Secrecy in the Shadow of Patenting: Firms' Use of Continuation Patents, 1975-1994

Stuart J.H. Graham[1]

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Abstract:

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[1] Doctoral Candidate, Walter A. Haas School of Business, University of California, Berkeley.

> **"**This patent was applied for in 1879 and granted in 1895. [] While [Selden] withheld his patent, the public learned from independent inventors all that it could teach. [] But the patentee acted wholly within his rights. He merely took advantage of the delays which the law permitted him."
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> Judge Noyes, *Columbia Motor Car Company vs. C. A. Duerr & Company* (1911)

1. Introduction

When George Selden's patent for a "Road Engine" issued from the United States Patent and Trademark Office (USPTO) in 1895, vehicle manufacturers recognized it for the threat it was: within a few years, Selden's patent was commanding royalties of 1.25% on the retail value of every automobile sold in the United States and had sparked a reorganization of the fledgling industry.[2] But Selden had not invented his "Road Engine" during the 1890s, or even during the 1880s. His original patent application had been made in 1879. Selden had used the *continuation* procedure available to patentees to keep the application hidden from competitors for sixteen years while the technology—and industry—developed. Upon issue in 1895, competitor firms that had been using the Selden technology for years were suddenly forced to disgorge earnings, or face the substantial threat of being shuttered.

The case of George Selden's patent is an example of a larger phenomenon: the use by patentees of complementary appropriability mechanisms to accomplish strategic goals. As knowledge assets are increasingly recognized as an important means of gaining competitive advantage, scholarly attention has focused on the protection of knowledge assets from competitive rivals, with necessary reference to the appropriability regime and intellectual property protections (Teece, 1986). While individual mechanisms such as secrecy and patenting have been studied in isolation, few attempts have been made to describe and test the manner in which different mechanisms may complement or substitute for one another, and the manner in which these interactions create opportunities for patentees to accomplish strategic goals.

This paper will examine the *continuation*, a procedure available under the Patent Act allowing patent applicants to delay a patent's issue, and thus prolong the period of secrecy prior to disclosure. It is notable that *continuation* applications are both extensively used and acutely understudied: my data analysis demonstrates that, in some U.S. patent issue-years, more than one in four issued patents have had a *continuation* in their application lineage, and that in some sectors this rate has reached greater than three in four. Because the use of these procedures is costly, their prevalence in patenting is a puzzle that raises several questions. First, what are the determinants of firms' use of the continuation application in patenting? And, second, how does the firm's use of continuation patenting drive firm performance?

[2] Selden had sold his patent 549,160 in 1899 to a syndicate for $10,000 and 20% of any royalties. Early manufacturers who had originally seen the Selden patent as a threat formed a cartel around the patent, the Association of Licensed Automobile Manufacturers, which limited membership and licenses to manufacture under the Selden patent.

The limited prior literature on continuation applications has suggested several possible explanations for applicants' use of the continuation in patenting. The classic policy justification for maintaining the continuation procedure is to afford applicants an opportunity to correct drafting errors—styled here an "uncertainty" continuation. Another hypothesis suggests that lengthy continuing applications "wear down" Patent Office employees who initially resist awarding the patent—styled here a "junk" continuation. Yet another hypothesis suggests that applicants use the continuation to keep patents hidden in order to engage in economic hold-up after markets have developed—styled here a "submarine" continuation. I add to these explanations a fourth: the *secrecy* continuation.

I argue that the use of the continuation procedure affords patent applicants a strategic opportunity. Continuation applications allow the patentee to file additional applications upon identical or amended disclosures, thereby preserving an early priority date for the invention while protecting an extended period of secrecy against competitors. A strategic opportunity arises from the added term of secrecy that the continuation procedure affords to patent applicants. This period of secrecy, may be a complement to the act of patenting itself.

This paper employs data on the use by firms of continuation applications in the United States from 1975-1994. It is organized as follows. Part two describes the continuation procedure and the motivations for its practice by firms. Parts three and four analyze the advantages stemming from continuation application strategies and present some testable implications. Parts five and six present the methodology and results. Part seven concludes.

2. Continuation patenting: Foundational characteristics

In the United States, inventors enter into a complex application process when seeking a patent. Procedurally, the application for a utility patent[3] must be filed within one year of the invention's public use or publication[4] with the United States Patent and Trademark Office (USPTO or "Patent Office") and must contain an adequate description with one or more claims.[5] Before the patent issues, the Patent Office ensures that the invention covers patentable subject matter,[6] is useful,[7] novel,[8] and not obvious.[9] The

[3] While the vast majority of US patents--and the focus in this paper--are the so-called Utility patents authorized by 35 USC §101, patents are also available on Plants (35 USC §161) and Designs (35 USC §171).

[4] 35 USC §102(b).

[5] 35 USC §112, 113, 114. The "written description" requirement is intended to allow any person skilled in the art to either make or use the invention. See Permutit v. Graver Corp., 284 US 52 (1931)(finding that the absence of any writing was an insufficient description when only drawings were provided). Claims are intended to delimit the subject-matter that constitutes the invention. See Flick-Reedy Corp. v. Hydro-Line Mfg., 351 F.2d 546 (7th Cir. 1965)(holding that withholding information from the claims failed to adequately describe the invention).

[6] 35 USC §101. See Diamond v. Chakrabarty, 447 US 303 (1980)(determining that man-made living micro-organisms are patentable subject-matter).

[7] 35 USC §101. See Brenner v. Manson, 383 US 519 (1966)(upholding examiner's determination that a the output of a chemical process was not useful if merely similar to a useful compound).

[8] 35 USC §101, 102. See Jamesbury v. Litton Industrial, 756 F.2d 1556 (CAFC 1985)(finding that an invention was "novel" when no prior art was precisely equivalent).

patent examiner, a Patent Office employee with specialized technical knowledge, is the arbiter of these requirements. Prosecution of the patent has been characterized as a "give-and-take-affair," with negotiation and re-negotiation between the patentee and the patent examiner that ordinarily continues for an average of 2-3 years (Merges, et al., 1997).[10] This mean statistic, however, fails to illuminate many abnormally long pendency periods in the tail of the distribution. Applicants routinely use a procedural mechanism—the *continuation application*—to postpone patents' issue.

In order to understand the full implications of the continuation, it is necessary to understand two key concepts: "Priority" and "non-disclosure." In the U.S. "first to invent" patent system, the filing of a patent application gives the applicant "priority," a government-sanctioned presumption that the invention is superior to later-filed applications by technology competitors.[11] Because prior to 1999 an application remained secret until "disclosed" upon publishing when issued, applicants enjoyed common-law trade secret protection on inventions during the pendency of their applications.[12]

[Figure 1 about here]

The continuing patent application permits an applicant to avoid the implementation of a patent examiner's issue decision by renewing at least some portion of an original application. As defined here, a continuing patent application may be of three types: the continuation, the continuation-in-part, and the division (Figure 1).[13] The "continuation" application discloses the identical invention claimed in the prior "parent" application, with a requirement that no extraneous matter be disclosed in the follow-up application.[14] The "continuation-in-part" application allows the addition of some new matter to the original application—although the benefit of early priority is awarded only for the original disclosures contained in the new application. A "division" occurs when the original application contains more than one independent invention. The USPTO

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[9] 35 USC §103. See Graham v. John Deere Co., 383 US 1 (1966)(finding an invention invalid on grounds that the improvement would have been obvious to a person of ordinary skill in the art).

[10] Lemley (1994) found an average length of 864 days (2.37 years) for 2,081 patents issued on December 27, 1994. There is reason to believe that patent prosecution terms may have shortened for applications made after 1994 (See Lemley, 1994), although Allison & Lemley suggests that pendency has not fallen in the years immediately following the passage of the Act (2000).

[11] The USPTO considers that the invention was reduced-to-practice by the application date. Competitors claiming earlier invention must show why they themselves were not diligent in reducing the invention to practice or can otherwise justify delaying the application. Public policy favors the early disclosure of inventions. This underlies the requirement for "reasonable diligence" in reducing an invention to practice, not unlike the requirement that, to avoid a holding of suppression of concealment, there be no unreasonable delay in filing an application once there has been a reduction to practice. *Naber v. Cricchi,* 567 F.2d 382 (CCPA, 1977), quoted in *Griffith v. Kanamaru*, 816 F.2d 624 (CAFC, 1987).

