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ABSTRACT

The continuations procedure within the U.S. patent system has been criticized for enabling firms to manipulate the patent review process for strategic purposes. Changes during the 1990s in patent procedures affected the incentives of applicants to exploit the continuations process, and additional reforms in continuations currently are being considered. Nonetheless, little is known about applicants' use of the three major types of continuations -- the Continuation Application (CAP), the Continuations-In-Part (CIP), and Divisions -- to alter the term and scope of patents. This paper analyzes patents issued from the three types of continuations to U.S. firms during 1981 - 2004 (with priority years 1981 - 2000), and links their frequency to the characteristics of patents, assignees and industries. We find that CIPs are disproportionately filed by R&D-intensive, small firms that patent heavily, and are more common in chemical and biological technologies. Patents resulting from CIP filings contain more claims and backward citations per patent on average, and cover relatively "valuable" inventions. In contrast, CAPs cover less valuable patents from large, capital-intensive firms that patent intensively, particularly in computer and semiconductor patents. We also analyze the effects of the 1995 change in patent term on continuation applications and find that the Act reduced the use of continuations overall, while shifting the output of CAPs toward "less important" patents.

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1. Introduction

A large literature spanning economics, law, and strategic management has considered the strategic use by firms of intellectual property, including patents. Among the topics covered by this literature are the causes of increased patenting (Kortum & Lerner 1999, Hall 2005), firms' decisions to acquire patents in fields in which company executives state that patents do not aid in appropriating the returns to innovation (Hall & Ziedonis 2001), and the incidence and outcomes of patent litigation among firms (see Hall & Ziedonis 2007, as well as Somaya 2003). The use by firms of patent examination procedures has received less attention from scholars, despite widespread acknowledgement by patent attorneys and other "IP professionals" of the importance of such procedures in the patent strategies of firms. This paper examines the characteristics of firms using one such procedural strategy, the patent continuation, to shed light on motives for and effects of this strategy.

The continuation procedure allows inventors to restart the examination of their patent application, retaining the filing date of a previous application that discloses the same invention. Inventors can use continuations to revise their claims to reflect technological developments affecting their invention after their initial application or to respond to an examiner's arguments and comments. According to the U.S. Patent Office, the procedure, which has been a part of the U.S. patent system since 1863, is intended to "lead to a well-designed set of claims that give the public notice of precisely what the applicant regards as his or her invention" (Federal Register 2006 p 48).

Continuations are unique to the U.S. patent system[1] and have been criticized by economists and members of the patent bar because of their potential for strategic manipulation, notably in so-called "submarine patents" that are issued following long periods of examination and revision through continuation applications (Graham & Mowery 2004).[2] Other critics claim that continuations are used by applicants to badger examinees into granting patents of dubious quality, so-called "junk patents," by repeatedly filing continuations on a single application (Quillen & Webster 2001). But patent attorneys and industry groups defend the use of continuations (see for example, Biotechnology Industry Organization, 2006) to protect the high-risk investments of "pioneering inventors" in "young" fields of invention that are subject to uncertainty. Indeed, proposed changes in Japan's patent examination system include procedures that resemble continuations. A quasi-official Japanese patent policy research organization argues that the introduction of continuations into Japanese patent procedures "will promote front-runners to strategically obtain patents" (I IP Bulletin 2005, p.2-5).

Not for the first time in patent policy, however, the debate over the use, abuse, benefits, and costs of the continuation procedure has been conducted in an evidentiary vacuum. The limited empirical work on continuations to date (Graham 2004, Graham &

[1] Continuation applications have been available to patentees in the United States 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).

[2] The closest parallels in other patent systems are the Divisional available in the European and Japanese Patent Offices, and the option allowing for the selective prosecution of claims from a search report by the German Patent Office (Quillen & Webster 2001). Since the 18-month publication requirement has been a part of the European Patent Convention since its inception, the opportunity for inventors to "hide" technology advances by using Divisions has been strictly limited.

Mowery 2004) has focused on interindustry differences in the incidence of continuations. Little if any work has analyzed the characteristics of the patents or patentholders that exploit the continuation procedure in the U.S. patent system. We do not know, for example, whether continuations are more likely to be filed in relatively “young” technological fields, or whether these applications more frequently cover “pioneering” inventions, as the Biotechnology Industry Organization asserts. This paper analyzes the characteristics of U.S. corporate patents that are subject to the three major types of continuations (see below for definition and discussion of these three types) and examines the use of all three types among publicly listed firms and technological fields during the 1981-2004 period.

