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Choosing the Scope of Trade Secret Law when Secrets Complement Patents

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Abstract. We present a model where an incumbent firm has a proprietary product whose technology consists of at least two components, one of which is patented while the other is kept secret. At the patent expiration date, an entrant firm will enter the market on the same footing as the incumbent if it is successful in duplicating, at certain costs, the secret component of the incumbent's technology. Otherwise, it will enter the market with a production cost disadvantage. We show that under some conditions a broad scope of trade secret law is socially beneficial despite the innovator is over-rewarded.

Keywords: patents, trade secret

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1. Introduction

The main instruments of intellectual property policy to promote innovations are the legal protection of patents and the legal protection of commercial and industrial secrets. As Friedman, Landes and Posner (1991) point out, trade secret law supplements the patent system as "Inventors choose trade secret protection when they believe that patent protection is too costly relative to the value of their invention, or that it will give them a reward substantially less than the benefit of their invention…, either because the invention is not patentable or because the length (or other conditions) of patent protection is insufficient". According to the authors, trade secret law is confined to protecting against conduct that is independently wrongful, that is, that violates some independent common law principle. Both reverse engineering and independent reinvention are admissible, as they often generate knowledge that will make it possible to improve on the original product. Besides, as trade secret protection has virtually no expiration date, the prohibition of reverse engineering and independent invention would make it stronger and preferable to patents. Nevertheless, citing a case like *E.I du Pont de Nemours & Co. v. Christopher* and considering that in assessing damages courts take account of trade secret's commercial value, the authors recognize the statement that there is no law of trade secrets as too bold.

Since patents and trade secrets have generally been perceived as mutually exclusive, with few exception the law and economics literature has separately concentrated on the design of optimal patent policy and on the design of optimal trade secret policy.[1] However, while the interest in optimal patent design is long standing and has given rise to large literature in the field, whose origins can be dated back to Nordhaus (1969),[2] the issue of the optimal strength of trade secret protection has received little attention until a short time ago. Only recently, starting from a provocative paper by Bone (1998), some authors have widely discussed the question of whether trade secret deserves a legal protection which goes beyond the contract law or the tort law. In the words of Lemley (2008), "Trade secret law is a puzzle. Courts and scholars have struggled for over a

[1] In some papers the choice between patent and trade secret protection is explicitly considered, but the strength of trade secret protection is treated as exogenous (e.g., Gallini, 1992; Denicolò and Franzoni, 2008; Cugno and Ottoz, 2006). For a discussion regarding the interplay between optimal patent and trade secret protection, see Erkal (2004).

[2] A selection of the first contributions includes Tandon (1982), Gilbert and Shapiro (1990), Klemperer (1990), Gallini (1992).

century to figure out why we protect trade secrets. …It seems odd, though, for the law to encourage secrets …..I argue that, paradoxically, trade secret law actually encourages disclosure, not secrecy. Without legal protection, companies in certain industries would invest too much in keeping secrets." Trade secret laws are then justified by the economic benefits that flow from their existence, in particular incentives for innovators to spend less money protecting secret information and for imitators attempting to appropriate secret information. According to Risch (2007) and Lemley (2008), the reduction of such costs is a sufficient reason for the existence of a trade secret law as a separate doctrine, whereas Bone (1998) has an opposite opinion.

The papers cited above prevalently refer to cases in which a proprietary innovation is protected by trade secret only. However, in spite of a common misperception of an alternative between patents and trade secrets, an innovator can use both intellectual property rights to protect different aspects of the same invention, as courts have long held that a published patent does not invalidate those trade secrets that are not disclosed in the patent itself.[3] Trade secrets can, in fact, be used in lieu of patents but, more importantly, they can be relied upon at the same time and side by side with patents to protect any given invention. With patents and trade secrets it is clearly possible to cover additional subject matter, strengthen exclusivity and extend intellectual property rights.

As patent protection is meant to assure the innovator with a reward just sufficient to cover her costs, it is clear that the association of patents and trade secrets can result in a over-reward of the innovator well beyond the one necessary to preserve the innovation incentive. Thus, a relevant policy issues arises. If the policy makers worry about the negative effects of a patent length reduction on the research incentive for innovations whose components are all protectable only by patents, do social benefits result from a decrease in trade secret protection, given the patent length, when the owner of the patent-secret mix is over-rewarded?