[12] The applicant is "promised that merely by soliciting, before the Patent Office, [patent protection for his secret invention] he is not giving up his common-law rights. Though the Patent Office may refuse to issue a patent, it must do nothing to jeopordize even an unsuccessful applicant's common-law rights." *Irons & Steel v. Dann,* 606 F.2d 1215 (D.C. Cir. 1979).

[13] The continuation and continuation-in-part are authorized under 35 USC § 120 "Benefit of earlier filing date in the United States." Divisions are authorized under 35 USC § 121 "Divisional applications."

[14] The fee required to request a continuing application is no higher than that for filing a first application—$710 in 2001, and $355 for small entities. 37 C.F.R. 17(e).

allows the applicant to "elect" one of these inventions while filing second and subsequent disclosed inventions separately—and generally later in time. So long as the later applications disclosing the non-elected inventions satisfy legal requirements, they, like the continuation and continuation-in-part applications, benefit from the earliest filing date.[15]

Continuation applications of these types permit an applicant to adopt the date of an earlier application still pending within the Patent Office.[16] The *sine qua non* of the continuation is that both the early and the new applications must disclose the same invention. Because earlier applications may be abandoned by the applicant freely, the invention can remain hidden for extended periods of time. There is no limit to the number of times this abandonment may occur, and thus chains of continuations may develop, having the effect of postponing the patent issue, in some cases for decades.[17]

In 1995, and again in 1999, Congress made changes to the Patent Act aimed, at least partly, at eliminating applicants' incentives to use continuations. The 1995 modification[18] increased the patent term from 17 to 20 years but began measuring the patent term from the application-date instead of the issue-date, thus forcing the applicant using continuation patenting to "trade off" *ex ante* secrecy for *ex post* protection.[19] This disincentive was compounded in 1999 when Congress[20] required that applications be published after 18-months, bringing the U.S. law into harmony with the patent laws of the major patenting jurisdictions.[21] These modifications to the U.S. patenting regime have

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[15] Continuation applications have been available to patentees in the United States at least since 1863. In Godfrey v. Eames, 68 U.S. 317 (1863), the U.S. Supreme Court interpreted the Patent Act of 1836 to allow continuation applications, in that case when the original application was abandoned on the same day that the new continued application was filed. The use of continuing applications was also upheld by the Supreme Court in Crown Cork & Seal Co. v. Gutmann Co., 304 U.S. 159 (1938) and General Talking Pictures Corp. v. Western Electric Co., 304 U.S. 175 (1938).

[16] The application must meet certain conditions. Under 35 USC § 120, a patent application is entitled to adopt the filing date of a "parent" application when (1) both applications disclose the same invention; (2) both applications are filed by the same inventor; (3) both applications are simultaneously co-pending; (4) the earlier application meets the disclosure requirements of 35 USC § 112; and (5) the later application contains a specific reference to the earlier application. Sampson v. Ampex Corp. (1971, DC NY), 333 F. Supp. 59, aff'd. (2nd Cir. NY) 463 F2d 1042. The language of 35 USC § 120 was initially adopted in the Patent Act of 1952, and legislative history suggests that the section was intended to write existing legal practice on the issue into the statute. In re Henriksen, 55 C.C.P.A. 1384 (1968).

[17] See, for instance, Jerome Lemelson's U.S. patent 5,283,641, Apparatus and methods for automated analysis, issued February 1, 1994. The priority date of this patent was December 24, 1954, and there were no fewer than eleven continuations and divisions in this patent's chain while it languished in the patent office for 39 years.

[18] The legislation was offered and passed in 1994 as part of the fast-track vote on the Uruguay Round of the General Agreement on Tariffs and Trade (GATT). The law's provisions did not take effect until 1995 so it will be termed the "1995 Act."

[19] The impact upon continuation applications is provided in 35 USC 154(c). For patents in force on or with application dates prior to June 8, 1995, the patent term is the longer of 20 or 17 years as calculated under their respective regimes. Therefore, only patent applications made after June 8, 1995 will be subject to the limitations of the new law.

[20] American Inventors Protection Act, Pub. L. No. 106-113, 1000(a)(9), 113 Stat. 1501, 36.

[21] Japan and the signatory nations to the European Patent Convention, including the Germany, France, and Great Britain, abide by an 18-month application publication rule. Effective lobbying by independent

significant implications for the use of continuation strategies in patenting, and thus form the basis of Chapter 2 of this dissertation.

2.1 Strategic Patenting: Motivations for firms' use of the **Continuation** *Application*

Because I argue that the strategic use of secrecy in the patenting process is an important determinant of continuation applications, and that one motivation for using this strategy is to maximize rents from valuable technological improvements, a more nuanced discussion of the procedure's characteristics of economic interest is necessary. While the literature has discussed "submarine" patenting, little effort has been directed toward understanding the manner in which secrecy, and the complementarities between secrecy and patenting, motivates the use of continuation applications.

Given the institutional structure of the patent laws, non-disclosure in and of itself cannot fully explain strategic uses of the continuation procedure. Absent other benefits, a rent-maximizing applicant seeking secrecy would have few incentives to protect secrecy through continuation. On its face, the added secrecy afforded by the continuation offers no advantage over extended and exclusive trade secret protection. If secrecy were the only benefit that continuation provided, an applicant could simply delay filing the application,[22] and thus avoid costs associated with patenting—including the costs associated with early USPTO fee payments, agents needed to prepare and prosecute the application, and the risks of knowledge spillover from the Patent Office to competitors.

But the patent applicant does receive a significant benefit from a chain of continuations: the early filing date. For applicants filing patents through 1994, "priority" and "non-disclosure" united in continuation patenting to create a strategic opportunity. Applicants could retain secrecy for their inventions throughout the application period, and a protected priority date created a more valuable secrecy.

The patent regime in place prior to 1995, moreover, enabled the applicant to extend this period of secrecy virtually without limit.[23] For the patenting analyzed in this study, the patent term was 17-years after date of issue. Absent any requirement that applications be published,[24] patentees could protect their priority-dates-at-filing for many

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inventors resulted in one important loophole: patent applications made in the United States but not also in another jurisdiction requiring 18-month publication are exempted from the U.S. publication requirements.

[22] This delay of filing would be predicated upon the inventor keeping the technology active and in-house, thus not running afoul of the provisions of 35 USC § 102(b) (loss of right to patent due to publication, sale, or use prior to one year before application date) or 35 USC § 102(c) (loss of right to patent due to abandonment).

[23] Due to changes in the Patent Law enacted by the U.S. Congress and effective June 1995, the patent term was changed from that which it had been historically, 17-years from the date of patent issue, to 20-years from the date of patent application. This legislation was aimed partly at reducing the incentives for applicants to engage in continuation patenting. These issues raised by this policy change, as well as the impacts that the change had upon firms' use of continuations, are the subject matter of Chapter 2 of this dissertation.

[24] A publishing requirement was enacted in the 1999 Inventors Protection Act, which requires that (most) applications be published 18-months after filing. Exceptions are allowed for inventors attesting that patents will not be sought in any other country requiring 18-month publication—such as Japan and most of the EU countries.

years before beginning the patents' *faux*-monopoly protections.[25] Because continuations are new applications based upon their predecessor "parent" or "grandparent" applications, they may thus incorporate new claims while retaining priority for the core technologies disclosed in the first application. Furthermore, the former application may be freely abandoned in order to stop the patent issuing, thus preventing the patent document's technology disclosures to competitors. Pursuing a continuation patenting strategy thus allowed the applicant to manage the technology and appropriation process, in terms of the timing of disclosures and managing technological change.

2.2 *The face of continuation practice, 1975-1994*

To shed light upon both strategic and non-strategic uses of continuation applications, continuation patenting data is presented in graphic form below. In order to frame the continuation trend, patenting as a whole in the United States over the 1975-1994 time period is presented in Figure 2. Much attention has been paid to increased patenting in the US after the mid-1980s (Kortum and Lerner, 1998; Hall and Ziedonis, 2001), with suggestions that an increase in "junk" patenting has played a significant role, particularly in the area of new technologies (Aharonian, 2000). Continuation has been touted as a mechanism allowing an applicant to increase the likelihood of patent issue (Quillen and Webster, 2001), a premise having implications for firms interested in increasing their patent stocks for strategic purposes, such as those using cross-licensing to manage the challenges created by patent thickets (Hall and Ziedonis, 2000; Shapiro, 2001). If Quillen and Webster's hypothesis is sustainable, some of the overall increase in patenting may be the result of "junk" patents issued as a result of strategic continuation practice.