The rest of the paper is structured as follows. Section 2 describes the role of continuations in the patent examination process, discussing procedural differences among the three types of continuations: the Continuation Application; the Continuation-In-Part; and the Division. Section 3 describes the construction of our data, compares the characteristics of continued patents with those of patents not subject to continuations, and analyzes variations in the use of each practice among technology classes. Section 4 deals with the continuations propensity of U.S. corporate patentees and Section 5 analyzes the effects of the change in patent term that became effective in 1995 (see below for further discussion) on the incidence and characteristics of continuations. Section 6 summarizes and discusses the implications of our findings.

2. Continuations: Provisions and Practice

2.1 The patent review process and continuations

The USPTO patent review process starts with the inventor filing an application containing a written description of her invention. This description is formalized in legal language by "claims" that define the invention covered by the application. The examiner compares the claims against existing knowledge or "prior art" to determine whether or not the application meets the standards of patentability. This "patent prosecution" process may result in the application being accepted or rejected in its entirety or (more likely) the rejection of one or more claims by the examiner. The applicant can respond to a rejection of claims by disclosing additional information showing that her claims are valid, or by narrowing them to accommodate prior art and/or the examiner's suggestions. The examiner reviews this response and may allow the patent claim, suggest modifications, or issue a "final rejection" of the application.[3] This entire process can go through several rounds, each of which lasts 2-3 years on average, and has been characterized as a "give-and-take-affair" between the applicant and the examiner (Merges 1997).[4]

2.2 Types of Continuations

[3] A determined applicant faced with a "final rejection" can pursue several options, including a Request for Continued Examination (RCE), which may or may not contain amendments to the original application, so long as it discloses the same invention. This application is treated like a new application, giving the applicant another chance for her claims to be allowed, amended, or even reviewed by a different examiner, while preserving the "priority date" of the original patent application (Lemley & Moore 2004). In the U.S. system, however, the continuation/divisional/CIP routinely is assigned to the examiner who handled the parent case. Exceptions occur if the examiner has retired from the USPTO or has been promoted to a position that does not include examining patent applications. Another exception occurs if the Office of Initial Patent Examination had classified the child application into a very different patent classification than the parent application. In that case it would go to a different art unit and thus to a different examiner. Applicants do not have a say in deciding who prosecutes their application (Personal communication with Carl Oppedahl, patent lawyer, January 21, 2006).

[4] The applicant also can seek an interview with the examiner, where she tries to persuade the examiner of the patentability of her claims, or appeal the rejection to the Board of Patent Appeals and Interferences and if unsuccessful there, to the U.S. District Court for the District of Columbia or to the U.S. Court of Appeals for the Federal Circuit.

Continuations permit an applicant to refile a pending patent application,[5] with or without substantial modifications, by renewing at least some portion of the original application. There are three types of "continuations": the "Continuation Application" (abbreviated hereafter as the CAP), the "Continuation-In-Part (CIP)," and the "Division."[6] The Continuation Application discloses the identical invention claimed in the prior "parent" non-provisional application before the parent application was patented or abandoned. The disclosure presented in the CAP must be the same as that of the original application; *i.e.*, the continuation should not include anything that would constitute new matter if inserted in the original application.[7] The CIP includes a substantial portion or all of the parent application and adds matter not disclosed in that application, although the benefit of early priority is awarded only for the original disclosures contained in the new application. A Division or divisional application occurs when the original application contains more than one independent invention. In such a case, the USPTO allows the applicant to "elect" one of the disclosed inventions for continued examination. The other inventions disclosed in the parent application can be withdrawn and pursued in new applications called Divisions. A new application can be filed as a divisional application and benefit from the early filing date of the parent application only if it discloses and claims subject matter disclosed in the "original" or "parent" application.

[5] 35 USC § 120 (1991). Benefit of earlier filing date in the United States.

[6] 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."

[7] 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).

All three types of continuations introduce a delay in the prosecution and final issue decision for a U.S. patent application and permit the applicant to adopt the date of the application that is still pending within the Patent Office.[8,9] So long as the original "parent" application and the follow-up continuation application disclose the same invention, the applicant can preserve the parent application's filing date. Because an application may be continued any number of times, and because there is no limit to the number of times that a parent application may be abandoned, continuations can be used to prevent the patent examiner from reaching a decision on a patent application. Strings of continuations may thus develop, with issue decisions being postponed for decades.[10] Prior to 1999, all U.S. patent applications remained secret until the issue of the patent, enabling applicants to maintain the secrecy of their application throughout this extended period.