In this paper we attempt to face this issue by using a model in which the social cost associated with the mixtures of patents and trade secrets includes, besides dead-weight

[3] Interesting examples of patent-secret mix reported by Arora (1997) include German organic dyestuff in the nineteenth century, the Haber Bosch process for producing ammonia, the industrial diamond process technology by General Electric in the fifties. Court decisions such as, *C&F Packing v. IBP and Pizza Hut* (Fed. Cir. 2000) illustrated by Jorda (2004) and *Celeritas Technologies v. Rockwell International* (Fed. Cir. 1998) provide more recent examples of a complementary use of patents and trade secrets. Moreover, it is well known that in the software industry source code secrecy frequently complements patents.

losses, the costs borne by an entrant trying to duplicate that part of the technology protected by trade secret. Leaving aside, for sake of simplicity, costs borne by the two firms to illicitly obtain or protect information, we can concentrate on the relations between duplication costs (by legal means) and social welfare, along the lines of previous models present in the literature (Gallini, 1992; Maurer and Scotchmer, 2002; Denicolò and Franzoni, 2008).[4] A special feature of our model is nevertheless the relation between the probability of duplication and the scope of trade secret law.

Considering a situation in which transaction costs of trade secret licensing are prohibitive, we determine conditions under which a strong legal protection of trade secret is socially beneficial even if it implies innovator's over-rewarding. The paper is organized as follows. In Section 2 the model is presented and some legal issues are briefly discussed. Section 3 is dedicated to the design of optimal secret protection when secrets complement patents, and Section 4 concludes.

2. Employee mobility, knowledge spillover, and duplication costs

The model we will put forward in Subsection 2.2 below refers to a duopoly environment where employee mobility is subject to some contractual and legal restrictions intended to limit spillovers of proprietary non patented information. The scope of trade secret protection is identified with the strength of these restrictions, which we shortly expound in the following subsection.

2.1. Labour mobility restrictions

Apart form clearly illegal means for appropriating secret information, such as industrial espionage, employee mobility seems to be the main cause of technology spillovers between firms.[5] To the purpose of limiting harmful losses of proprietary information, in employment contracts firms may insert post-employment clauses, known as "post-employment covenants not to compete". In the absence of these covenants, in some cases firms may still resort to a lawsuit by appealing to the "inevitable disclosure

[4] Accurate analyses of the relation between costs incurred by rival firms in order to protect or misappropriate secret information and the scope of trade secret law can be found in the cited papers by Bone, (1998), Risch, (2007), and Lemley (2008).
[5] With reference to high technology districts see, for example, Saxenian (1994) and Gilson (1999).

doctrine" or similar arguments. The scope of trade secret law largely depends on the degree of jurisdictions' acceptance (and enforcement) of these protection tools.

While post-employment covenants consist of promises by employees not to work for a competitor for a specified period after employment ends, the inevitable disclosure doctrine refers to cases in which such covenants are not signed in the hiring contracts or during the employment relationships. This legal doctrine assumes that if an employee has knowledge of trade secrets, and accepts a similar job with a direct competitor in a highly competitive firm, he or she will "inevitably" disclose the trade secrets in the course of performing his or her new employment duties, so that when the former employer would suffer "irreparable harm" from disclosure this sort of employee mobility should be restricted irrespective of the existence of post-employment covenants. Classical cases where the inevitable disclosure doctrine has been adopted are *PepsiCo., Inc. v. Redmond* (7th Cir. 1995) 54 F.3d 1262 and *IBM v. Papermaster*, 2008 WL 4974508 (S.D.N.Y.), where the notion of "irreparable harm" is introduced. An example of rejection is *Schlage Lock Company v. Whyte* (2002) 101 Cal. App. 4th 1443.

