Submarines in Software? Continuations in U.S. Software Patenting in the 1980s and 1990s

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Abstract:
This paper examines the role of “continuations” (procedural revisions of patent applications) within software patents and overall patenting in the United States during 1987-99. Our research represents the first effort of which we are aware to analyze data on continuations in software or any other patent class, and as such provides information on the effects of 1995 changes in the U.S. patent law intended to curb “submarine patenting.” Our analysis of all U.S. patents issued 1987-99 shows that the use of continuations grew steadily in overall U.S. patenting through 1995, with particularly rapid growth in continuations in software patenting. Sharp reversals in these growth rates after 1995 suggest that changes in the U.S. patent law were effective. Continuations were used more intensively by packaged-software firms prior to the effective date of the 1995 changes in patent law than by other patentees, and both software and non-software patents subject to continuation tend to be more valuable.

Keywords: Patents, Software, Continuations, Submarine Patents, Intellectual Property Strategy

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1 INTRODUCTION

Research in “knowledge management” has grown significantly during the past few years in the study of innovation. An important part of “knowledge management” involves firms’ protection of knowledge assets, and firm strategies for the use of patents accordingly have received increased attention. But this research has devoted little attention to the ways in which the characteristics of national patent systems and the characteristics of specific fields of technological innovation interact in the development and implementation of firms’ patent strategies. Moreover, few studies have examined the operation of national patent systems in novel areas of technology that have little well-defined “prior art” but are cumulative, meaning that innovation in a given area is closely linked with other areas and prior generations. Since patent-based prior art is scarce in such areas, patent offices face difficulty in evaluating the “novelty” and “obviousness” of patent applications. Inventors and entrepreneurs in such industries confront an environment of high uncertainty in which the artifacts on which they rely for their innovations may unexpectedly obtain patent protection, thus exposing them to litigation and the invalidation of their patents.

Computer software is an excellent example of a field of innovation in which patenting, particularly in the United States, has grown rapidly in recent years (Graham and Mowery, 2002) despite the fact that the underlying “technology” is several decades old. As we note below, much of this increased patenting reflects changes in industry structure and in U.S. policy toward software patents that have increased the economic value of patents. This paper builds on earlier work on software patenting (Graham and Mowery, 2002; Graham et al., 2002) that analyzed growth in such patenting during the 1980s and 1990s. By focusing on the role of “continuations” (procedural revisions of patent applications) within software and overall U.S. patenting during the 1980s and 1990s, we hope to shed additional light on the causes of the growth of U.S. software patenting. This research also represents the first effort of which we are aware to analyze data on
continuations in software or any other patent class, and as such provides some information on the
effects of the 1995 changes in U.S. patent law that sought to reduce the use by inventors of
“submarine patents.”

2 GROWTH IN SOFTWARE PATENTING

2.1 Causes

Change in the structure of markets for computer software in the U.S. and global economies since the early 1980s has increased the economic importance of formal instruments for protection of software-related intellectual property (Mowery, 1999; Graham and Mowery, 2002). For much of the short life of the computer industry, computer software was custom-designed for a given machine and application by the manufacturer of the hardware or by the user, thus limiting the importance of intellectual property protection. Only during the 1970s did independent software firms begin to play a significant role in developing and marketing “standard” software for mainframes and minicomputers. With the development and widespread adoption of the desktop computer in the early 1980s, a large and rapidly growing market for “packaged” computer software emerged that exhibited few if any of the “custom-engineering” characteristics of the products in other segments of the software industry. Instead, packaged software markets more closely resembled those for entertainment or books, in which “hits” were extraordinarily profitable. The growth in markets for packaged software meant that formal protection of the intellectual property contained in the packages was of much greater importance.

2.2 The evolution of intellectual property protection in the U.S. software industry

In 1980, the United States Congress selected copyright as the appropriate protection for computer software (Samuelson, 1984). A series of federal court decisions during the late 1980s and early 1990s initially strengthened, and then weakened, the power of copyright to protect intellectual property in packaged software. These shifts in the judicial treatment of copyright, along with a supportive decision from the U.S. Supreme Court upholding the patentability of
software (Diamond v. Diehr), led software developers to expand their use of patents in the
1980s. The economic value of these patents was highlighted in several high-profile cases during
the 1990s, including the 1994 Stac Electronics decision that found Microsoft guilty of patent
infringement. As the USPTO adopted a more favorable posture toward applications for software
patents, the ability of patent examiners to identify “novelty” in an area of newly patentable
subject matter was criticized, well before the criticism surrounding the surge of “business
methods” software patent applications in the late 1990s.

