China's automobile from 1992 to 2008, Yin (2010) show that for each 1% of strengthening IPP, 0.9111% of technological innovation will come about. Using the data from 1986 to 2006 Qian and Pan (2007). have approved the IPP's promotional effect for economic growth. In this phase, strengthening IPP brings about an upgrade of innovative capability and a virtuous cycle of economic growth.

3.4. *The advanced phase of building an innovation-oriented country*

In this phase, with $\lambda_0 > 3(5-4\theta)/(\theta-2)^2$, the overall economy's innovative capability is relatively strong. When the initial IPP is at an interval of $0 < \theta < 1/2$, strengthening IPP is beneficial to innovation-oriented enterprises, imitation-oriented enterprises, and consumers and will further promote the upgrade and cementing of innovative capabilities. Specifically, according to this first-order condition, when $\lambda_0 > 3(5-4\theta)/(\theta-2)^2$, it is bound to have $0 < \theta < 1/2$ and $1/2 < \theta < 1$ is not possible. In this phase, we have $\partial \pi_1^{**}/\partial \theta < 0$, $\partial CS^{**}/\partial \theta < 0$ and $\partial \pi_2^{**}/\partial \theta < 0$, so as long as there is a strengthened IPP, the whole economy has the potential to benefit. In reality, economies such as the US, was among the top five "Most Innovative Countries" in 2013 according to the report on global innovation index, have a G-P index for IPP at a level of 4.88—the highest on the list for the whole world.

4. **The judgment on the phase of building China into an innovation-oriented country**

According to theoretical analysis, a country should implement IPP strategy for each phase in accordance with the characteristics of each phase. However, the precondition to implement this strategy is to identify which the phase the country is in. There are two ways for developing countries to achieve technological progress: one is independent innovation, and the other is imitation of international technology. At different phases of innovation capability formation, the reliance on each of them is also varied. Experiences from Japan and South Korea show that the transition from one phase to another through imitation is an important approach to achieve technological catch-up, which also embodies the characteristics of stages a country experiences in its process of becoming an innovation-oriented economy. In this way, by judging a

country's reliance on independent innovation or imitation in a certain period, we can infer which stage it is in, in terms of building an innovation-oriented country. On such a basis can we further diagnose the effectiveness of IPP. In order to infer which stage China is in for building an innovation-oriented country, we need to conduct empirical studies into the sample data from China. As the size of time-series samples is too small, it is hard to get a reliable result, making the fixed effects regression model of provincial panel data necessary. These panel data have covered almost all the provinces, direct-controlled municipalities, and autonomous regions, except for Tibet, in the hope of better utilizing the differences among regions in innovative capabilities and making a similar analysis on China's capabilities in different phases. In this paper, two key questions are answered. First, in recent phases, which is the main force for China achieving technological progress—-independent innovation or imitation? Second, based on the innovative capabilities, what is the optimal strength for IPP?

Given the great gap among different provinces in terms of economic development and innovative capabilities, we put forward hypothesis 1 as a testament. After analysis, we conclude from the theoretical model that a country should adopt different IPP strength in different phases of innovative capability. Hypothesis 2 is thus put forward.

Hypothesis 1: In provinces where innovative capability is strong, the motivational effect on technological progress by independent innovation is prominent.

Hypothesis 2: Due to the big difference in innovative capability among provinces, the economic effect of IPP in different regions is different.

4.1. Specification of the measurement model

Suarez-Villa (1990) maintains that the patent available can measure the innovative capability of a country. The FP&S model further points out that the input into research is one of the factors for the difference of internal innovative capability (Furman, 2002). Faber and Heslen (2004) point out that, with condition of openness, the formation of a country's innovative capability is influenced by the influx of international capital, technological transfer, and international trade. It can be discovered after analysis that the key element of influencing a country's technological innovation includes technological inputs and the technological level of the country, which is closely related to the research input into independent innovation, as well as the past research results, and the economic development level. Judging from the actual situation of developing countries, We can find that the reliance of developing countries on international technological imitation is quite heavy (Jakob, 2010). The reserve of human resources of a country and the relative technological level is the key variable in influencing a country's imitation capability. The mechanism on technological innovation by IPP is that it endows the innovator power of pricing, which induce them to add input. (Nelson & Phelps, 1996). Thus, in measurement models, the inline on independent innovation by IPP is mainly through the interaction between IPP and independent innovation.