[Figure 2 about here]

Illustrating the overall use of continuations, Figure 3 plots the fraction of patents issued in each of the listed years that had at least one continuation[26] in their application lineage. The data thus represent only the terminal patent, the patent that emerges at the end of the chain of continuations. Because some applications may have been abandoned, this terminal patent may be the only evidence of a continuation chain. The data in these figures are calculated using the issue-date, not the application-date because, under continuation practice, the application-date recorded on the face of the patent document is simply the "last" application in a chain of continuations. This date is, therefore, an artificial measure of inventive activity when continuation applications are filed. Under these circumstances, issue dates may be a more meaningful metric of the use by patentees of the procedure, because the issue date is one over which the applicant exercises greater

[25] Patents do not offer true monopoly protections because they afford the patentee the right to exclude, and not the right to manufacture. Furthermore, the patent at best offers the patentee control over products, not markets.

[26] The use here of "continuation" includes also the "continuation-in-part" process by which particular claims or groups of claims can be continued as opposed to an entire application and all disclosures therein. Because the use of the continuation-in-part process to shroud certain critical claims under a veil of secrecy is, in effect, virtually identical to secreting the entire application, both are considered "continuations" for this analysis. Divisions, which have the same effect as continuations, are considered here also.

control than in the "normal" single-application patent case, and gives an indication of when, within a certain distribution, the patentee intends the period of secrecy to end.[27]

[Figure 3 about here]

The numbers presented in Figure 3 suggest that the continuation is an important economic phenomenon, accounting for at least 17% and as much as 25% of annual issued patents throughout the 1975-1994 period. The increased incidence of issued continuation patents shown after 1986 actually reflects applications that were filed several years earlier, prior to the 2-3 year mean pendency for non-continuation applications. For instance, the priority date for continuation patents issued in 1987 and 1988 is almost 4 years before issue, placing the mean first filing date at 1983 and 1984, respectively. More frequent use of continuation applications by patentees began well before the upturn in their issuance demonstrated in Figure 3, and may correspond with the pro-patent legal regime ushered in with the founding of the Court of Appeals for the Federal Circuit (CAFC) in 1983 (Kortum & Lerner, 1990; Merges, 1997).

Data indicate that the effect of using the continuation application is to delay the issue of the patent. Figure have had at least one continuation in their application lineage and those that are issued with no continuation practice. Figure 3a offers statistics for the entire sample of 1,682,032 patents issued from 1975-1995 inclusive. Patents issued after 1995 were dropped to reduce lag issue effects. While non-continuation patents pend for an average of 688 days in the Patent Office, those with at least one continuation in their lineage pend for an average of 1442 days—some 754 days, or 2.1 years, longer. These longer periods of pendency do not appear to be due overwhelmingly to multiple-continuation applications: restricting the sample to patents with only one continuation in their application lineage yields a mean pendency of 1230 days—542 days, or 1.5 years, longer than those non-continued patents. Panel B suggests that the length of application pendency inside the USPTO, for both continued and non-continued patents, has fallen over time, but that continuation applications continue to enjoy significant advantages in added pendency.

[Figure 3a about here]

3. Strategic uses of the continuation application process at the USPTO

These continuation trends beg a host of questions. Why did patentees begin to use the continuation process in greater numbers during the 1980s through the time when the 1995 Act was passed? Was increased use of the procedure primarily fueled by "submarining," or by other motives? How does the continuation application create opportunities for firms to appropriate value from innovations and protect competitive advantage? To aid in answering these questions, I now describe in more detail the circumstances under which patentees use continuation practice and derive economic benefits from the its use.

[27] There will always be a certain amount of uncertainty about the date of issue, although the patentee can minimize this uncertainty through the negotiation process with the USPTO examiner and the deft use of the continuation process itself.

[Figure 4 about here]

The decisions and options available to applicants and examiners during the patent negotiation process are presented in Figure 4. This flow chart can be thought of one in which profits and associated probabilities dictate the actions of rational actors. Players can be assumed to maximize their expected payouts.

In this stylized representation, discovery of a technological advance presents the inventor with two options: to patent or not to patent. The decision to forego a patent likely indicates that the property right is a costly or uncertain option compared to alternatives. In the event that an inventor makes an application, the examiner has two options: to declare the invention either "patentable" or "not patentable." Although this decision is presented here as a simple choice, the examiner's decision is ordinarily made after extensive communication and negotiation with the applicant.

3.1 Unpatentable Inventions

If the examiner determines that the application does not describe a patentable invention, Figure 4 shows that the applicant is presented with two options: to terminate the application, or to file a continuation application. An termination ends the process, but the continuation application allows the applicant to force another action from the patent examiner. The examiner would again have the option of declaring the application patentable or unpatentable, after another period of communication with the applicant and information gathering, and so on. Continuation applications thus offer applicants the opportunity to win patents on their inventions despite being declared initially "unpatentable." Two situations may lead to such a altered outcome: initial mistakes, and strategic delay.

3.1.1 Accidental Continuations

The filing of a continuation application may be due to misunderstandings between the actors—"accidental" continuations. Because the continuation allows an applicant to correct errors in the claims that come to light during the "give and take" of the prosecution process, some patents that emerge at the end of a continuation chain are the result of disagreements concerning patentability and may not be principally motivated by a desire for added secrecy. The continuation process is costly, and because the rational applicant would avoid investments in monetary fees and the time entailed, an accidental submarine patent, when it occurs, is likely the result of information asymmetries between applicants and examiners concerning the patentability of the invention disclosed in the pending application.

Such information asymmetries between the parties are more likely when the technology is new or is undergoing an era of rapid change. When the subject matter of the patent is a new or newly changed technology, applicants and their agents, as well as the examiners, have had limited time or opportunities to learn. Parties may thus face increased uncertainty about the invention's patentability. In a similar manner, information asymmetries can also be expected to increase with technological complexity. Applicants with an objectively patentable invention negotiating with an examiner who

mistakenly considers the invention unpatentable may use the continuing application to capture more time in which to educate the examiner. From these arguments, the following hypotheses may be postulated:

H1a: Patents are more likely to show a continuation application lineage when the technology is new or rapidly changing.

H1b: Patents are more likely to show a continuation application lineage when the technology is complex.

3.1.2 Strategic Delay: The examination continuation

Apart from these "accidental" continuations, the institutional structure of the Patent Office may also present a strategic opportunity by allowing the applicant to simply *delay* the process. By using the continuation, the applicant can postpone the Patent Office's issue of a ripened patent, or the examiner's decision *not* to issue. This strategy is pursued with the goal of increasing the likelihood of winning patents. Perverse incentives inside the USPTO may make delay a particularly effective lever for improving the likelihood of securing patents on inventions that do little to advance the scientific art. Merges (1999) identifies an institutional set-up at the USPTO that rewards patent examiners for clearing files, and a piece-rate system for examiners that creates incentives fostering patent approval. Lemley (2001) lends some support by suggesting that examiners, for a host of reasons, are prone to mistakenly issue patents on objectively unpatentable inventions.

Institutions at the Patent Office may, accordingly, present applicants with opportunities to use continuations as a means of delaying patent examiner final patentability decisions, thereby improving the likelihood of securing low-quality patents (Quillen and Webster, 2001).[28] "Junk" patents may be particularly valuable in settings[29] where the sheer number of patents is considered valuable, and may be important for purposes other than capturing value from innovation. In the semiconductor industry, negotiations over patent rights or cross-licensing agreements involve the parties producing stacks of patents to intimidate competitive rivals. These negotiations are described as a process in which the parties produce a "proud list" of only a few very valuable patents, but also a stack of patents, thus making the absolute number of patents quite important. Hall and Ziedonis (2000) and Shapiro (2001) suggests that, in several key industries, among them semiconductors and computer products, patent thickets have become the norm, with firms increasingly seeking patents for strategic purposes. Cross-licensing "thickets" of this type have been tied to complex technologies (Somaya, 2000; Cohen, Nelson, and Walsh, 2001). These considerations lead to the following hypothesis:

[28] There is some evidence that continuations may also operate as a reward to examiners in the USPTO piece rate system. Such a system may give examiners an incentive to continue negotiations with a patentee over a "close call," thus gaining low-effort rewards through continuation applications.