2.3 Trends in software patenting, 1987-1997

In earlier work (Graham and Mowery, 2002), we showed that software patenting by both
packaged-software “specialists” and electronics system firms in the United States grew
significantly after the mid-1980s in the face of a decline in the use of copyright protection for
software. There are at least two broad explanations for the rapid growth in software patenting
during this period. One interpretation argues that increased patenting, especially by large firms
such as Microsoft and IBM, reflects the growing importance of “defensive patenting.”

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4 93-0413 (S.D. Cal. decided Feb. 23, 1994).
5 Lacking a clear a priori definition of “software-related” patent classes, we focused on the following
eleven main groups in the International Patent Class classification scheme:

**G06F**  Electric Digital Data Processing:
3/ Input arrangements for transferring data to be processed . . .
5/ Methods or arrangements for data conversion . . .
7/ Methods or arrangements for processing data . . .
9/ Arrangements for programme control . . .
11/ Error detection; Error correction; Monitoring . . .
12/ Accessing, addressing or allocating within memory systems or architectures . . .
13/ Interconnection of, or transfer of information or other signals . . .
15/ Digital computers in general . . .

**G06K**  Recognition of Data
9/ Methods or arrangements for reading or recognising printed or written characters . . .
15/ Arrangements for producing a permanent visual presentation of the output data

**H04L**  Electric Communication Technique
9/ Arrangements for secret or secure communication

Since they exist throughout the 1984-97 period, these patent classes provide a useful basis for examining
time trends in U.S. software patenting. They do not cover all software patents, but they do provide
imperfect but reliable longitudinal coverage of the segment of the overall software industry. The share of
all U.S. patents accounted for by patents in these IPC groups more than doubled during 1987-97, from
1.7% in 1987 to 3.8% in 1997. See Graham and Mowery, 2002.
Competing firms seek patents less to support the commercial development of specific invention than as a means of avoiding costly litigation (See Hall and Ziedonis, 2001 for a discussion of “defensive patenting” in semiconductors). “Defensive patenters” apply for a large number of patents for exchange in cross-licensing agreements thus preserving their “freedom to innovate.”

But growth in software patents alternatively might reflect a decline in the rigor of USPTO review of the increased number of software-related patent applications that followed the changes in the legal treatment of software patents. Lacking patent-based prior art to guide their evaluation of a much larger flow of applications, USPTO examiners may issue low-quality patents. Both of these explanations suggest that the “quality” of software patents should have declined during the 1980s and 1990s. But the “defensive patenting” explanation predicts that the patents assigned to large software firms should exhibit particularly significant declines in quality, whereas the “weakened review” explanation predicts an across-the-board decline in the quality of all issued software patents.

In earlier work, we found no evidence of a decline in “quality” in major software firms’ software patents.\(^6\) This finding may mean that defensive motives are not driving the patenting behavior of these firms, if one assumes that such defensive patents are on average less “important” than those issuing to other patentees. To probe the implications of this finding, we extended our analysis of the causes of increased software patenting by analyzing the use by software-patent applicants of “continuations.”

\(^6\) Graham and Mowery (2002) analyzed trends in citations to the software patents obtained by our sample of packaged-software specialists and electronic-system firms, focusing on the possibility that the expansion in patenting might have been associated with the issue of patents that obtained fewer “forward citations,” relative to other software patents. We found no evidence of a decline in the relative intensity with which these firms’ software patents were cited by other software patents in the 1987-97 period. This evidence must be treated with caution—it is possible, for example, that “forward citations” to all software patents are declining during this period, perhaps in reaction to the lessened rigor of USPTO of all applications in this area, and the patents assigned to these firms simply declined by a smaller amount.
2.4 Continuations in Software Patenting

The continuation is a procedure available under U.S. patent law that permits an applicant to re-file a pending patent application. So long as the original “parent” application and the follow-up continuation application disclose the same invention, the applicant can preserve the parent’s filing date. Since an application may be freely continued and there is no limit to the number of times that a parent application may be abandoned, the continuation process can be used to prevent a patent examiner from reaching a decision to issue or deny issuance of a patent. In extreme situations, strings of continuations have led to postponements in USPTO decisions on an application for decades. Prior to 1999, all U.S. patent applications remained secret until the issue of the patent, and an applicant thus could maintain the secrecy of their invention and application throughout this extended period. The continuation is unavailable in other industrial nations’ patent systems, including those of Europe and Japan.