It is worth noting that while enforceability of post-employment covenants not to compete are provided for by the law in almost all U.S. and E.U. jurisdictions, with more or less differences and with the notable exception of California where they are banned, the adoption of inevitable disclosure doctrine is typical of several, but not all, U.S. courts. Besides California, where the doctrine is explicitly refused, some jurisdictions such as Michigan, Missouri, Maryland and Minnesota expressed a few reservations about its application. Despite European courts never refer to some form of inevitable disclosure doctrine, something similar has nevertheless been formulated by the Court of Appeals of Paris in a case reported by Thiébart (2003), where the employee did not signed any post-employment restrictive clause. In its decision rendered on November 10, 1994, the court ruled that "if it is legitimate, in all cases, that an employee harvest the fruit of the experience he gained with prior employers, which constitutes for the employee a normal factor of enhanced value, this does not justify unfair behavior which can consist in disorganizing a former employer by massive employee departure or in disclosing manufacturing secrets and technical or commercial knowledge in order to enable the latter to capture the clients of the former employer". In any case, it is obvious

that where the inevitable disclosure doctrine, or some equivalent argument, is adopted, the scope of trade secret law tends to be broader than elsewhere.

The differences in conditions for enforceability of post-employment covenants mainly concern geographical and temporal restrictions, employees' job positions with respect to access to trade secrets, and employee financial compensations. For example, financial compensation to the employee must be explicitly provided for in employment contracts (personal or collective) in almost all E.U. states, while other jurisdictions –notably, the overwhelming majority of states in the U.S., Norway, Switzerland, Iceland and, inside E.U., Great Britain– do not require special consideration in labor contracts for worker's agreement to a non competition covenant. As far as California is concerned, Business and Professions Code section 16600 provides that "every contract by which anyone is restrained from engaging in a lawful profession, trade, or business of any kind is to that extent void." Californian courts have interpreted section 16600 "as broadly as its language reads",[6] so that they not only reject the doctrine of inevitable disclosure, but they also refuse to enforce post-employment covenants. See Gilson (1999), where the high labour turnover in Silicon Valley is ascribed to the weakness of trade secret protection in California, in contrast with the low employee mobility in Route 128 district governed by Massachusetts trade secret law.

2.2. The model

Let's consider two firms, labeled I (incumbent) and E (entrant). Firm I owns a proprietary product jointly protected by patents, whose duration is t, and trade secrets, which have no fixed expiration date.[7] For example, we can assume that at the time the patent was filed firm I disclosed the best mode for carrying out the invention; successively, firm I discovers a better best mode which it can keep secret without bearing the risk of patent invalidation. A possible alternative hypothesis is that the proprietary product consists of several parts, some of which are patented while others are kept secret. In any case, at the time t firm E attempts to duplicate the secret information by spending resources at this aim. It may enter the market bearing the same

[6] *Scott v. Snelling & Snelling, Inc*. 732 F. Supp. 1034, 1042 (N.D. Cal 1990).
[7] Although an innovator can often choose the extent patents and trade secrets combine with one another, in this paper we assume a given patent-secret mix. For a model where the patent-secret mix results from a maximizing choice, see Ottoz and Cugno (2008).

production costs of firm I, if duplication is successful, or higher costs –those associated with the information disclosed in the patent– if the duplication attempt fails.[8]

We assume that each employee of the incumbent firm has only a piece, more or less important, of information on the whole set of secrets owned by his or her employer. To the purpose of duplicating the secret parts of firm I's technology, firm E may take advantage of some knowledge spillover, whose intensity essentially depends on the employee mobility between the two firms. Employee mobility in turn depends on the scope of trade secret law, more specifically on the enforceability of post-employment covenants not to compete, and on the adoption or rejection by courts of the inevitable disclosure doctrine (in the U.S.) or similar legal arguments.

By utilizing the set of information obtained through employee mobility, whatever its dimension is, at time t firm E will spend resources to duplicate all components of firm I's technology protected by trade secret. Given the sum spent for duplication, called K, the probability of success, γ, will increase with the dimension of the preexisting set of disposable information, which in turn diminishes as the scope of trade secret law increases. In what follows, for sake of simplicity we treat the scope of trade secret law as a continuous variable depending on the conditions required by the relevant courts for enforcing post-employment covenants or applying the inevitable disclosure doctrine.

On these bases, and adopting the usual convexity hypothesis for a cost function, we assume that the probability of duplication success, γ, the duplication effort, K, and the scope of trade secret law, X, are linked by the relation

$$K = \theta(X)g(\gamma), \qquad (1)$$

where $g(\gamma)$ is an increasing and convex function: $g'(\gamma) > 0$ and $g''(\gamma) > 0$, and $\theta(X)$, with $\theta'(X) > 0$, is a measure of the duplication difficulty. Note that this approach is very similar to the one adopted by Takalo (2004) in a model with costly patent imitation: the only difference is that in our case the duplication difficulty depends on the scope of trade secret law, not on the strength of patent protection.