[29] A preference for more patents may, ceterus pariubus, also work at firm level, insofar as firms use patent counts as R&D production indicators or as elements in employee compensation schemes.

H2a: Low-quality patents are more likely to show a continuation application lineage.

H2b: Low-quality patents are more likely to show a continuation application lineage in complex technology industries than are those in discrete technology industries.

3.2 Patentable Inventions

While applicants may file "corrective" and "delaying" continuations when presented with an "unpatentable" finding by the patent examiner, the continuation is also an option for applicants presented with a "patentable" finding by the patent examiner. If the examiner finds that the invention fulfills the statutory requirements of patentability, the scheme in Figure 4 shows the applicant having two options: Allow the patent to issue, or file a continuation application. I argue that benefits stemming from added secrecy and the institutional structure of the application process can create an expected payoff from continuation that is more valuable to an applicant than immediately allowing the patent to issue.[30]

3.2.1 Secrecy Strategy

Both patenting and secrecy are mechanisms that enable innovators to capture value from their knowledge assets. Although the protection of knowledge assets has long been recognized as an important goal of research and development efforts (Scherer, 1965; Nordhaus, 1969), firms' protection strategies are still not well understood. For instance, in industries where patents are seen by managers as relatively ineffective means of appropriating value as compared to secrecy, firms continue to patent, often seeking strategic benefit (Levin, et al., 1987; Hall and Ziedonis, 2001). Other firms forego patenting and use secrecy as the exclusive means of capturing value from innovations, although the mechanisms by which firms create and sustain secrecy are not well understood (Brewer, et al., 1996; Liebeskind, 2001). Despite an extensive literature on these mechanisms, the extent to which innovators use secrecy and patenting together has been given little attention.

Secrecy and patenting have been traditionally viewed as substitute mechanisms for capturing value from innovation. Secrecy, when compared with patenting, has been identified both by corporate managers (Levin, et al., 1987) and by corporate R&D labs (Cohen, et al., 1997) as a more effective mechanism for appropriating value from innovation in numerous industries. The choice for an inventor is often posed as one between preventing "reverse engineering" by seeking a patent at the cost of disclosing the invention through publication following issue (Horstman, et al., 1985). If the "anti-diffusion" effects of secrecy make trade secrecy a substitute for patenting, then the economically farsighted inventor who foregoes a patent is determining that the patent is

[30] An alternative course is also available—to simply abandon the application. This option, to abandon a "patentable" invention, is an infrequent event according to practitioners, and is ignored here due to its *de minimus* economic significance.

too costly or the reward from it too minimal[31] when compared with the value of the invention and the risks of "reverse engineering" (Friedman, Landes, and Posner, 1991).

Given the innovator's decision, it is possible to develop a taxonomy of the uses of patenting and secrecy, as presented in Figure 5. This matrix displays the strategic positions occupied by the innovating firm after making its choice to use patenting and/or secrecy to appropriate value. The traditional view—that patents and secrets are substitutes—is illustrated in the lower-left and upper-right quadrants of the matrix. In these "naked" forms, patenting is associated with disclosure and, conversely, non-patenting with trade secrecy.[32] Naked patenting has been associated with quick-to-market products that display the technological advance readily on the product's face. Examples include a wide variety of consumer products.

[Figure 5 about here]

Cases of the upper-right quadrant, naked trade secrecy, can be found in technologies protected exclusively with trade secrecy. Traditional trade secrecy has been associated with process technologies or products with a substantial tacit-knowledge component that is difficult if not impossible to translate into a patent application. These innovations can remain hidden, either because the technological advance cannot be read on the face of the final product, as is the case with many process technologies which leave no signature on the manufactured good, or because the advance is veiled behind technological barriers, as in the software industry with product source code. The archetypal example of naked trade secrecy protection is in the process for manufacturing chemical products.

Viewing patenting and secrecy exclusively as substitutes, however, fails to recognize the conditions described by the alternative quadrants in Figure 5. The lower-right quadrant portrays innovations neither patented nor kept as secrets, a condition which can occur when an innovation yields no net benefits given the costs of protection, or because the innovator sees the technology as either unprotectable or as the basis for some blocking property right in the hands of a competitor. International Business Machine has been following the latter tactic for decades, printing knowledge advances in its technology circulars to disclose know-how that the firm chooses not to protect. These motivations are contrasted, however, with the strategies depicted in the upper-left quadrant—those in which patent and secrecy are used together to capture value from innovation.

3.2.2 Patenting and Secrecy as Complementary Appropriability Mechanisms

[31] The reward may be too thin either because the scope is too narrow, or the length too short. The inventor might also perceive that the invention is unpatentable.

[32] This view parrots the traditional justification for intellectual property protection, that the innovator is granted a monopoly for a limited time in exchange for a public disclosure of his knowledge, the latter having welfare-increasing spillover effects that rewards society for the monopoly power given the innovator.

The appropriation strategies described in the top-left quadrant of Figure 5 are based on a more nuanced view of the relationship between secrecy and patenting, viewing them instead as complementary mechanisms. Strategies using both patents and secrecy contemporaneously to protect different types of knowledge embedded in a technological advance were used by firms in the early chemical industry. Hounshell and Smith's (1988) study relates how companies in the turn-of-the-twentieth-century German dye industry used patents and trade secrets as complements in their strategy to build walls around entire research areas. Arora (1997) suggests that patents and trade secrets can serve as complements because of the character of the knowledge inherent in the invention: tacit elements of the knowledge, being difficult to transmit, may be better protected through secrecy, while capturing value from the codified knowledge is more effective using patent protection.

Evidence from Cohen, Nelson and Walsh's survey (1997) of R&D labs suggests that these mechanisms may indeed be used as complements. Correlations of industry-level mean effectiveness scores of the various surveyed mechanisms (e.g., lead time, secrecy, patenting) demonstrate that in the case of process technologies, the use of these two mechanisms are positively correlated at significant levels. Moreover, factor analyses show that, in some circumstances, secrecy loads with patenting, leading the authors to suggest that there may be a premium to keeping to-be-patented innovations secret until the patent actually issues. (Cohen, et al., 1997). Another explanation may be that trade secrets are being used as a complement to patents.

The continuation application may allow an applicant to realize this premium, but in a different manner than other complementary patent-secrecy strategies. While continuation is similar to the case of the German dye industry described by Hounshell and Smith, it is somewhat less complete. While the German firms were able to leverage full-blown patent protection with complete trade secret protection on different knowledge elements of the same invention, these mechanisms may fail to operate in a continuation application. The continuation strategy instead forces the patent applicant to make a more determined choice between patent protection and secrecy, and in this sense suggests that the secrecy available under continuation practice covers the same knowledge that is being patented, unlike the case of the German dye firms. Thus, although Arora suggests that these types of knowledge are different, one codified and the other tacit, the wide use of continuation practice implies that there may be a premium to keeping even patentable—and thus codified—knowledge secret for extended periods. This may suggest that certain firms are choosing to hide their codified, easily-transferable know-how inside the Patent Office for extended periods. It may also suggest that the codified and tacit dichotomy used to describe the complementary patent-secret strategy is incomplete, and that instead some other dimension is at work.

To gain a better understanding of the interplay between patent and secrecy choices in firm appropriability strategies, I consider two different types of secrecy: technology secrecy, and application secrecy. *Technology secrecy* refers to the firms' intent—or ability—to keep knowledge about its technological discovery from spilling outside the firm. Its ability to successfully secret this know-how is often dictated by technological characteristics, such as the extent to which the invention is "written on the face" of the

product or process, and the amount of tacit-"difficult to codify"-knowledge embedded in the discovery.

Application secrecy, on the other hand, refers to a firm maintaining secrecy over the existence of the patent application itself. The applicant is aided in accomplishing *application secrecy* by the Patent Office, the latter having rules and procedures that prevent the agency or examiners from disclosing any pending application. Recall, also, that applications enjoy a common law trade-secret harbor: the simple act of disclosing a discovery to the Patent Office does not prevent the availability of state trade-secret protection. For the firm wanting to disclose the existence of a patent application, the Patent Office allows a "patent-pending" mark to be attached to goods, but requires under penalty of law that the applicant must in fact have a patent under examination. However, because there is no requirement that the *technology* disclosed in the application be made public, applicants may still enjoy *technology secrecy* while disclosing the *application's* existence to competitors with a "patent pending" mark.