Revisions in U.S. patent law effective in 1995 changed the term of patent protection from 17 years from the date of patent issue to 20 years from the date on which the application was filed. These legislative changes sought to reduce the incentives for inventors to pursue so-called “submarine” patents. An inventor seeking a “submarine” patent submitted an application, thereby establishing a priority date for his application, and filed numerous continuations on the initial application, which remained secret throughout the period of USPTO review of repeated revisions (“continuations”) in the original application. The long-hidden patent, which prior to June of 1995 was valid for 17 years from its date of issue, would issue covering technologies in widespread

8 The use here of “continuation” includes also the “continuation-in-part” and the “division.” The former procedure allows a subset of all claims to be continued, instead of the entire application. The “division” allows an applicant to “elect” a single invention to pursue from an application with multiple disclosures, delaying processing of those remaining.
9 Jerome Lemelson’s U.S. patent 5,283,641 was issued February 1, 1994 but the priority date of this patent was December 24, 1954. There were eleven continuations and divisions in this patent’s application chain and it was examined—and thus remained undisclosed—in the USPTO for almost 40 years.
10 Although Europe allows a divisional application.
industrial use. After 1995, continuations still offered some strategic benefits to an applicant by allowing an extended period of secrecy prior to issue of a patent, but even this benefit was reduced by 1999 legislation mandating the publication of most patent applications 18 months after submission.

2.5 Other strategic uses of continuations

Quillen and Webster (2001) propose an alternative motivation for the use of continuations by applicants, arguing that continuations are used to “wear down” an examiner and lead him or her to allow a patent of dubious merit to issue. If Quillen and Webster’s characterization is accurate, a large share of continuations in a given technology field’s patents may indicate an unusually high incidence of “low-quality” patents. But continuation applications may be more common in new technologies simply because neither applicant nor examiner understand the prior art or the interpretation of novelty and non-obviousness requirements. Significant information asymmetries between examiner and applicant can thus produce a larger share of continuations in patenting within a given field.

3 RESEARCH QUESTIONS

Especially prior to 1995, some inventors used continuations to extend the period of secrecy associated with their patent applications. And there are celebrated cases of the use of continuations to create and exploit such “submarine” patents in the software field before 1995. But the overall importance of such continuations before 1995 in software and the effects of the statutory changes that took effect in 1995 on the incidence and characteristics of continuations in

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11 When these inventions were covered by patents applied for after the priority date established by the original “submarine” application, the owner of the original patent might pursue infringement actions against other late-filing patentholders.
12 The U.S. patent law now requires the publication of all applications after 18 months, but applicants are granted exemptions from this requirement upon declaring no intention to file the application in a foreign jurisdiction that requires the 18-month publication of its local patent applications.
13 According to Quillen and Webster, the USPTO compensation system creates incentives for examiners to decide on patent applications quickly. An examiner confronting numerous continuations from an applicant may elect to issue the patent rather than face prolonged delays in resolving the application.
these fields of patenting have not been examined. We address the following questions in our analysis of continuations in software patenting:

1. How does the share of continuations in issued software patents compare with this share for all patents before and after 1995?

2. How does this share differ among leading packaged-software firms before and after 1995?

3. Do issued software patents subject to continuations differ in terms of their forward citations (a measure of the “importance” of these patents) or their probability of litigation?

We hope that the examination of these questions will shed additional light on the effects of the 1995 changes in U.S. patent law and on the relative importance of strategic motives and field-specific uncertainty on the growth in U.S. software and biotechnology patenting since 1985.

[ Figure 1 about here ]

3.1 Data on continuations in software and non-software patents, 1987-99

We computed the incidence of continuations as the shares of all U.S. software patents and non-software patents issuing each year during 1987-1999 that had at least one continuation in their application lineage and plotted these with continued patents in all other technology classes (Figure 1). Continuations account for roughly 18% of all issued patents in 1987, climbing to a peak of 28% in 1997 and declining to roughly 21% in 1999. The downward trend in the share of non-software continuations after 1997 likely reflects the fact that such patents issuing in this year

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14 Defined in note 3, supra.
15 These 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 Figure 1 are based upon issue date rather than upon application date because under continuation practice, the recorded application date for what is essentially the final application in a chain of continuations is a somewhat artificial measure. Issue dates are a more meaningful metric of the use by patentees of the procedure because the issue date is one over which the applicant exercises somewhat more control than in the “normal” single-application patent case, by virtue of their use of the continuation procedure. We note that there will always be a certain amount of uncertainty
and subsequently are the first to reveal the effects of the 1995 changes in U.S. patent law.