To sum up, innovative achievements such as patents are the direct embodiment of national innovative capabilities, while research inputs, international technological transfers, and IPP systems are the driving forces to elevate national innovation

capabilities. On such a basis, inspection on the overall innovative capability can be done from the perspective of patent output function, which can be divided into two categories according to the sources, imitation and independent innovation. Imitation mainly means the simulation of international technology. Under such a framework, for hypothesis 1, we specify the measurement equation as follows:

$$\log(\text{patent}_{jt}) = \alpha_0 + \alpha_1 \log(\text{imitation}_{jt}) + \alpha_2 \log(\text{rd}_{jt}) + B \log X_{jt} + \beta_j + \varepsilon_{jt} \quad (6)$$

In this equation, dependent variable patent_{jt} is the number of applied patents domestically for province j ; control variable imitation_{jt} is the sum of FDI and international trade, symbolizing the promotional effect on innovation by imitation. The reason is that, among international technological dissemination, there are three approaches for technological dissemination: FDI, international trade, and technological permission. For China, the former two approaches are the main ones; rd_{jt} is the internal expenditures on R&D, symbolizing the promotional effect of independent innovation on innovation; X_{jt} are factors influencing patents output such as input of human resources, market scale, and relative technological level; ε_{jt} is a disruptive term, symbolizing other factors that have not been observed; α_0 is the common intercept term, while β_j is the fixed effect of province j . The coefficient of control variables α_1, α_2 and B do not change according to time and intersecting surfaces; $\log(\dots)$ means the natural logarithm adopted for test variables.

On such a basis, the effects of IPP on independent innovation are inspected. As in this thesis, we care more about the estimated coefficient of the interaction between IPP and R&D. We change equation (6) into an estimated equation as follows:

$$\log(\text{patent}_{jt}) = \partial_0 + \partial_1 \log(\text{ipprd}_{jt}) + C \log Z_{jt} + \eta_j + e_{jt} \quad (7)$$

Dependent variable patent_{jt} is the number of patents applied for domestically; ipprd_{jt} is the interaction between IPP strength index and the internal expenditure of R&D of the province; Z_{jt} is a control variable including IPP strength, human resources, and market capital; η_j is the fixed effect of province j , while e_{jt} is a disruptive term denoting other factors that have not been observed.

4.2. Sources of data and the variable declaration

(a) Selection of samples. First, to test hypothesis 1, the author has adopted the provincial panel data from 1995 to 2008 after China's accession into the WTO to inspect which is the reliance of China's overall innovative capability between imitation or independent innovation. As the statistic specifications changed after 2009, and the economy has fluctuated greatly since the financial crisis, the comparability of the data between those before 2008 and after 2009 is quite low, making the data unable to be adopted. Secondly, to testify hypothesis 2, the provincial panel data between 1997 and 2006 is selected. The reason for the reduction of the sample size is the availability of the provincial IPP index, but this would not affect the basic conclusion we have

testified.

(b) Sources of data. All the data concerning patent output, independent innovation (internal expenditure of R&D fund), and human resource capital input (the number of participators into technological activities) came from the China Statistical Yearbook. GDP data per capita across the country or from provinces concerning market scale (the size of population at the year end), the commodity value of imports and exports, as well as relative technological levels all come from the China Statistical Year Book. Data on the utilized investments of the FDI from 1995 to 2003 are from the China Statistical Year Book, and those from 2004 to 2009 are from the statistical year book across provinces, directly-controlled municipalities, and autonomous regions; the provincial IPP index from 1997 to 2006 is from “Intellectual Property Protection and the Economic Growth in Developing Countries ”(Yu, 2009).

(c) Descriptive statistics. It can be seen from table 1 that there exists a great gap in terms of economic development level, innovation capabilities, independent R&D, and imitation among all provinces, municipalities, and autonomous regions. First, the imbalance of economic development is quite heavy. The minimum figure denoting relative technological levels is 0.347, while the maximum is 3.776, with 1.107 as the average. The difference in relative development among provinces is also quite big, especially the gap between developed provinces and backward provinces. Second, variables such as patent output, independent R&D, and imitation can also denote the existence of the gap or the imbalance.

