On The Interaction Between Patent and Trade Secret Policy*

Nisvan Erkal†

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Abstract

Patent and trade secret protection are two methods innovators frequently use to protect their intellectual property. We explore to what extent patent and trade secret protection have complementary and substitute roles. We argue that trade secret law complements patent law in earlier stages of the innovation process by allowing innovators to work on their ideas until they become patentable. After the innovations become patentable, patent and trade secret protection become substitutes. In such cases the relevant policy question is not how much patent protection to have, but how much patent *and* trade secret protection to have. Our discussion reveals that optimal patent length and scope should be determined by taking into consideration the fact that innovators will have incentives to keep secret innovations that are less obvious. Moreover, trade secret policy targeting innovations that are not yet at a patentable stage and trade secret policy targeting innovations that are sufficiently nonobvious and, thus, will be kept secret should be relatively stronger.

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† Department of Economics, University of Melbourne, Victoria 3010, Australia. E-mail: n.erkal@unimelb.edu.au.

1. Introduction

The ability to create, protect and use knowledge-based assets plays a crucial role in defining firms' boundaries and their competitiveness in the marketplace. This is especially true in high-technology industries. Effective protection of intellectual property depends on the legal instruments available as well as the measures taken by the innovators. This paper focuses on the legal instruments available for the protection of intellectual property. Our goal is to explore the interaction between two methods of intellectual property protection that are widely used by firms: patent protection and trade secret protection.

From a social perspective, the rate of technological progress is an important driver of economic welfare. The aim of a system of intellectual property protection is to encourage the production of knowledge. The production of new knowledge is closely linked with the dissemination of prior knowledge since overlapping generations of innovators rely on each other's ideas for inspiration and guidance (Scotchmer, 1991). Thus, access to prior knowledge as well as protection of own knowledge play an important role in the production of new knowledge (Landes and Posner, 1989). Given this cumulative nature of innovation, the main challenge in the design of optimal intellectual property policy is how to divide the profits between sequential generations of innovators in a way that provides them with optimal incentives to invest.

One of the common assumptions made in economic models of innovation has been that innovators always patent their innovations. As a consequence of this assumption, the economics literature has given a considerable attention to the design of optimal patent policy. However, an analysis of firm behaviour reveals that trade secret protection is used at least as widely as patent protection. Since both methods are widely used by firms in order to protect their intellectual property, it is necessary to consider the interactions between optimal patent and optimal trade secret policy in an attempt to come up with a consistent optimal intellectual property policy.

We start the discussion in the next two sections by briefly summarizing what patent and trade secret protection entail. After discussing the ways in which patent protection

differs from trade secret protection in Section 4, we move on to provide some evidence for how frequently the two methods of protection are used by firms in Section 5.

Section 6 contains the discussion regarding the interplay between optimal patent and trade secret protection. An interesting aspect of these two policy domains is that on the one hand, both have the goal of protecting intellectual property. On the other hand, while patent protection offers protection in exchange for disclosure, trade secret protection offers protection by giving support to secrecy. This is an important difference given that encouragement and dissemination of innovations are the two goals of intellectual property protection.

Our goal in Section 6 is twofold. First, we explore to what extent patent and trade secret protection have complementary and substitute roles by discussing at which stages of the innovation process innovators are likely to use them. In this discussion, we differentiate between innovations that are sufficiently developed to be patentable and innovations that are potentially patentable if they are developed further. This is an important distinction to make since one of the goals of trade secret policy is to protect knowledge that is not at a patentable stage. However, innovators can also rely on trade secrecy to protect knowledge that is patentable. Thus, our second goal is to analyse what optimal policy should be in cases when innovators are likely to regard the two protection methods as substitutes. We argue that if innovators regard secrecy as an alternative to patenting, the relevant policy question is not how much patent protection to have, but how much patent and trade secret protection to have. We point out that innovators' choice between patent and trade secret protection may depend on the degree of obviousness of their innovations and discuss the policy implications of this observation.