[8] Patents are assumed to be broad enough to make any non-infringing imitation impossible. This hypothesis is harmless to our purposes, as the introduction of patent breadth as a control instrument responsible of the possibility of imitation of the patented technology and related costs, would not modify conclusions. In particular, in our model a patent guaranteeing temporary monopoly would still be optimal, as in Gallini (1992).

If the attempt is successful, from time t firm E will compete on the same footing with firm I, so that it will obtain for ever a stream of symmetric duopoly profits equal to π_D. If the attempt fails (or there is no attempt at all), firm E may enter the market with a production cost associated with the information disclosed in the patent application, that is with higher costs than firm I. Then, it will gain a stream of profits $0 < \pi_{AD}^E < \pi_D$ provided that the cost differential is rather limited. Otherwise, firm E will not enter the market, and $\pi_{AD}^E = 0$. Given that r represents the discount rate, firm E will then choose γ by maximizing

$$\Pi^E = \frac{\gamma\pi_D + (1-\gamma)\pi_{AD}^E}{r} - \theta(X)g(\gamma)\,. \tag{2}$$

If an interior solution $0 < \gamma < 1$ exists, the optimal value of γ will be given by

$$g'(\gamma) = \frac{\pi_D - \pi_{AD}^E}{r\theta(X)}\,, \tag{3}$$

from which

$$\frac{d\gamma}{dX} = -\frac{\pi_D - \pi_{AD}^E}{r[\theta(X)]^2}\frac{\theta'(X)}{g''(\gamma)} = -\frac{g'(\gamma)\theta'(X)}{\theta(X)g''(\gamma)}\,. \tag{4}$$

In the following section we use our simple duopoly model to determine the optimal scope of trade secret law for a give patent length. In doing this we assume that, due to high transaction costs, trade secret licensing is not mutually convenient.

3. Choosing the scope of trade secret law

If firm E is not successful in the duplication attempt, then after patent expiration firm I will enjoy a production cost advantage: it will obtain a stream of monopoly profits π_M during the patent life and a stream of profits π_{AD}^I, greater than symmetric duopoly profit π_D, after patent expiration. So, remembering that r is the discount rate and t is the patent length, firm I's discounted profits will be $T\pi_M / r + (1-T)\pi_{AD}^I / r$, where $T = 1 - e^{-rt}$. This event has probability $1-\gamma$, with γ determined by equation (3). If, on the opposite, firm E succeeds in its attempt to duplicate the secret, the stream of profits

of firm I will be π_M during the patent life and π_D soon after the expiration date, so that the present value of innovator's total profits will be given by $T\pi_M / r + (1-T)\pi_D / r$. This event has probability γ. If we then denote by Π^I the expected value of the flow of discounted profits of firm I, we get

$$\Pi^I = T\frac{\pi_M}{r} + (1-T)\frac{(1-\gamma)\pi^I_{AD} + \gamma\pi_D}{r}, \qquad (5)$$

with $\pi_D < \pi^I_{AD} \leq \pi_M$.

Let's indicate with L_M the stream of dead-weight loss associated with monopoly, with L_D the stream associated with symmetric costs duopoly and with L_{AD} the stream associated with asymmetric costs duopoly. With probability $1-\gamma$ the stream of dead-weight loss will be L_M during patent life and L_{AD} after expiration, whereas with probability γ it will be L_M during patent life and L_D after expiration. Social expected cost of the patent-secret mix, SC, is the sum of the expected present value of dead-weight losses and of the expected present value of the cost borne by firm E to duplicate the secret, $(1-T)K = (1-T)\theta(X)g(\gamma)$, minus the present value of the perpetual flow of dead-weight associated to the symmetric duopoly (which is not dependent on the patent-secret mix). Then,

$$SC = T\frac{L_M}{r} + (1-T)\frac{(1-\gamma)L_{AD} + \gamma L_D}{r} + (1-T)\theta(X)g(\gamma) - \frac{L_D}{r}, \qquad (6)$$

where $L_D < L_{AD} \leq L_M$.