Revisions in U.S. patent law that became effective in 1995 changed the term of patent protection from 17 years from the date of patent issue to 20 years from the application date. This change sought (among other things) to reduce the incentives for inventors to pursue "submarine" patents. An inventor seeking a "submarine" patent

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[8] In case of the CIP, only those claims that are carried over from the original application receive the benefit of the priority date.

[9] 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).

[10] 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 in this patent's chain while it languished in the patent office for 39 years.

submitted an application, thereby establishing a priority date for her invention, 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. Even after the 1995 changes in patent term, continuations offered some strategic benefits to an applicant by allowing an extended period of secrecy prior to the issue of a patent, but this benefit was reduced by 1999 legislation mandating the publication of most patent applications 18 months after their submission.[11] The "publication" requirement, however, has not removed all of the benefits of continuations. Applicants can still make changes to individual claims reported in the published disclosure, and thus can use the continuation procedure to extend the period of secrecy during review by at least 18 months for these individual claims (Glazier, 1997).[12]

The effects of these changes in U.S. IPR policy on continuations are unclear, for several reasons. The 1995 change in patent term forced patentees using the continuations procedure to forego some portion of the patent term in exchange for a longer period of pendency. But this tradeoff may be of far less significance in technologies for which product life cycles are short (e.g., software) than in sectors exhibiting longer product life cycles, such as drugs and chemicals. Moreover, the 1999 Act allows applicants to "opt out" of the 18-month publication requirement for patents filed solely in the United States,

[11] The US patent law now requires the publication of all applications after 18 months, but applicants are granted automatic exemptions from this requirement by filing a statement that they have no intention of filing the application in a foreign jurisdiction that requires an 18-month publication of its patent applications.

[12] For example, an applicant may use the continuation procedure to make subtle changes in one or more claims consistent with the original disclosure, but not identical to the original published claims. The continuation may thus delay issue of the patent while the applicant observes the uses to which the technology is put in the marketplace, and alters the claim accordingly. Thus, when the patent ultimately is allowed to issue, the technology disclosed in the patent may be of no surprise to competitors, but the precise boundaries of the claims may be a surprise, thus allowing the patentee to demand royalties from competitors infringing on the altered claim.

meaning that some "submarine incentives" may remain for applicants who do not file applications outside of the United States. The U.S. remains a huge market, and the ability of applicants to recapture their foreign-filing rights has yet to be tested in the U.S. courts. The effects of the publication requirement on post-1999 applicants' use of continuations therefore may be limited. Indeed, as late as 2005, well after the 1995 and 1999 reforms, continuation filings accounted for 30% of all applications received by the PTO (Federal Register 2006).[13]

Despite extensive debate over the benefits, costs, uses, and abuses of continuations, there exists little if any analysis of the characteristics of patents subject to continuations and the characteristics of the assignees of continued patents. Nor has the overall importance of continuations before 1995 in U.S. patenting or the effects of the 1995 statutory changes on the incidence and characteristics of continuations been examined. We address the following questions in our analysis of continuation applications:

1. How do important characteristics (number of claims, forward and backward citations, payment of patent-renewal fees) of issued patents subject to continuations and/or continuations of different types compare with those of corporate patents overall?

2. Are continuations concentrated in "emerging" fields of inventive activity, which may be subject to greater uncertainty concerning claims or feasibility? To what

[13] During 2005, the PTO received approximately 317,000 nonprovisional applications, of which about 63,000 were continuing applications and about 52,000 were requests for continued examination. Thus, about thirty percent (63,000 + 52,000)/(317,000 + 52,000) of the Office's patent examining resources must be applied to examining continued examination filings that require reworking earlier applications instead of examining new applications (Federal Register 2006, p 50). Recent proposals for patent reform (dated 2006) seek to curtail the practice by limiting applicants to two continuations per application.

extent are assignees using the practice to patent inventions in fields in which they have not previously been active (and therefore may be more likely to revise their applications), i.e., fields in which they might be described as recent entrants or as “pioneers?”

3. What are the characteristics (*e.g.*, patenting intensity, capital intensity, size) of corporate assignees of continued patents, and have these characteristics changed since the 1995 changes in patent term? Do the characteristics of assignees differ among continuation types?