Figure 1 also displays trends in continuations within issued software patents, highlighting some interesting contrasts. Continuations were less common in software patenting than in overall patenting during 1987-92; 11-20% of patents issuing each year included at least one continuation. After 1992, however, the incidence of continuations in software patents grew to levels exceeding those in overall patenting. By 1996, continuations accounted for nearly 40% of all issued software patents, substantially above the share (27%) within all patents in that year with continuations. The incidence of continuations in software patenting declined after 1996 more rapidly than in overall patents, and the shares in the two categories (20%) are essentially equal by 1999. The post-1997 decline in the share of continuations in U.S. software and non-software patents suggests that the 1995 legislation reversed growth in continuations within overall U.S. patenting, although the share of continuations has been reduced only to levels roughly equal to those observed in the mid-1980s.

The rapid growth in software-patent continuations during the early 1990s to rates exceeding those for non-software patents remains surprising. In an industry such as software, where short “time to market” for new products is critical to competitive performance and product lives are short, the secrecy and delays made possible by continuations appear to be of little economic value. The combination of rapid growth in patenting and high levels of continuation practice in software patenting during the 1990s thus may reflect the operation of the “attrition strategies” proposed by Quillen and Webster, information asymmetries in applicant/examiner negotiations over the validity of software patent applications, or frequent revisions in their patent

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16 The low rates of continuation in software patenting during the 1987-92 period may reflect the fact that our measures of continuations necessarily lag trends in patent applications by at least 2-3 years. Continuation trends for the 1987-92 period therefore reflect patenting practice during the early to mid-1980s, a period of relatively modest rates of patenting in software. But we note that continuations grow as a share of software patenting during the period of rapid growth in such patenting by software and electronic systems firms (Graham and Mowery, 2002).
applications by corporations (primarily the packaged-software firms) with little experience in patenting. Alternatively, firms may be using patents to protect foundational technologies that underpin several product generations. For these technologies, the delays in patent issue and prolonged secrecy associated with continuations may provide important competitive benefits.

[ Figure 2 about here ]

We also analyzed the patenting and continuation practices of the four largest patentholders among the leading specialized U.S. producers of packaged software, Microsoft, Adobe Systems, Novell, and Borland International (now Inprise).\textsuperscript{17} Figure 2 displays the share of continuations in the patents assigned to each of these firms during 1991-1999 (as three-year moving averages).\textsuperscript{18} Microsoft, which has the largest number of software patents among these firms, displays a relatively flat continuation rate that ranges between 24\% and 31\%. Adobe Systems and Novell present interesting contrasts, since Adobe has increased its use of continuations in patenting practice and Novell has markedly reduced the use of continuations. Indeed, Novell’s use of continuations declined during the period of significant growth in its overall patenting and patenting propensities (Graham and Mowery, 2002). Borland International (Inprise) exhibits a significantly higher propensity to patent (Graham and Mowery, 2002) and a significantly more intensive use of continuations in its patent applications than its competitors after 1994. This trend may reflect the firm’s unhappy experience in litigation.\textsuperscript{19}

[ Figure 3 about here ]

3.2 “Long chain” software continuations before and after 1995

In order to further examine potential strategic motives for the use of continuations by software patentees, we examined the share of software patents that were the subject of more than

\textsuperscript{17} As reported in the Softletter100 for 1997, a trade publication.
\textsuperscript{18} We used the 1991-1999 period for this analysis because patenting was virtually absent in these firms prior to 1991.
\textsuperscript{19} Borland International was party in the 1980s and 1990s to a series of high-profile court actions against Lotus Development, these two software firms contesting the originality of their spreadsheet programs Quattro Pro and Lotus 1-2-3, respectively.
one continuation application from 1987-99. “Submarine patent” strategies are more likely to produce multiple continuations, inasmuch as repeated continuations afforded the most reliable means of prolonging the period of secrecy without jeopardizing the patent’s priority date during the pre-1995 period. The data plotted in Figure 3 indicate that during 1987-97, the share of these “multiple” continuations in software patenting increased from 2% of all software patents in 1987 to 11% by 1997. By 1999, however, the share had fallen to 5%, a drop that may reflect the disincentives for continuations introduced by the 1995 Act.