From the problem $\min_{T,X} SC$ under the constraint $\Pi^I \geq H$, where H is the research cost born by firm *I*, we in general determine the socially optimal pair (T^*, X^*) for innovations of the kind we are dealing with. As the choice of patent length is, nevertheless, relevant also for innovations whose components are all protectable only by patents, may be that policy makers wish to fix it at a level higher than T^*, which is socially optimal for innovations protected by a mixture of patents and secret. Let's then consider the case where at the outset $T > T^*$ and X is such that the innovator is over-rewarded. The problem is to verify if a reduction in the scope of trade secret law, diminishing the over-reward of the innovator, also reduces the social cost of the patent-

secret mix. The following proposition shows that under certain conditions the opposite happens.

Proposition 1. Let's consider a generic policy (T, X) which over rewards the patent-secret holder. Then, if

$$\frac{L_{AD} - L_D}{\pi_D - \pi_{AD}^E} < \eta + \gamma \frac{d\eta}{d\gamma}, \tag{7}$$

where η is the reciprocal of the elasticity of $g(\gamma)$, a reduction in X, given T, worsens social welfare.

Proof. Differentiating equation (6) with respect to X, given T, we have

$$\frac{dSC}{dX} = (1-T)\left[\theta(X)g'(\gamma)\frac{d\gamma}{dX} - \frac{L_{AD} - L_D}{r}\frac{d\gamma}{dX} + \theta'(X)g(\gamma)\right]. \tag{8}$$

By using equations (3) and (4), it is easy to verify that the derivative dSC/dX is negative if

$$\frac{L_{AD} - L_D}{\pi_D - \pi_{AD}^E} < \frac{[g'(\gamma)]^2 - g''(\gamma)g(\gamma)}{[g'(\gamma)]^2}. \tag{9}$$

On the other hand, defining the reciprocal of the elasticity of $g(\gamma)$ as $\eta = g(\gamma)/g'(\gamma)\gamma$, we have

$$g''(\gamma)g(\gamma) = [g'(\gamma)]^2 - \frac{g'(\gamma)g(\gamma)}{\gamma} - [g'(\gamma)]^2\gamma\frac{d\eta}{d\gamma}, \tag{10}$$

so that inequality (9) can be written

$$\frac{L_{AD} - L_D}{\pi_D - \pi_{AD}^E} < \frac{g(\gamma)}{g'(\gamma)\gamma} + \gamma\frac{d\eta}{d\gamma}, \tag{11}$$

which corresponds to condition (7).■

To gain some insight into the meaning and plausibility of condition (7) it is useful to consider the special case of linear demand function, constant marginal costs and Cournot competition, so that

$$\pi_D = \frac{(a-c)^2}{9}, \quad L_D = \frac{(a-c)^2}{18},$$
$$\pi_{AD}^E = \frac{(a-c-2\varepsilon)^2}{9}, \quad L_{AD} = \frac{(a-c+\varepsilon)^2}{18} + \frac{\varepsilon(a-c-2\varepsilon)}{3}, \tag{12}$$

where a is the intercept of the demand function $p = a - Q$, c is the marginal cost of both firm if the duplication attempt by firm E is successful, and ε is the cost disadvantage of firm E if the duplication attempt fails.

By using equations (12), and under the further hypothesis that $g(\gamma)$ is a constant elasticity function, that is $d\eta / d\gamma = 0$, condition (7) can be written

$$\varepsilon > \frac{8(1-\eta)(a-c)}{11-8\eta}. \tag{13}$$

Since for $\varepsilon > (a-c)/2$ the solutions for π_{AD}^E and L_{AD} are the same as for $\varepsilon = (a-c)/2$, that is $\pi_{AD}^E = 0$ and $L_{AD} = L_M$, there exists a level of η below which inequality (13) cannot be fulfilled. This level is $\eta = 0.625$. For $\eta \geq 0{,}625$ inequality (13), and then condition (7) in Proposition 1, can instead be fulfilled, provided that ε is sufficiently high. In particular, this event is the more likely the more relevant is the secret part of technology in terms of production costs and the more productive is at the margin the expense for duplication, that is for high levels of ε and η (see Figure 1).