Table 1
The variable definition and descriptive statistics

	Variable definition	Observed	Mean	Standard deviation	Minimum	Maximum
Patent output	Symbolized by the number of applied domestic patents in IPP Bureaus in each province. Unit: item	418	8188.2060	15321.6400	92	128002
Relative technical level	Signified by the ratio of GDP per capita against national GDP average	420	1.1069	0.7282	0.3466	3.7759
Market scale	Signified by the size of population at year end. Unit: ten thousand	418	4220.1630	2580.6890	481	11430
Independent innovation	Signified by the internal expenditure of R&D fund of each province. Unit: ten thousand Yuan	418	667624.9	1017443	979	6570131
Imitation	Signified by the sum of FDI and gross imports and exports of each province. FDI means the actual utilized investment.	411	3412908	8172496	11259	70400000
Human capital	Signified by the number of participators of science and technological activities. Unit: person	418	111634.9	98915.17	3587	837670

	Variable definition	Observed	Mean	Standard deviation	Minimum	Maximum
Strength of IPP	IPP index of each province	290	2.2141	0.5932	1.1580	3.7880
Log(IPP)* log (independent innovation)	The interaction of IPP and the natural logarithm of the variable on independent innovation of each province	290	9.6329	4.0968	1.3641	20.3519

Note: As the data of FDI for Tibet is absent, we do not consider it. Meanwhile there are no related statistical data for some provinces, thus we suppose the hypothesis is testified.

4.3. The verification of stage characteristics of building China into innovation-oriented country

To judge China's innovation capability is inofvated by imitation or innovation, one just observe the signs and significance of imitation and rd (independent innovation) in the equation (6). According to the theoretical analysis, in the initial stage, the national innovative capability's progress is mainly dependent on imitation; in the transitional stage, independent innovation capability has been improved but is still greatly reliant on imitation; in the advanced stage, national innovative capability's progressis mainly through independent innovation, and less on imitation. Based on this, we foresee three possible scenarios for the signs of variables, see table 2.

Table 2

Prediction and corresponding stages of the estimated coefficient of Imitation and independent innovation

	Signs	Imitation	Signs	Independent innovation	Corresponding stages
		Significance		Significance	
1	“+”	Significant/non-significant	“+”	Non-significant	Initial stage
2	“+”	Significant	“+”	Significant	Transitional stage
3	“+”	Non-significant	“+”	Significant	Advanced stage

Notes: (1) As a country's imitation capability is might quite weak in the initial stage, there may be cases of non-significant role of imitation and independent innovation. (2) “+”signifies the sign of estimated coefficient value is positive.

Comparing the judgment standard in table 2 with the regression result in table 3, we can make the judgment that China is in a transitional stage of building itself into an innovation-oriented nation whose characteristics of technological progress is creative imitation. From the sign of coefficient, all the estimated results of equations ranging from (1) to (4) show that the estimated coefficient of imitation and independent innovation are positive, and the upgrade of China's innovative capability is driven by the above-mentioned elements spontaneously. Judging from the significance of this coefficient, the estimated coefficient of variables for imitation and independent innovation is below 1% (only in equation 2 is the coefficient 5%), meaning independent innovation has become the core force in

upgrading China's innovation capability. But from the perspective of the relative size of coefficients, the estimated coefficient of the variable of imitation is far larger than that of independent innovation, showing the changes on imitation by China's innovative capabilities is more sensitive. This also means that in the period of sample inspection, although independent innovation has been gradually playing a role, it is not yet a main force.

Table 3

The result of test on the stage characteristics of building China into an innovation-oriented country

	(1)	(2)	(3)	(4)
	FE	FE	FE	FE
Log(imitation)	0.3623*** (0.0596)	0.3522*** (0.0584)	0.3339*** (0.0587)	0.2911*** (0.06196)
Log (independent innovation)	0.1208*** (0.0315)	0.0834** (0.0322)	0.0847*** (0.0321)	0.0836*** (0.0319)
Log (human capital)		0.1841*** (0.0457)	0.1661*** (0.0462)	0.1655*** (0.0460)
Log (market scale)			0.6203** (0.2816)	0.7141** (0.2839)
Log (relative technological level)				0.3960** (0.1904)
Constant	1.2669 (0.7727)	-0.2070 (0.8409)	-4.7899** (2.2425)	-4.9397** (2.2335)
Fixed effects for provinces	yes	yes	yes	yes
Fixed effects for years	yes	yes	yes	yes
Number of samples	411	411	411	411
R ²	0.8759	0.8812	0.8828	0.8841

Notes: (1) ***, ** and * signify the significance at the level of 1%, 5%, and 10% respectively. (2) The value inside the brackets is the standard deviation of the estimated coefficient. (3) Dependent variables of equations ranging from (1) to (4) are the number of applied patents, and are all estimated results of fixed-effect models. The controlled variables of equation (1) are imitation and independent innovation, while equations (2), (3), and (4) are gradually added with variables such as human capital, market scale, and relative technological level. (4) Here, equation (3) is a basic regression equation.