[Figure 5a about here]

Strategic positions emerging from the relationship between these two modes of secrecy are diagramed on Figure 5a. The matrix presents four firm strategies, conditioned on the firm having selected to patent its discovery, and given different levels of its chosen secrecy, subject to its technological constraints. At low levels of both technology and application secrecy, the firm is said to be pursuing a *Sprinting* strategy. This strategy is appropriate for firms, like Mattel, selling a quick-to-market product with technological improvements disclosed on its face. Such firms are likely to disclose the pending application, with a "patent-pending" mark, as a disincentive to competitors' copying, but otherwise rely upon the competitive restrictions embodied in the patent once issued and, more than likely, on complementary appropriability mechanisms such as lead-time to capture value from their invention.

Submarining describes a strategy sought by firms that possess incentives to prevent disclosure of their patent applications but not necessarily of the underlying technology. This strategy can be used to describe George Selden and his "Road Engine:" while Selden had substantial incentives to keep his pending patent buried secretly in the Patent Office for sixteen years, competitors were openly adopting and making complementary investments in Selden's invention. In fact, Selden was ultimately enriched by the *technological* information spillovers: as a consequence of the technology's adoption by automakers, Selden was likely able to demand higher royalties when he ultimately allowed his patent to issue. Had there been *application* disclosure, however, Selden may have seen his rents dissipate as competitors instead adopted competing technologies not covered by the Selden patent, or innovated in novel areas, thus reducing Selden's hold-up opportunities. An example of the *Submarining* strategy in the software sector can be found disclosed in the Rambus, Inc. litigation. Rambus, while disclosing technologies as member of the industry board setting DRAM chip-interface standards, kept the existence of its covering patent application secret. When Rambus finally allowed the patent to issue from the continuation application process, it claimed that competitors were infringing, prompting firms who also participated in the standard-

setting process—Hyundai Electonics, Infineon Technologies, and Micron Technology—to take Rambus to the court.

When technology secrecy is technically feasible and an objective of the firm, firm strategies are as described on the left-hand side of Figure 5a. Firms choosing to disclose the existence of a patent application to competitors while still enjoying secrecy over the discovered technology are described as pursuing an *Emptying* strategy. This strategy may be pursued to "clear the field" of potential innovators in a technology space. For products or processes with technological characteristics which make technology secrecy possible, a "patent pending" mark may introduce sufficient uncertainty into the marketplace to keep competitors from pursuing follow-on innovations. This uncertainty may take the form of market or technology uncertainty, but has the effect of making the net benefits from follow-on innovation less transparent to competitors, particularly given the existence of an as-yet-undefined patent in the technology space.

The last category displayed on the matrix, *Optioning* strategy, is enabled by high levels of both application and technology secrecy. In *Optioning*, firms may be taking advantage of the opportunity that its technology secrecy affords it to pursue follow-on innovations in the shadow of secrecy, while concurrently choosing to maximize the information asymmetries to competing firms by foregoing the "patent-pending" mark. Thus, the patent application may be an option taken-out by the firm to fix its priority of invention and ensure that rents may be captured from the early innovation within a larger strategy of technology—and application—secrecy as the optimal strategy chosen by the firm as a means of capturing value from the fruits of the technology trajectory, which the firms intends to own.

I frame these left-side strategies, *Emptying* and *Optioning*, within a broader context of sequential innovation, although these strategies may also have utility in preventing competitors from inventing-around an innovation by raising search costs. I argue that these strategies have more relevance when the innovating firm has embarked on a research agenda with the aim of securing valuable follow-on discoveries. I formalize the economics underpinning the innovating firm's decision by presenting the following simple two-firm model derived from Green & Scotchmer (1995).

Consider two products, the first with quality x and the second with quality $x + y$, such that the incremental improved-quality of the second is y. Assume that x and y are related to the consumer's willingness to pay such that the revenue to the monopolist producing the lead innovation is π_x and to the monopolist controlling also the follow-on innovation is π_{x+y}. The net benefits to the monopolist producing the first and second inventions are thus $\pi_x - c_1$ and $\pi_{x+y} - c_2$, respectively. The net benefits to firms producing these goods in competition are $\pi^c{}_x - c_1$ and $\pi^c{}_y - c_2$, and, by assumption, $\pi_x \geq \pi^c{}_x$ and $\pi_{x+y} \geq \pi^c{}_x + \pi^c{}_y$.

Considering the setting in which Firm 1 (F1) discovers x and Firm 2 (F2) discovers the improvement y, Figure 6 presents the sequence of decisions and payoffs. The schematic makes it apparent that, because $\pi_x \geq \pi^c{}_x$, F1 prefers to be at the left node when the game is completed, producing product x as the monopolist. It is thus in F1's interest that F2 foregoes innovation in y, and accordingly F1 can create disincentives for F2 by pushing F2's expected net benefits to $0 \geq \pi^c{}_y - c_2$. F1 can accomplish this

objective by driving F2's innovation costs c_2 upward or by depressing F2's expectations over its revenues π^c_y.

The strategies on the left-hand side of the matrix presented in Figure 5a present the firm with an opportunity to accomplish these objectives. Technology secrecy, by its nature, introduces uncertainty and information asymmetries into the innovation process on the technology path, having the effect of driving the costs of follow-on innovation upward for competitors. These costs may be magnified by the announcement of a "patent-pending" which introduces a hazard—with hidden and as-yet-to-be-determined boundaries—into the technology landscape.

By the same token, technology secrecy or the announcement of a "patent-pending" may serve to introduce uncertainty and thus lower a competitor's expected profits from the follow-on innovation π^c_y, thus lowering the competitor's net benefit from investing in discovery. Again, the technological characteristics of the invention will likely drive the choice of these available strategies: process discoveries may be particularly prone to the use of *Optioning* because information asymmetries may be heightened with these technologies veiled within the firm, while product discoveries, the existence of which will necessarily be known when marketed, may invite the use of *Emptying.* The most favorable outcome for F1 may indeed be to pursue the necessary investment in y itself, potentially enjoying a lower cost to innovation c_2' where $c_2 \geq c_2$' and the monopolist's revenue π_{x+y}.

While each of the continuation strategies displayed in Figure 5a requires the applicant to choose between patent protection and secrecy, these are not simply substitution strategies. The continuation in fact allows firms to choose strategies to realize overlapping benefits from secrecy, retaining all the protections available under trade secrecy (protected by law during pendency of the application) along with one important benefit—early priority—available to the first-in-time applicant to the Patent Office. By using the continuation, patentees gain benefits from both mechanisms, bypassing in some sense the classic *quid pro quo* demanded by the patent system, that innovators are awarded a monopoly in exchange for disclosure.

Thus, as in the case of the German dye manufacturers, firms using the continuation strategy today are using both patent and secrecy in a complementary fashion, albeit in a decidedly different manner than those early chemical firms. For firms pursuing a *Submarine* strategy, benefits are reasonably straightforward: they seek to capture rents from later-adopting firms that infringe the later-issuing patent. For other firms using the continuation strategy, benefits can be different, stemming instead from the different opportunities made available through technology and application secrecy. These may include an extended period of time in which to manage the burgeoning technology out of the light of day as a means of gaining competitive advantage over rivals, or even added time to secretly develop complementary capabilities or technologies upon which successful commercialization of the initial technology relies.[33] The foregoing allows the formulation of the following hypotheses:

[33] It may be, in fact, that the institutional structure of modern U.S. patent law may make the German dye firms' strategy difficult as compared to a continuation strategy that requires disclosure at some point in the patenting process. Arora (1997) points to the fact that the early German dye industry was operating under

H3a: Patentees are more likely to file a continuation application when operating in an industry that highly values secrecy as an appropriability mechanism.

H3b: Patentees are more likely to file a continuation application when the patentee demonstrates control over the technological trajectory.

3.2.3 Submarine Patents

I argue here that innovators pursue a continuation patenting strategy to protect an extended secrecy, thus allowing the innovator to capture added value from a technological improvement. The *Submarining* strategy used by George Selden in prosecuting his "Road Engine" can be viewed as an extreme form of this secrecy strategy.