2. What is patent protection?

The purpose of patent protection is to give the patentholder the right to exclude others from the use of the innovation covered by the patent for a limited period of time. Currently this period is 20 years in most developed countries. Although the patent system provides innovators with the right to exclude others from using the innovation,

it also requires them to disclose the innovation. Specifically, under the patent law, an applicant is required to disclose sufficient knowledge about the innovation in order to enable someone skilled in the art to make and use all the embodiments of the innovation claimed in the patent. Thus, patent protection has two goals: the fostering of innovation and the diffusion of new technologies.

The first step in the design of an incentive scheme for innovation is to define what qualifies as an innovation. Under the patent law, an innovation needs to satisfy the requirements of novelty, utility and nonobviousness to be eligible for patent protection.[1] The scope of protection offered by a patent depends on its claims. In reality, the scope of protection offered by a patent also depends on the patentholder's ability to enforce them. Patents are effective to the extent that the patentholders can enforce them.

The classical work by Nordhaus (1969) initiated the analysis of optimal patent design by arguing that the optimal patent length is finite. In case of a single innovation (as opposed to cumulative innovation), the trade-off faced by policymakers is between static efficiency and dynamic efficiency. Providing innovators with exclusive rights over the use of their innovations results in a deadweight loss. Since the prospect of market power is necessary to encourage investment, Nordhaus (1969) concludes that these two forces can be balanced with a finite length of patent protection.

Optimal patent length is not the only design issue. Several papers after Nordhaus (1969) explored the optimal combination of patent length and patent scope. As is pointed out in Scotchmer (1991), the analysis of optimal patent design critically depends on whether innovations are modelled as isolated events or as a cumulative process. In reality, innovation takes place in an attempt to advance what has been discovered by previous innovators. This cumulative nature of innovation implies that the social value of innovations should include the value of subsequent innovations they inspire since early innovators lay the foundation for later innovators. In case of cumulative innovation, the instruments of patent scope and patentability requirement have different meanings. They play a key role in determining the effective life of a

[1] Although the terms used for the requirements may differ across countries, similar requirements exist in the patent system of many countries including Australia, the US, the UK, and Japan.

patent, which is the expected time until the patented innovation is replaced in the market (O'Donoghue, Scotchmer and Thisse, 1998). Innovators may not be interested in the statutory life of a patent anymore as their investment incentives are more likely to be shaped by the effective life of a patent. Thus, the main policy issues addressed in the cumulative innovation literature have been how broad patent scope and how strict the patentability requirement should be.[2]

3. What is trade secret protection?

A trade secret (or confidential information as it is referred to in Australia) is a form of intellectual property that gives the firm who owns it an advantage over its competitors as long as the firm manages to keep it a secret. The intellectual property protected under trade secret protection does not have to satisfy any requirements of novelty, utility or nonobviousness. The only requirements are that there is no prior art or prior disclosure (that is, the information has the quality of being secret) and that the owner has been taking reasonable measures to maintain secrecy.

The government's trade secret policy determines the amount of protection innovators get against theft and unauthorized disclosure of their trade secrets (Beckerman-Rodau, 2002; Milgrim, 1978). Both the use of improper means to discover trade secrets and the use of improperly discovered trade secrets are illegal. One place where such protection is especially important is in the case of employer-employee relationships. This is because it is generally the employees who develop and know the most about the innovations that give firms an edge in the marketplace. Thus, firms usually sign confidentiality agreements with their employees. Such agreements play more important roles in industries characterized by high levels of labour mobility. This implies that both the legal rules that govern intellectual property rights and those that govern labour mobility determine the strength of trade secret protection that innovators receive (Gilson, 1999). For example, in some places, the employment contract can specify for how long an employee cannot work for a competitor after leaving the employer. Such a legal rule allows the employer to have some control over the length of trade secret protection it receives.

[2] See, for example, Erkal (2004), Hunt (2004), Chang (2001), O'Donoghue (1998), O'Donoghue, Scotchmer and Thisse (1998), and Green and Scotchmer (1995).