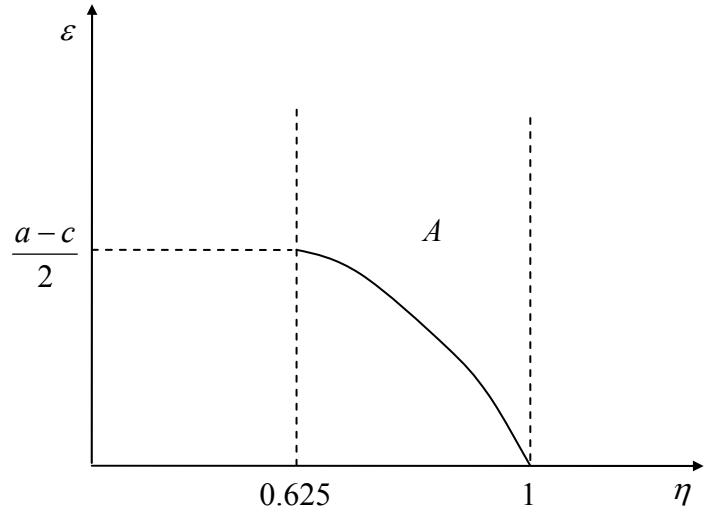

Figure 1. In the zone *A* inequality (7) is fulfilled.

Summing up, in this special case a necessary condition for inequality (7) to hold is $\eta = 0.625$. As there is no empirical evidence on the value of η –which measures the elasticity of individual probability of duplication success with respect to the individual expense for duplication– the only thing we can say is that likely it varies greatly according to the innovation type, in the same way as the elasticity of the supply of inventions –which can be viewed as the elasticity of the aggregate probability of invention success, empirically proxied by the number of patent applications, to aggregate research expenses– appears to vary greatly across sectors and over time (see Denicolò, 2007, and the literature cited therein).[9] Since something similar seems to hold for the cost differential ε, the only conclusion we can sensibly drawn is that there may exist particular market situations where a negative effect on social welfare of a reduction in the scope of trade secret law cannot be excluded, despite the patent-secret holder is over-rewarded. Obviously, at the present no policy implication can be deducted, either for the aggregate or for specific sectors.

The reason for a high level of trade secret protection would be the best policy when condition (7) holds is that in these circumstances a reduction in the scope of trade secret law decreases expected innovator's profits more than it increases the expected value of consumer surplus net of the duplication costs, so that social welfare decreases. In other words the beneficial effect of a high legal protection of trade secret is due to the fact that this sort of protection allows society to save on duplication costs that would be otherwise borne by firm E. This saving may be sufficient to more than compensate the increase of the expected present value of dead-weight losses caused by the reduction of the probability that the duplication attempt is successful.

It is worthwhile noticing that the hypotheses we have formulated on the relation between γ, K and X are crucial for the above result. Other models assume that the probability of success in duplicating the secret technology is equal to 1 provided that the entrant invest a given amount of resources for that purpose and that there exists a positive probability (obviously smaller than 1) of total leakage of the secret. (See Denicolò and Franzoni, 2008; see also Gallini, 1992, where the duplication cost of the

[9] Available estimates of the elasticity of the supply of inventions range from about 0.3 to about 1, depending on data sets and estimation methods. This great variability of estimates just suggests that the true elasticity may vary across sectors and over time.

secret doesn't play any role, but there is a probability of total leakage and a probability equal to 1 of non infringing patent imitation if the imitator invests for that goal a sufficient sum.) In these circumstances, if the probability of total leakage is negatively affected by the scope of trade secret law, it would be always optimal to adopt a policy of minimum trade secret protection. In fact, as duplication expenses do not depend on policy makers' choices, it would be advisable to get the maximum probability of total leakage.

4. Conclusions

We presented a simple model in which a producer innovator own a proprietary product protected by a mixture of patent and trade secret. An entrant tries to duplicate the secret part of the incumbent's technology, with a probability of success depending on the amount of resources devoted to this aim and on the quantity of usable knowledge spilled out of the incumbent firm, which in turn depends on the scope of trade secret law. At the patent expiration date, the competitor will enter the market at the same production cost as the incumbent if duplication is successful, or higher costs if the duplication attempt fails. We showed that in this context, when the secret part of technology is rather relevant in terms of production costs and at the margin the expense for duplication is sufficiently high, a strong trade secret protection is socially preferable to a weaker one, even when the innovator is over-rewarded. This result is due to the fact that a strong protection allows society to save on duplication costs that would be otherwise borne by the entrant firm. Such saving may be sufficient to more than compensate the relatively high expected present value of dead-weight losses associated with a low probability that the duplication attempt is successful.

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