Patents that issue after extended periods of continuation secrecy are often called "submarine" patents. A *Submarine* is as a pejorative term for a patent, like George Selden's, that combines extended secrecy with economic hold-up. The archetypical example of the "hold-up submarine" is a patent that, after having languished in the patent office for many years, is released into a marketplace in which competitors are extensively using the patented technology. The applicant has the opportunity to observe the technology develop over time and use the continuation process to subtly alter the claims of the pending application to fit the advancing technology—so long as no "new" matter is added in the process. When the applicant ultimately allows the submarine patent to surface, competitors may be held hostage to the owner of the fresh property right. Competitors using the technology may be willing to settle even in the face of a patentee's questionable claims to invention: the cost of extended legal battles—coupled with the risk of an injunction order suspending the firm's operations—may justify settling, regardless of the quality of the patentee's claim.

The matrix displayed in Figure 5a suggests that the *Submarine* strategy is reliant upon *application secrecy*, but that *technology secrecy* is not necessary, and indeed that disclosure may increase the likelihood of swift adoption by competitors, thus increasing the present value of future rent streams. By way of explanation, consider the following submarine strategy. Firm 1 (F1) applies for a patent on its discovery at time t_0 and thereafter uses the continuation application process to keep the application secret while other competitors Firms 2 and 3 (F2 & F3) adopt the technology at times t_1 and t_2. The continuation application process may be used by F1 to alter the wording of the claims to better capture the observed uses to which these later-adopters F2 and F3 are putting the technology in the marketplace, each ignorant of the pending patent due to the maintained *application secrecy* of F1. During the period after t_1 but prior to the patent's issue at t_3,

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an institutional structure that supported the maintenance of both patent and trade secret protection upon the knowledge underlying an invention. The patent law in the United States, however, requires the patent applicant to disclose the invention so as to "enable" one skilled in the art to make and use the invention. 35 USC 112 (2000). This "enablement" requirement limits the ability of a patentee to use both full-blown patent and trade secret protections for a single invention contemporaneously, thus increasing the value of using continuation practice for extending the period of pre-issue secrecy. This distinction suggests that, in the United States, continuation strategies are more likely to be characteristic of patent-secrecy strategies portrayed in Figure 3.

the adopters F2 and F3 may develop valuable follow-on technologies or deploy assets alongside the adopted technology, making specific investments that open them to hold-up by F1 when the patent issues and gives the patentee the right to exclude uses by the adopters throughout the patent term.[34] This situation is not fanciful, instead having been modeled after a real-world example of this type of submarine strategy: bar-coding patents that lay submerged for decades were used by patentee Jerome Lemelson to collect royalties from both semiconductor and automobile manufacturers in much the same manner as Selden had done with his "Road Engine" a century earlier.[35]

5. Data and Methodology

The data source used to identify patents issued at the end of a chain of continuations is the Micropatent Database. The data include 266,066 firm-assigned and continued patents during the period 1975-1994. Because this study is primarily aimed at understanding firm strategies, the sample of patents is restricted to those assigned to corporate entities—assigned patents not assigned to individuals or governments—following the definitions in Hall, Jaffe and Trajtenberg (2001). The sample is further restricted to include only patents issued prior to 1995 to correct for any effects of the 1995 amendments to the Patent Act which were intended to significantly alter the incentives for seeking the continuation application.

Information concerning continuation applications and associated dates is collected from a text field on the face of the patent document styled "Related Patent Data" by the USPTO. A "continuation" patent is defined as any patent containing the term "continuation" or "division" in this field.[36] Other information beyond the scope of the statutorily defined terms continuation and division is not contained in the "Related Patent Data" field. Information on a range of characteristics for both continued and non-continued patents was collected from the Micropatent Database, the NBER patent database (Hall, Jaffe, and Trajtenberg, 2001), Derwent Information, and the United States Patent and Trademake Office. Data is generally available on the range of patent-based measures beginning in 1975. My data includes 1,258,880 issued patents assigned to entities during the period 1975-1994.

The unit of analysis in this study is an issued United States patent. Many studies have used the issued patent as a unit of analysis despite the fact that inventive activity is the phenomenon of interest. In this study, I am principally interested in patenting behavior, not inventive activity, and so the unit of analysis is appropriate. I note at the outset that any decision to seek a continuation is contingent upon a decision to apply for

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[34] The institutional set-up dictating the rules of the game to the adopters prior to the issue of a patent are important to consider. In Figure 1, the uses of the patented technology prior to t_3 are "free" to 1st User and 2nd User because the t_3 patentee is precluded from collecting rents from uses prior to the issue of the property right. Furthermore, in the event that an adoption later than t_0 but prior to t_3 is accompanied by an application for patent by 1st User or 2nd User, an attentive Patent Office is likely to adjudicate the dispute over priority and rights to the patent on the innovation in an "interference" proceeding. The "interference" would give both parties notice of the other applicant's disclosure, with the result being a conclusion that one of the applicants has actual priority-in-time and, thus, is entitled to the patent.

[35] *Id.*

[36] By including the term "continuation," "continuation-in-part" patents were also captured.

the patent, although the availability of the continuation as an option may effect the likelihood of the initial decision to apply for the patent. Moreover, the availability and benefits of secrecy protection, as well as the perceived stance of the Courts and the Patent Office as regards patentability, may bias the types of patents that make their way into the system.

5.1 Accidental Continuations: Hypotheses 1a and 1b

I begin the discussion of independent variables by discussing those associated with asymmetric information, namely AGE, and ORIGINALITY. The variable AGE is constructed by measuring the average age of the citations contained on the face of an issued patent. AGE is considered a proxy for the age of the technology underlying the patented invention (Lowe, 2001). This measure proxies for uncertainty in that "newer" technologies are likely to be characterized by greater uncertainty than are older, more established technologies. The variable ORIGINALITY proxies for the range of technologies with which the inventor and examiner must be familiar in order to understand the disclosure. This variable was first given by Trajtenberg, Jaffe, and Henderson (1997) and is the Herfendahl concentration index giving the percentage of citations made by a patent that belong to a breadth of different classes. A high value in ORIGINALITY demonstrates that the patents cited by patent *i* belong to a wide range of patent classes, and are said here to be indicative of higher complexity.

5.1 Strategic Delay: Hypotheses 2a and 2b

I test for continuations used as a mechanism for strategic delay by using a definition of "complex" and "discrete" technologies following Kusonaki, Nonaka, and Nagata (1998). Cohen et al. suggests that the key distinction between these two types of technologies is whether the new commercializable product is composed of many—"complex"—or few—"discrete"—patentable elements. Archetypal examples of complex and discrete industries are electronic products and chemicals, respectively. In "complex" product industries, firms are less likely to control the patents covering all the complementary components, and thus are more prone to cross-licensing negotiations than are firms producing "discrete" products. I operationalize this distinction by coding patents by sector: Drugs/health (DH); Chemical (CH); Electronics (EL); and Mechanicals (ME). The sector indicators are dummies after Lanjouw and Schankerman (1997), defined as follows: Drugs & Heath, International Patent Classes (IPC) A61 and A01N; Chemicals, IPC A62, B31, C01-20, D; Electronics, IPC G01-21, H; and Mechanical, IPC B21-68 except B31, C21-30, E01-F40. Drugs & Health and Chemicals will, following Kusonaki, Nonaka, and Nagata (1998), proxy for discrete technologies, while Electronic and Mechanical will proxy for complex technologies.

The definition of "low-quality" patents is problematical, due to the fact that the available indicators of value are latent. I propose to use the forward citation measure which has been shown to correlate with other indicators of value (Lanjouw and Schankerman, 1997; Hall, Jaffe, and Trajtenberg, 2000). I code the patent data by assigning patents to one of three categories: those patents that received fewer than the mean number of citations in each of the broad industrial sectors (Drugs, Chemicals, Electrical, Mechanical) in a five-year forward window measured from the issue date (F01,

patents receiving either zero or one forward citation); those patents receiving more than the mean number of citations in each of these broad industrial sectors for the identically-defined window (F4mo, patents receiving four or more forward citations); and all other patents (F23, patents receiving either two or three forward citations). The first and second measures are intended to proxy for low-quality and high-quality patents, respectively. I am cognizant that this proxy is likely to contaminate the sample by introducing some valuable patents with long latency periods. I will test for Hypothesis 2b by determining whether low-quality patents are more likely to show a continuation application lineage, *ceterus paribus*, in "complex" product industries than in "discrete" product industries.