On the basis of the above judgment, we further inspect that under the condition of tremendous disparity on innovative capability across the provinces of China, whether there are differences on the driving effects of innovative capability by independent innovation and imitation. In specific verification, we divide the general samples into two branches according to the economic development level (GDP per capita), the group with lower income and the group with higher income. Then, we conduct fixed effect regression for equation (6). Here, we still focus on the signs and significance of imitation and R&D (independent innovation). The difference is here is the comparison of the estimated coefficient of two subsamples. According to the judgment standards for the stages in table 2 and similar judgment on the stage China in its process of

building an innovation-oriented country during the sample inspection period, we have made the following forecast for the signs of estimated coefficient for imitation and independent innovation, which can be seen in table 4.

Table 4

The expectation of the estimated coefficient of the variables of imitation and independent innovation in the regression of subsamples

	Imitation		Independent innovation		Corresponding phases
	Signs	Significance	Signs	Significance	
Group of low income	“+”	Significance/non-significance	“+”	Non-significance	Initial phase
Group of high income	“+”	Significance	“+”	Significance	Transitional phase

Notes: “+” shows the signs of estimated coefficient is positive.

From the regression results in table 5, in the regression of the fixed effect for the two subsamples, the signs and significance of the estimated coefficient are all in accordance with our expectations. From the significance of the coefficient, among the group of low income provinces, adding different controlled variables gives us such basic results that the estimated value of the coefficient of imitation variables is significant when the figure is under 5%, while the estimated value of the coefficient of independent innovation variables is not significant. By contrast, the regression results of the high income group is quite different. Apart from the estimated value of the coefficient of independent innovation that is significant at around 5%, the estimated value of the coefficient of the imitation variables are all significant below the level of 1%. This shows that for the low income group, innovation is mainly dependent on imitation. For the high income group, imitation and independent innovative capability have all played a significant role, with imitation playing the major role.

Table 5

The regression results of fixed effect for subsamples

	Group of low income (equations 1-4)				Group of high income (equations 5-8)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	FE	FE	FE	FE	FE	FE	FE	FE
log(imitation)	0.1561** (0.0745)	0.1547** (0.0751)	0.1608** (0.0721)	0.0708 (0.0743)	0.5236*** (0.1063)	0.5036*** (0.1040)	0.4756*** (0.0938)	0.4669*** (0.0961)
log (independent innovation)	0.0263 (0.0378)	0.0268 (0.0380)	0.0224 (0.0366)	0.0147 (0.0354)	0.2088*** (0.0507)	0.1400** (0.0543)	0.1729*** (0.0492)	0.1742*** (0.0494)
log (human capital)		-0.0119 (0.0687)	0.01455 (0.0663)	0.0477 (0.0648)		0.2082*** (0.0675)	0.1358** (0.0617)	0.1338** (0.0620)
log (market scale)			-1.3301*** (0.3402)	-1.0800*** (0.3366)			2.9766*** (0.4543)	3.0097*** (0.4619)
log (relative technological level)				0.9889*** (0.2786)				0.1010 (0.2358)

	Group of low income (equations 1-4)				Group of high income (equations 5-8)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	FE	FE	FE	FE	FE	FE	FE	FE
Constant	4.6336*** (0.8998)	4.7724*** (1.2065)	15.1985*** (2.9077)	14.4410*** (2.8208)	-1.8312 (1.5460)	-3.0992** (1.5655)	-26.2564*** (3.8050)	-26.4252*** (3.8340)
Fixed effects of provinces	yes	yes	yes	yes	yes	yes	yes	yes
Fixed effects for years	yes	yes	yes	yes	yes	yes	yes	yes
Quantity of samples	201	201	201	201	210	210	210	210
R ²	0.8918	0.8918	0.9008	0.9077	0.8807	0.8867	0.9087	0.9088
Number of provinces	15	15	15	15	15	15	15	15

Notes: (1) ***, ** and * signifies the significance at the level of 1%, 5%, and 10% respectively. (2) The value inside the brackets is the standard deviation of estimated coefficient. (3) The dependent variable of equations (1) - (4) is quantity of patent, estimated by fixed effect unodel. Equation (1) is the basic regression equation for low incomesamples and equation (6) is the basic regression equation for high income samples.