U.S. packaged-software firms expanded their use of multiple-continuation patent applications during the pre-1995 period and reduced such applications after 1995. The post-1995 decline in multiple continuations within software patenting suggests that strategic or “submarine” motives may indeed have figured prominently in software-patent continuations during the pre-1995 period. These and other data also indicate that the 1995 changes in U.S. patent law likely reduced the payoff to patent continuations sufficiently to curtail their use by software patentees.

3.3 The “importance” and “originality” of software patents with continuations: citations and litigation data

In earlier work, Johnson and Popp (2001) analyzed the relationship between patent “importance” (measured as the number of citations to the patent by subsequent patents) and the length of time elapsed between the application and issue of the patent, concluding that longer-pendency patents are more heavily cited. Grant lags of up to five years are associated with significantly higher numbers of citations to the issued patent, and the greatest marginal effects in citations occur for an increase in pendency from two to three years. Since Johnson and Popp do not explicitly control for continuations, it is not clear whether the long pendency lags associated with highly cited patents reflect continuations or other influences. In addition, information on the characteristics of continued patents may shed additional light on motives for and effects of continuations. Accordingly, we compared the “importance” of software patents with
continuations against that of software patents with no continuations, utilizing two measures of importance: forward citations and the incidence of litigation following the issue of the patent.

The number of citations to a patent made by other patents after the original patent’s issue (hence the term “forward citations”) is one measure of patent importance. A number of studies suggest that more highly cited patents tend to be more economically and technologically important (Trajtenberg, 1997; Hall, Jaffe, and Trajtenberg, 2000). Moreover, Lemley suggests that costly patent litigation is more likely for economically valuable and/or “important” patents (2001), and other empirical studies conclude that the likelihood of litigation is significantly correlated with increasing incidence of forward citations (Lanjouw and Schankerman, 1997).

For patents issuing during the years prior to the 1995 policy change (1987-94), we find that software patents with continuations are cited significantly more frequently than those with no continuations.20 This higher rate of forward citations for patents with a continuation history is attributable mainly to patents with a string of less than five continuations in their application lineage: patents with five or more continuation applications attracted significantly fewer forward citations than those with no continuations.21

Our analysis of citations also examined the “originality” of continued and non-continued software patents, using the originality measure first proposed by Trajtenberg et al. (1997) as a proxy for the technological scope of a patent. The measure is based on a Herfindahl concentration index of the technology classes included in a patent’s backward citations, and provides an index of the “breadth” of the fields of knowledge on which a patent draws (Hall et

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20 At the 95% level of confidence, using a standard paired difference statistical test. Continued patents attracted 0.97 citations per patent during the first two years following issue, while those with no continuation attracted 0.92 citations during the same window. We employ a 2-year forward window to avoid truncation bias that would otherwise depress citations received by more recently issued patents. Because we wish to include as many recent patents as possible (especially those with application dates after the June 1995 effective date of the legislated changes in patent term), we employ a relatively short forward window, rather than the 5- or 6-year window employed in other work. We also exclude self-citations from this analysis.

21 These long-chain continuation patents attracted 0.59 citations during the two year window.
al., 2001). Patents with higher “originality scores” draw on a greater breadth of existing technological fields, and therefore may represent more novel technological advances. Analysis of software patenting during the 1987-94 period reveals significant differences in the originality score for patents with and without continuations. Although non-continued software patents show a mean originality measure of 0.44, continued patents exhibit a significantly higher mean originality score (0.50). These statistically significant differences hold for all years in our sample, and thus are not driven by a change in citation practices during the period covered by our analysis. Moreover, patents with longer continuation histories tend to have higher “originality” scores.

These results suggest that patents with longer continuation histories draw on a wider array of technologies and therefore may indeed display higher levels of both “newness” and complexity, but the results must be interpreted with caution. It is possible, for example, that the more prolonged and repeated reviews of continued patent applications by the applicant, the applicant’s agent, and the patent examiner may lead to the revelation of additional “prior art.” If this additional patent-based prior art comes from a more diverse array of technology fields, a higher originality score would result.