6.2 Secrecy Continuations: Hypothesis 3

To test for complementarities between patenting and secrecy, I rely principally upon the responses in the Carnegie-Mellon Survey (CMS) (Cohen, et. al, 1997) as an indicator of the importance of secrecy in various sectors. Because the CMS elicited responses only from R&D managers at firms, my assigned-patent restriction is again appropriate. A "firm" patent is defined by reference to the NBER database, using codes that limit the sample to patents assigned to non-governmental organizations, a definition that tends to include some organizations that are not corporations. These defined "firm" patents comprise 78.4% of all patenting 1963-99 (Hall, Jaffe, and Trajtenberg, 2001).

The CMS was limited to industries in 34 separate ISIC codes. From the population of firm patents, I truncated on the right for patents issued after 1994 to allow me to construct measures consistently and also to mitigate the effects of the 1995 regime change on firms' patenting behavior. Between 1975 and 1994, a total of 266,066 patents have been issued showing some use of continuation practice in their application lineage. Issued patents are coded "continued" if the Micropatent Database shows at least one continuation, continuation-in-part, or division in the patent's application lineage.

I will conduct a multivariate test that permits me to test for the existence of complementarities between patenting and secrecy in continuation practice while also allowing me to incorporate other independent variables. I test for the effects of firms' valuing secrecy as an appropriability mechanism on the likelihood of a patenting firm using the continuation process while, concurrently, considering asymmetric information and strategic delay explanations for increased likelihood of continuation use. I specify a binomial logit model, in which the dependent variable CDCIP=1 if the issued patent shows either a continuation, a division, or a continuation-in-part in its application lineage, and CDCIP=0 otherwise.

Accordingly, I let $y^* = X_i\beta + \mu_i$ where y^* is the latent variable reflecting the decision to employ the continuation application procedure. A continuation will thus be observed when $y^* > 0$ but not when $y^* \leq 0$. Using standard assumptions for μ_i allows me to specify a logit model. Firm decisions to file more than one continuation on a single issued patent are treated identically to those in which we see a single continuation being filed.

I construct a set of independent variables from the CMS associated with my theory on complementarities between patenting and secrecy. I use the variable SELFCT as a measure of the percentage of forward citations made by patent *i* to patents assigned to

the same assignee. This measure proxies for the patent holder's control over the technological trajectory and is indicative of the patentee's exclusion of competitors from the technology path on which patent *i* lies. My principal measure indicating the importance of secrecy as an appropriability mechanism to individual patentees is derived from the CMS (Cohen, et al. 1997) and styled SECRET. The variable SECRET is constructed using the responses reported in the CMS, matching individual patents to the 34 ISIC codes used as the basis for classification in the survey. Patent-ISIC matching was performed using the Statistics Canada-based concordance produced by Brian Silverman (1994). While Silverman used a distribution of international-patent-classed (IPC) Canadian patents to match with USSIC codes, the CMS grounding in the ISIC required me to back out the Silverman concordance and match these IPC-assigned patents instead to the ISIC. For this purpose I used the NTIS CSIC-ISIC concordance available from the United States Commerce Department.

6. Results

TBD [Tables 1, 2, 3, 4 about here]

7. Conclusion

TBD

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Figure 1: Schematic, Continuation, Division, and Continuation-in-part procedures

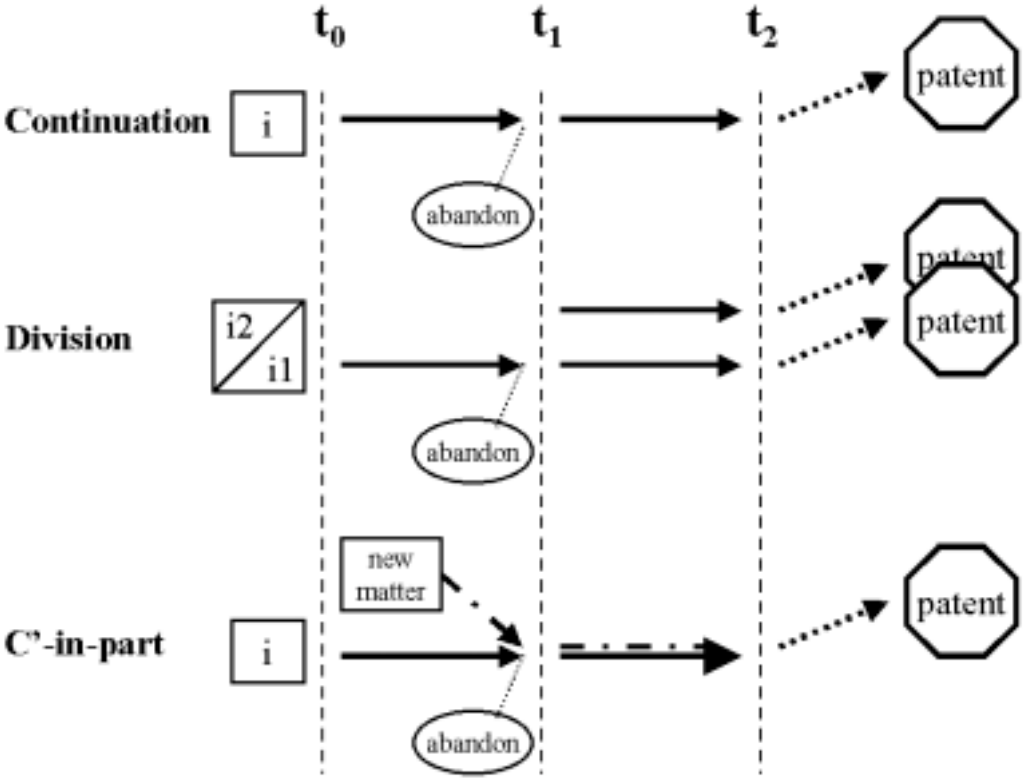

FIGURE 2: United States Issued Patents, 1975-1994

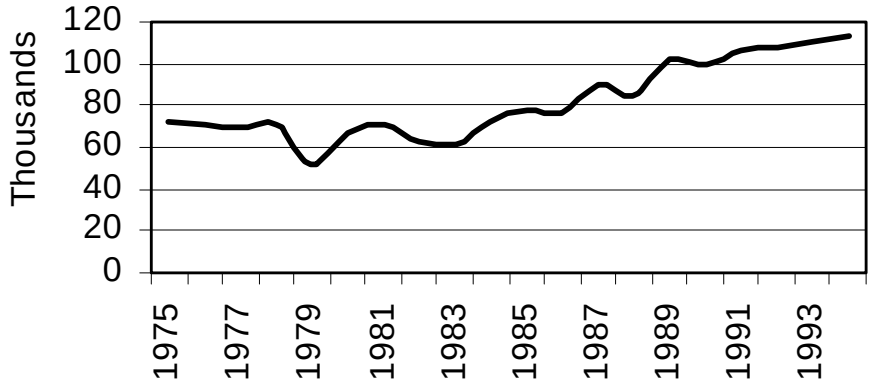

FIGURE 3: Continuation patents, share of all issued patents, 1975-94

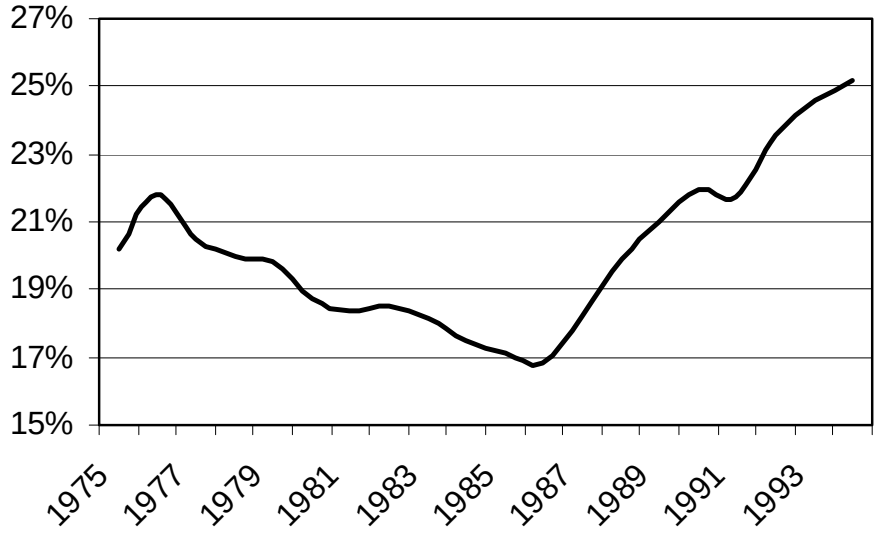

Figure 3a: Issue lags, Non-continued and Continued patents, 1975-94 (in years)