Other contexts where firms may want to have confidentiality agreements is when they are considering to form an alliance with other firms, dealing with suppliers, negotiating for the sale of their intellectual property, or looking for financial support for their business ideas. Thus, trade secret protection can be used by innovators at various stages of the innovation process.

In recent years, trade secret protection has been the subject of ongoing policy debates worldwide. For example, the Economic Espionage Act of 1996 in the US is regarded as providing greater protection from misappropriation of proprietary information (Dreyfuss, 1998). Moreover, the Agreement on Trade Related Aspects of Intellectual Property Rights (commonly called the TRIPS Agreement) requires member countries to pass trade secret law that is similar to the US trade secret law.

Despite its growing importance both from the innovators' and the policymakers' point of view, the literature on the economics of trade secret protection is sparse. The three related papers are the following. Friedman, Landes and Posner (1991) contains a comparison of trade secret protection and patent protection. They argue that the trade secret law supplements the patent system because innovators choose trade secret protection when they find patent protection too costly or when they believe patent protection will give them a lower degree of protection. In Horstmann, MacDonald and Slivinski (1985), innovators may prefer not to patent in order not to transmit valuable private information to their rivals. It is assumed that during the innovation process, innovators gain some private information regarding the profitability of their innovations. Patenting may help rivals to update their beliefs regarding the profitability of the innovations and, hence, may increase the rivals' incentives to come up with a competing product.

In Scotchmer and Green (1990), innovators may choose not to patent because the patent application itself (not the patenting decision) results in the disclosure of valuable technical information to rivals. In a model where innovators build on each other's innovations, they analyse how stringent the novelty requirement in patent law should be by taking into consideration the patenting decisions of innovators. A weak novelty requirement implies innovators can benefit from the disclosure of each small

advance. Such disclosure is socially valuable since it reduces the R&D costs of subsequent innovators. However, it is possible to the extent that innovators find patenting desirable.

4. What are the main differences between patent protection and trade secret protection?

There are significant differences between the type and level of protection provided by the patent law and the trade secret law that affect innovators' choices between the two. The first way in which patent and trade secret protection differ from each other is in their definition of what constitutes an innovation that qualifies for protection. As discussed in Section 2, innovations need to satisfy the requirements of novelty, utility and nonobviousness to be eligible for patent protection. The standard for trade secret protection is much lower. For an innovation to qualify for protection under the trade secret law, it should not be known to the public and it should provide a competitive advantage to its owner. Thus, the knowledge protected under the trade secret law may not always be patentable.

Second, the disclosure requirement under the patent law indicates that if patented, innovations are likely to be disclosed earlier than they would be under trade secrecy. However, they cannot be used by others without the patentholder's permission until the patent expires. Under trade secret protection, on the other hand, the disclosure of innovations depends on how well innovators can monitor the flow of their technological information. Once the innovation is disclosed though, everybody who has access to it can use it. The government's trade secret policy determines how effectively the people who have caused the disclosure of the information will be punished, but it does not prevent others from using the information.

This indicates that one of the reasons innovators may prefer trade secret protection over patent protection is to avoid the disclosure requirement. Given the cumulative nature of innovation, private incentives of firms may be in complete contradiction with the social goal of dissemination in this regard. From the innovators' point of view, patenting of intermediate discoveries may allow the innovators to earn interim profits

from those innovations. However, it may also result in the disclosure of valuable information. Thus, winners of earlier R&D races may be reluctant to patent in order to get a head start in the subsequent races (Erkal, 2004; Scotchmer and Green, 1990). In fact, in an analysis of data collected in Switzerland, Harabi (1995) finds that the two most important reasons why firms prefer secrecy over patenting are the ability of competitors to invent around patented innovations and the disclosure of too much information in the patent applications.