4.4. The verification of the optimal IPP strength

After the analysis of equation (7) on the estimated coefficient of the interaction between IPP and independent innovation, we can further analyze the effect of IPP strength on independent innovation. Then we can infer from the process of building an innovation-oriented country, and make the best IPP decision on the basis of the changes on independent innovation capabilities. The estimated results of table 6 reveal that the estimated value of the coefficient of the interaction between IPP and independent innovation is positive, and significant under 1%. The basic connotation is, for the provinces whose innovative capability is above average, strengthening IPP is favorable for innovation. For provinces whose independent innovation capability is below the average, strengthening IPP is harmful for innovation (seen in the regression equation 1-3, with equation 1 as the standard). On such basis, we put the GDP per capita in a right order and divide it into three groups. Combined with the controlled variables, we conduct regression once again and acquire the estimated results for equations from (4) - (6). No matter whether it is the general sample or a subsample, the estimated value of the coefficient between IPP and independent innovation is larger than zero and the level of significance is 1%. From this, we can see that the IPP of different provinces should be different. In provinces where the innovative capability is quite strong, we should conduct protection, and vice versa.

Table 6
The verified regression results of hypothesis 2

	Total samples (equations 1-3)			Subsamples (equations 4-6)		
	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	FE	FE	FE	FE
Log(Intellectual property) *log(Independent innovation)	0.3380*** (0.0317)	0.3374*** (0.0312)	0.3231*** (0.0312)	0.2255*** (0.0497)	0.2807*** (0.0675)	0.2721*** (0.0826)
Constant	10.5901*** (0.7413)	1.5180 (3.1713)	2.0407 (3.1348)	19.6592*** (7.0322)	11.6463*** (1.8271)	11.9517 (7.2220)
Fixed effects in provinces	yes	yes	yes	yes	yes	yes
Fixed effects for years	yes	yes	yes	yes	yes	yes
Quantity of samples	290	290	290	100	90	100
R2	0.8923	0.8960	0.8991	0.9308	0.8580	0.9297

Notes: (1) ***, ** and * signifies the significance at the level of 1%, 5%, and 10% respectively. (2) The value inside the brackets is the standard deviation of estimated coefficient. (3) Equations form (1) to (3) are the analysis results of the total samples. Dependent variables are the number of applied patents, and are all estimated results of fixed-effect models. In addition to the integration, the controlled variables of equation (1) include human capital, input of independent R&D, and the strength of IPP in each province; Equations (2) and (3), on the basis of equation (1) are gradually added with variables such as human capital, market scale, and relative technological level. (4) Equations (4) to (6) are all results of the sample analysis, among which (4) is the estimate of the first one third of samples, while (5) is the estimate of the middle one third of samples, and (6) is the estimate of the last one third of the samples.

4.5. The main conclusion

(a) The upgrade of China's provincial innovative capability is dependent on both independent innovation and imitation, but the latter is playing a more prominent role currently. The innovative results of each province depends more on the imitation of international technology, as the independent innovation capability is still not adequate. From the perspective of different provinces, in provinces where the innovative capability is weak, imitation plays a more important role, while in provinces whose innovative capability is strong, the upgrade of imitation and independent innovation contribute significantly to both imitation and independent innovation, with imitation being more prominent. On such a basis, we conclude that China is in the transitional stage in building an innovation-oriented country.

(b) The effect of IPP on different provinces is different. It is shown after the fixed effect regression, for those provinces whose innovative capability level is above average, strengthening IPP is favorable for innovation. For those provinces whose independent innovative capabilities is below the average, strengthening IPP is not favorable for innovation. This means that due to the differences in innovative capabilities, the optimal IPP strength should be different.

5. The approach to realize optimal IPP strength in building an innovation-oriented country

In the process of building an innovation-oriented country, in order to realize the optimal IPP strength with the characteristics of building an innovation-oriented country, we must establish an adjustment model to realize the optimal value, which includes structure arrangement, tools selection, and operation mechanism.

5.1. Establishing a specialized organization to adjust IPP strength

Although the law enforcement system of China's intellectual property is being perfected gradually, there is a long way to go before realizing the changes in accordance with China's overall innovative capability and adjusting the strength of 'accurate law enforcement' for IPP. "Accurate law enforcement" must be dependent on some specialized organization. Currently, it is necessary to separate specialized organizations for adjusting the IPP strength whose core task is to match IPP strength with innovative capability and whose main responsibility is, on the basis of identifying the targets of IPP strength for each stage, to protect the calculation, supervision, and adjustment of IPP. Meanwhile, "innovation traps" should be avoided. This organization should have the following features. First, the operation scope should be certain, meaning that it should have only one target, regulating IPP strength. Second, the operational capability is professional, and able to measure and calculate each step accurately. Third, the operation should be timely. Among the process of information collection, analysis, judgment, and policy formulation, action must be accurate and quick to reduce the latency related to the speedy changes in the market.