Finally, we used litigation data from Derwent to compare litigation rates for software patents with and without continuations. Figure 4 plots the litigation rates in 1987-99, by issue year, for software patents with and without continuation applications in their lineage, and all other non-software patents. We restricted this analysis to patents that had been assigned to firms in order to minimize the effects that of litigious individual inventors—particularly those pursuing submarine

22 The measure is computed as follows:

\[ \text{Originality}_i = 1 - \sum_{j=1}^{n_i} s_{ij}^2 \]

where \( s_{ij} \) is the percentage of citations made by the patent \( i \) that belong to patent class \( j \) from \( n_i \) patent classes (Hall, et al. 2001).

23 At the 99% level of confidence, using a standard paired difference statistical test.

24 The mean originality scores for a patent with one, two, and three or greater continuations in its application lineage are 0.50, 0.53, and 0.55, respectively, significant at the 99% level of confidence using a standard paired difference statistical test.
strategies—on our results. Litigation appears to be much more common in this analysis for software patents than for non-software patents, regardless of continuation status. Litigation rates approach 35 per 1000 patents among non-continued software patents in 1991, well above a peak of less than 10 per 1000 patents in all other technologies in 1992-3. The litigation rate for continued software patents is even higher, peaking at nearly 70 suits per 1000 patents in 1991, and is higher than that for non-continued software patents during 1990-99. Clearly, software patents with a continuation lineage are particularly prone to litigation.

Overall, the results of the analysis of litigation data are consistent with those for patent citations—patents with continuations tend to receive more citations, they tend to drawn on a broader range of patent classes in their own “backward” citations, and they are subject to higher litigation rates. But caveats are in order for the litigation findings as well: We cannot exclude the possibility that continued patents are more likely to be the subject of litigation simply because of the widespread use by “submarine” patentholders of litigation, rather than because of some intrinsically greater technological or economic importance of these patents.

4 CONCLUSION

Continuations in the U.S. patent system have received virtually no attention in scholarly research on patent strategies, in spite of their occasional use for “submarine” patent strategies. Our exploratory analysis of the use of continuations in U.S. software patents focuses on the 1980s and 1990s, a period during which patents assumed greater importance in the innovation strategies of software firms. Continuations grew rapidly as a fraction of total software patenting during the early 1990s, when software patenting was growing. The simultaneous growth of the use of patents and continuation applications in the software field may reflect increased use by applicants of continuations as a response to uncertainty over the standards employed by examiners in dealing with a relatively new area of patent activity in a field with limited patent-based prior art.

The changes in U.S. patent law that became effective in 1995 appear to have reversed the rapid growth in continuations in both software and non-software patent classes. The sharp
reversal in the growth trend for continuations suggests that the expanding use of continuations in the early 1990s in both software and non-software patent classes was influenced by various forms of “submarine” patent strategies. Inasmuch as these legislative changes were justified in part as a way to discourage submarine patenting, they appear to have been successful. Nonetheless, the reversal in the growth of continuations has not eliminated continuations, instead reducing their share in both software and non-software patents to levels observed in the late 1980s.

Our results are intriguing but do not support strong conclusions about the motives for and effects of the rapid growth in patenting within the U.S. computer software industry during the 1980s and 1990s. There is some evidence that continuations were used by packaged-software firms more intensively than by patent applicants in other fields during the pre-1995 period, but we are not able to determine whether this relatively intensive use of continuations reflected asymmetries in information or expectations between applicants and patent examiners rather than the conscious use of secrecy-lengthening “submarine” patent strategies. Our evidence on litigation and citations suggests that patents subject to continuations also tend to be more “important,” but this finding is not dispositive with respect to an interpretation of the causes of continuations in patenting. A fuller analysis of the role and motives for continuations will require expanded analysis of their importance over time in a more diverse sample of patent classes.
Bibliography


FIGURE 1
Continuation patents as a share of issued patents, software patents compared with all other patents, 1987-1999

FIGURE 2
Continuation firm-patents as a share of all issued firm-patents, top patenting packaged-software firms (Microsoft, Adobe, Novell, Borland), 3-year moving average, 1991-1999
FIGURE 3
Continuations in software patents, shares of single (1) and multiple (2+) continuations in application chain, 1987-99

FIGURE 4
Litigation rates for assigned patents, by issue year, comparing continued software patents, non-continued software patents, and all non-software patents, 1987-99 (3-year moving averages)