Third, there are differences between the two methods of protection in terms of the length of protection they provide. Patent protection lasts for a fixed period of time, which is 20 years after the date of filing an application in most developed countries. However, the effective length of protection may be shorter than the statutory length of protection since the value of the patent would be significantly decreased after the product is replaced in the market with an improved version. Obviously, the speed with which a firm may lose control of its innovation under trade secrecy would play a crucial role in its decision to patent. Trade secret protection potentially has an unlimited term. Although trade secret protection does not require innovators to disclose, it does not protect against imitation either. Therefore, once the secret is out, the innovator loses all its protection. Thus, the length of protection under trade secrecy is determined by how long it takes for rivals to come up with an independent discovery, to reverse engineer, or to learn about the innovation through an improper disclosure. The innovation is protected, by definition, as long as it remains a secret.

Fourth, patent protection may be costlier than trade secret protection. The preparation of each patent application involves a significant fixed cost. Moreover, if the application turns out to be a successful one and if the innovator is granted a patent, the patent gives the patentholder the right to exclude others from the use of the innovation covered by the patent. The patent is effective to the extent the innovator has the funds to enforce the patent. That is, the degree of protection that innovators receive depends on how successful they are in detecting infringement and in defending their rights in court. Both of these activities may be considerably costly.

The use of trade secret protection is not costless, though. In fact, trade secret law requires innovators to take reasonable measures to protect their innovations against

improper disclosure. To start with, this involves the determination of what is perceived as a trade secret. Then, signing confidentiality agreements with those people who need to know the trade secret, determining how much needs to be disclosed to the different people involved in the innovation process, limiting access to the ideas and information protected under trade secrecy (perhaps by modifying the production process or changing the organizational structure), and paying employees not to leave as well as the enforcement of rights through trade secret protection may all involve considerable costs.

5. Evidence on the use of patent and trade secret protection

Studies carried out in the US (Cohen et al., 2000; Levin et al., 1987), Europe (Arundel, 2001; Harabi 1995) and Australia (McLennan, 1995) consistently report that manufacturing firms regard secrecy as a more important protection mechanism than patenting. Based on a survey questionnaire administered to 1478 R&D labs in the US manufacturing sector, Cohen et al. (2000) find that patents tend to be the least preferred protection mechanism by firms while secrecy and lead time tend to be the most heavily used ones. They report that, especially in case of product innovations, firms use secrecy to protect just over 50% of their innovations. Moreover, by comparing their results with the earlier survey findings of Levin et al. (1987), they conclude that there is an apparent growth in the importance of secrecy as an appropriability mechanism and a decline in the importance of patents.

Analysing a sample of 530 manufacturing firms based in Massachusetts, US, Lerner (1994) documents that 43% of all intellectual property litigation cases involved trade secrets. Moreover, he reports that trade secret protection is more critical for smaller companies. This finding is consistent with the view that smaller firms may prefer trade secret protection due to the costs of applying for and enforcing patents.

In his analysis of data from 2849 European R&D-performing firms, Arundel (2001) finds that a higher percentage of firms in all size classes rate secrecy as more valuable than patents. Arundel (2001) further reports that the probability that a firm rates

secrecy as more valuable than patents declines with an increase in its size for product innovations, while there is no relationship for process innovations.

6. The interaction between optimal patent policy and optimal trade secret policy

The process of innovation starts with the conception of an idea. During the development of the idea until the stage of commercialization, innovators explore the potential of the idea and identify the ways in which it is novel. Patent and trade secret policy are complementary to each other during this process to the extent that one plays a role that cannot be fulfilled by the other one. This may be the case for innovations that are not developed enough to qualify for patent protection or for innovations that are outside of the subject matter that can be patented under the patent law. In both of these cases, it is the strength of trade secret protection that shapes the investment incentives of innovators.

Thus, the patent law supports the disclosure of innovations for the use of future innovators only after they reach a certain stage of maturity. Having a strong trade secret protection for innovations that do not qualify for patent protection allows innovators to work on their ideas until they become patentable. As long as innovators use patent and trade secret protection in order to protect themselves against misappropriation in different stages of the innovation process, the two methods of protection supplement each other.