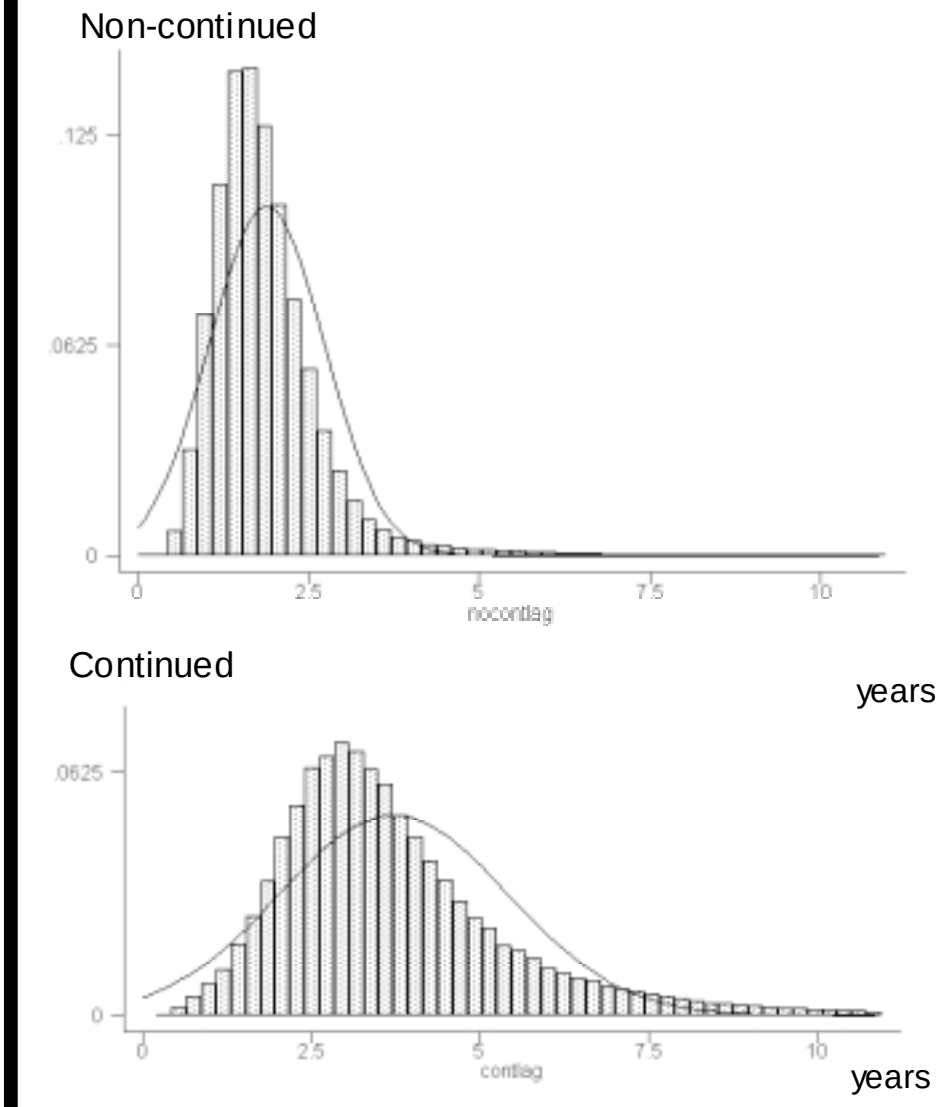

FIGURE 4: Schematic of Continuation Patenting Process

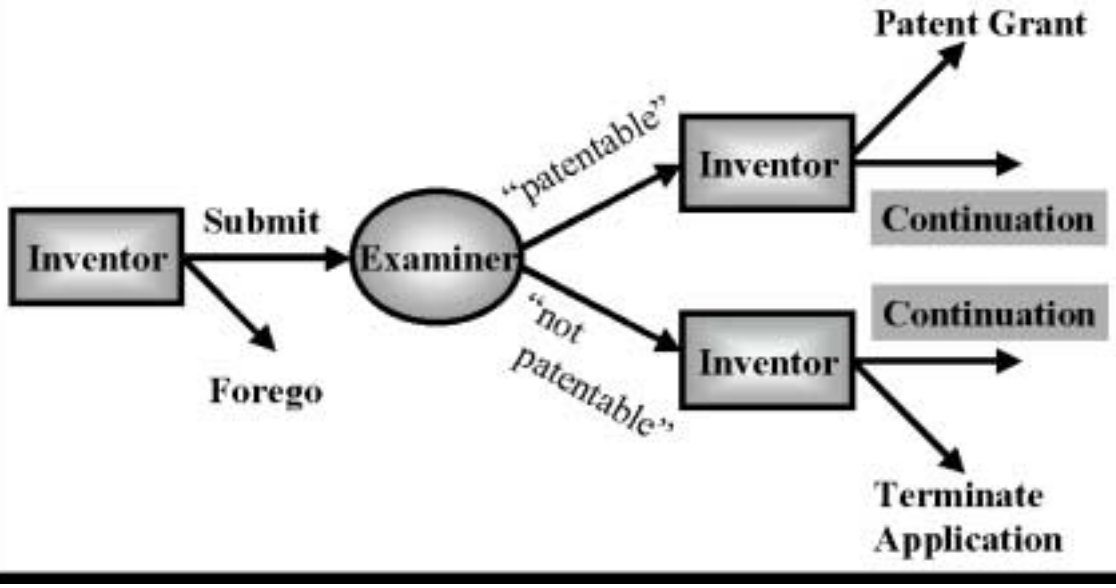

FIGURE 5: Uses of Patenting and Secrecy

	Patent	Not Patent
Secret	Patent–Secrecy Strategies:	Pure Secrecy: Trade Secrets - perpetually undisclosed - processes
Disclose	Pure Patenting: Quick-to-market - products - reverse-engineering - readable on-its-face	Publish: - little value - unprotectable - blocking

Figure 5a: Technology/Application Secrecy

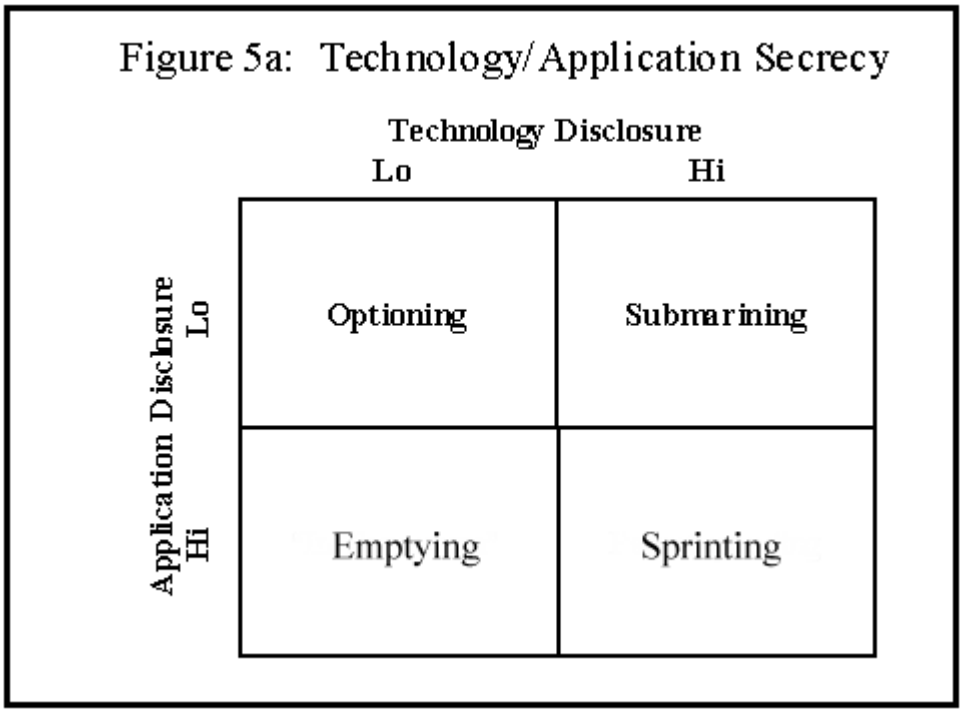

Figure 6: Profits from Sequential Innovation