5.2. Select and control the adjustment tool for IPP strength

Adjustment tools include two categories, legislation and law enforcement. We should select adjustment tools from three perspectives. One is legislation tools. This refers to the national legal norms related to IPP, including general laws, administrative regulations, department rules, and some other norms of at a lower level. Normal laws should be enacted and edified by the standing committee of NPC with a relatively long time period. Administrative laws and department rules are adjusted accordingly. The adjustment procedure is relatively simple for other normal documents as well. The related departments can adjust the strength and time period with regulatory means of law establishment in a timely fashion. Second is the law enforcement tool. According to the difficulty of regulation, law enforcement tools can be divided into short-term, medium-term, and long-term ones. Short-term means the tools that can be carried out without stagnation, including judicial blows, administrative law enforcement, and judicial inspection. Medium-term tools are those that cannot be carried out instantly, including hardware facilities, law enforcement procedure, and

supervision by the public. Long-term tools are those cannot be carried out or reap effects in a short time period even after some procedures due to reasons such as complicated interests. These tools include elimination of local protection and maintain the continuity of law enforcement. Relevant departments should flexibly use all tools for law enforcement in accordance with the needs of adjustment for IPP. Third is the adjustment of legislation and law enforcement. In developed countries, the means for legislation and law enforcement are almost the same. As long as there is legislation, there must be law enforcement. In developing countries, the two are not in the same pace. Actually, such discord may not necessarily bring negative influence, especially under the framework of IPP based on trade related intellectual property (TRIPS). When developing countries are in a weak position, IPP strength must embody the requirements of TRIPS, referring that the room for adjustment is quite small. However, we can consolidate or reduce our requirement on law enforcement in light of our own conditions, so the optimal IPP strength for the country's industry can be achieved. South Korea and Japan are successful cases.

5.3. Establish a constraint mechanism to ensure the smooth implementation of adjustment mechanisms

The adjustment of the strength of IPP by a special organizations needs the cooperation of each department, so what is the driving force for the cooperation of each department? The key to incorporate complicated administrative organizations is not the initiative mechanism, but the internal and external supervision and check system of administrative organs. First is the internal supervision of administrative organs. We need to treat cooperation with IPP organs as the regular work for each department and conduct administrative supervision and inspection on the fulfillment of tasks. Second is supervision outside the administrative organs. This includes supervision on legislation, democratic supervision, public supervision, and media supervision. If there are problems in the cooperation among departments, it can be constrained by all aspects. Third is the requirements of administrative procedures. When a specialized organization has passed legal procedures and put forward the requirement of cooperation among different departments, but is met with little cooperation by each department, responsibilities will not be taken by those that do not render help in case of problems. Thus, although the adjustment of IPP strength is led by specialized organs, these organs are not separate. They are the component of the administrative system in which the adjustment work is completed with joint efforts.

5.4. Establish a long-term mechanism to avoid "innovation traps"

"Innovation traps" are the product of misunderstanding on the road to building an innovation-oriented economy. The fundamental reason lies in the fact that with low innovative capability, excessively strong IPP is not appropriate, as it will be detrimental to the progress of a country's innovative capability. When innovative capability is

weak, IPP strength must be appropriate in order to avoid an “innovation trap”. We should firmly keep the following four points in mind. Firstly, being “appropriate” in this case means relatively weak. With low innovative capability, China cannot adopt excessively strong IPP, nor too weak IPP. Instead, China should strike a balance on the “relatively weak” side. Since a weak IPP would bring unfavorable influence to the nation’s innovative capability, it can even destroy all the efforts made for innovation. Secondly, to independently seek for an appropriate IPP strategy. Judging from the international environment, if a slow-developing country develops within the rules of developed countries, the process of building an innovation-oriented country will be an arduous one. It is essential to choose the proper IPP strength independently. Thirdly, to identify an appropriate approach to IPP. Adopting excessively strong IPP due to eagerness for success will not only be detrimental to technological progress, but also bring about further negative influences. Fourthly, to stay as far away as possible from the lines of “innovation traps”. Around the sensitive area of potential “innovation traps”, we should establish a point of θ , forming a warning area for precaution. Once the strength of IPP is close to this area, policy makers should pay greater care and attention to avoid setbacks to development.

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