Once the innovation qualifies for patent protection, the innovator makes a choice between relying on patent or trade secret protection. After this stage, the two methods of protection can be regarded as playing substitute roles. In fact, Kim and Marschke (forthcoming) show that the risk of an employee's departure, which implies that the firm is likely to have a weaker control over the disclosure of its trade secrets, increases firms' propensity to patent their innovations.

If innovators choose to rely on trade secret protection and commercialize their innovations, they lose their right to patent after a one-year grace period. Legally, this is

because commercialized products are generally regarded as prior art. In case of process innovations, if the new manufacturing process is used to make a product that is sold publicly, such secret use can also be a reason for questioning the validity of a patent. That is, if an innovator secretly uses an innovation for a period of time that exceeds one year before patenting the innovation, the patent can be found invalid based on the existence of secret use, which effectively extends the period of protection the innovator receives for the innovation. Although secret use can be difficult to verify, it is important to note that the ability to determine its existence is crucial in having an effective intellectual property policy.

After the innovation qualifies for patent protection, the related policy question becomes how strong patent and trade secret protection to have. This is because innovators' incentives to patent are determined by the strength of trade secret protection they will receive in case they do not patent. Although it seems like having a policy of weak trade secret protection and strong patent protection may best serve the goals of encouraging the development and disclosure of innovations, this is not necessarily the case. As shown in Erkal (2004), strong patent protection may be less desirable in cases when secrecy is not an attractive option for innovators if innovation is cumulative. To see this, consider the case of two innovations. In such a set-up, a policy of strong patent protection has, first, the effect of increasing the incentives to invest in the first innovation and, second, the effect of encouraging the disclosure of the first innovation. While the first effect reduces the incentives to invest in the second innovation, the second effect strengthens the incentives to invest in the second innovation. Having a weak trade secret protection implies that innovators may have relatively strong incentives to patent anyway. Hence, it makes it less necessary for the government to use strong patent protection as a mechanism to encourage disclosure. That is, if there is weak trade secret protection, it may not be optimal to have strong patent protection since early innovations are likely to be disclosed through patenting whether or not there is strong patent protection. Instead, it may be optimal to have a relatively weaker patent policy in order to further encourage investment in the second innovation. If, on the other hand, early innovations are likely to be kept secret in the absence of strong patent protection, having strong patent protection may increase social welfare by encouraging earlier disclosure of innovations.

To carry the discussion further, it is useful to define more precisely what we mean by strong patent protection. The strength of patent protection has mainly been modelled in the economics literature in terms of either the length or scope of protection that innovators get under the patent system. Although emphasized to a lesser extent, the patentability requirement also plays an important role in determining the degree of protection patentholders receive (Hunt, 2004; O'Donoghue, 1998; Dijk, 1996; Scotchmer and Green, 1990). Patentability refers to the requirement that innovations need to be sufficiently different from the prior art in order to be patentable. It is a reflection of what the government finds desirable to have disclosed. Formally, the patentability of innovations are determined by the extent to which they satisfy the requirements of novelty and nonobviousness.

On the other hand, two factors affect the strength of protection innovators receive under secrecy. As stated in Section 3, trade secret law protects innovators against improper disclosure, but not against disclosure by independent re-invention or reverse engineering. What protects the innovator from independent re-invention and reverse engineering is how nonobvious the innovation is. Thus, the degree of obviousness of an innovation first determines whether the innovation legally qualifies for patent protection. Second, it determines the length of trade secret protection the innovator is likely to get under trade secret protection. Third, it determines whether the innovation is actually going to be patented.

This discussion implies that it is important to distinguish between innovations that are legally allowed to be patented and innovations that will actually be patented. Consider an innovator who is considering whether to patent her innovation. Suppose for the moment that trade secret law provides perfect protection against improper disclosure and reverse engineering is not possible. If the innovator does not patent and chooses to rely on trade secret protection instead, she will be the sole user of the technology until some other innovator independently re-invents. The speed with which such independent re-invention will take place depends on how obvious the innovation is. If the innovator believes that independent re-invention will take a longer period than the length of protection she will receive under patent protection, then she will choose to

rely on trade secret protection.[3] Thus, the degree of obviousness of the innovation plays an important role in the patenting decision of the innovator. Moreover, there is a type of adverse selection going on since the types of innovations that will be patented are likely to be the more obvious ones which have a higher probability of being independently re-invented. Nonobvious innovations which are not likely to be independently re-invented are not likely to be patented.

To reach some conclusions as far as optimal policy is concerned, let us represent the degree of nonobviousness of an innovation with α. The patentability requirement puts a lower limit on how nonobvious an innovation needs to be in order to patented. Let that limit be α^{min}. The upper limit depends on the length and scope of protection innovators expect to get under the patent system (which may in turn depend on how strict the patentability requirement is). Relatively less obvious innovations may not be patented if the innovators expect to get a longer protection by keeping them secret. Let α^{max} be the most nonobvious innovation that will patented under the patent system.

While determining the optimal patent length or scope, it is important to balance the cost of providing too much protection to the more obvious innovations with the benefit of encouraging the disclosure of less obvious innovations. For the more obvious innovations, the main consideration while determining the optimal patent length and scope is whether there are sufficient incentives to develop them. For the less obvious innovations, the determination of optimal patent length and scope should consider whether there are sufficient incentives to both develop and disclose (patent) them. For any given combination of patent length and scope, those innovations with $\alpha > \alpha^{max}$ will not be patented. Thus, patent and trade secret protection cease to be substitutes for owners of innovations with $\alpha > \alpha^{max}$.

Note that we have so far assumed that trade secret law provides perfect protection against improper disclosure. For innovations that will not be patented under the current patent system, weakening the trade secret protection provided by the government would be another way of making disclosure more likely, provided there are sufficient

[3] This point is also made by Friedman, Landes and Posner (1991), who go on to argue that trade secret law supplements the patent system because it allows innovators to protect innovations for which the patent system provides an insufficient length of protection.

incentives to invest in the development of the innovation in the first place. That is, for innovations with $\alpha > \alpha^{max}$, the design of optimal trade secret policy should target balancing the benefits from their development and disclosure.

Finally, in cases when intellectual property policy is completely ineffective in achieving disclosure, Erkal (2004) shows that it is optimal to have a lenient antitrust policy instead. In such cases, having a lenient antitrust policy is optimal in order to stimulate investment in the future R&D races. This is because non-disclosure of early innovations decreases the investment incentives of future innovators, who have the strongest incentives to invest when collusion is allowed between different generations of innovators.

7. Conclusion

The growing importance of knowledge in determining firm value has made firms more sensitive to issues related to the creation and protection of knowledge-based assets. Patent and trade secret protection are two methods innovators frequently use to protect their intellectual property. The main challenge in the design of optimal intellectual property policy is to strike the right balance between encouraging the investment incentives of sequential generations of innovators.

In order to encourage innovative activity, innovators need to be supported at all stages of the innovation process. We have argued that trade secret law complements patent law in earlier stages of the innovation process by allowing innovators to work on their ideas until they become patentable. After the innovations become patentable, patent and trade secret protection become substitutes. This implies that optimal patent and trade secret policy cannot be analysed in isolation since innovators regard the two protection methods as alternatives for each other. The relative strength of patent and trade secret protection determines the types of innovations that will be disclosed. Optimal patent length and scope should be determined by taking into consideration the fact that innovators will have incentives to keep secret innovations that are less obvious. Since patent protection results in a deadweight loss and it is not optimal to have perfect patent protection for all types of innovations, our discussion indicates that

there is scope for trade secret protection for those innovations that are less obvious and, hence, will not be patented.

Our discussion also implies that optimal trade secret policy should depend on whether the innovation in question is at a patentable stage and whether it is a sufficiently nonobvious one. Specifically, trade secret policy targeting innovations that are not yet at a patentable stage and trade secret policy targeting innovations that are sufficiently nonobvious and, thus, will be kept secret should be relatively stronger.

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