3. The data

Our empirical analysis utilizes U.S. utility patents granted between 1981 and 2004 from the NBER patent database (Hall, Jaffe, and Trajtenberg 2001), and the United States Patent and Trademark Office. We gathered the continuations history of each patent from the “Related Patent Data” on the wrapper of patent documents, which reports the type of continuation applied for and their application dates. From the latter, we calculated the “priority date” as the date on which the first in a series of continuation applications was filed in office. For patents that were never subject to the continuations procedure (referred to below as “ordinary” patents), the first and only application date is the priority date. Next, we separated patents that were subject to only one type of continuation (the CAP, CIP, or Division) from those that resulted from multiple continuation types (referred to below as “Combination” continuations).

The USPTO assigns patents to one of nearly 500 technology classes. We used the NBER classification developed by Hall et al. (2001) to aggregate the 500 classes into 36 two-digit technological subcategories for use in our regression analyses, and further combined these 36 subcategories into 6 main categories: Chemical; Computers and Communications; Drugs and Medical; Electrical and Electronics; Mechanical; and Others (the subcategories that are aggregated to the main categories are apparent from Table 4).

3.1 The frequency of continuations

Since we are primarily interested in the continuations behavior of U.S. firms, we exclude other assignees (foreign, government, individual and unassigned applicants) in our patent dataset. Patents assigned to U.S. corporations are more likely to have undergone a continuations procedure than those in any other assignee category (see Graham 2004 for a comparison of the continuations propensities of different assignee classes). Indeed, U.S.-owned corporations and small businesses are assigned 44% of all patents in our dataset, but 55% of the patents with a history of at least one continuation application.[14] Table 1 summarizes the use of the three different types of continuations (the share of each type as a share of all corporate-assigned continued patents) by year of issue during 1981 – 2004 for the 1,122,935 patents that were assigned to U.S. corporations.

Table 1 here

Continuation applications take longer on average to issue than applications that are not continued. Patents that were not subject to continuations are granted 2.2 years from the date of first application (standard deviation of 1.1), but applications subject to the procedure pend for 4.4 years (s.d. of 2.3) on average. The longer pendency for

[14] This category is identified by assignee code number 2 in the USPTO patent records. Over 96% of patents in this category are assigned to corporations (Hall, *et al.* 2001). Note that some universities patent under university-owned foundation and corporations.

continued patents introduces a truncation bias that makes it problematic to infer trends in continuation applications from patents issued during the later years of our study.[15] We deal with this truncation problem by using the priority year or date of first application for the patents in our dataset, and limit our analysis to the 966,020 patents applied for during 1981 – 2000 and issued during 1981 – 2004.[16]

Figure 1 here

Figure 1 depicts trends in continuation types by priority year. Continuation applications were common between 1981 and 2000 -- 29% of all corporate-assigned patents applied for during the period included at least one continuation in their review. The practice peaked in the half-decade preceding 1995, with nearly 40% of applications during the period issued via continuations. For the entire 1981 – 2000 period, CAPs were the most common type of continuations, accounting for 30% of all patents within these data that had been through the continuations procedure at least once. The shares of CIP's and Divisions are slightly smaller, at 28% and 22% respectively. Within our U.S.-firm sample, 20% of all continuation patents are "Combinations," *i.e.* including more than one type of continuation in their prosecution history.

[15] In other words, *ceteris paribus*, a patent that was applied for in 2003 and was not subject to a continuations procedure is more likely to show up among patents issued in or before 2006 as compared to a patent that was first applied for in the same year, but was subject to continuations after.

[16] 63% of continuation patents (but 96% of "ordinary" patents) issue with a pendency period of 4 years or less and 94% of continuation patents issue with a pendency period of 8 years or less. Nearly 37% of the continuation patents with a priority date of 2000 have not issued by 2004, and 6% of continuation patents with a 1996 priority date have not issued by that year. Figure A1 in the Appendix plots the distribution of "pendency," lags between priority and issue years, for continuation and ordinary patents. Table A1 disaggregates mean pendency lags by continuation type.

3.2 Characteristics of continued patents

We next compare the characteristics of patents resulting from the three types of continuations with each other and with ordinary patents. The characteristics are: the number of claims, the number of backward and forward citations, and the payment by the patentholder of patent renewal fees four years after issue. We briefly describe each of these variables before presenting our findings.

(i) Claims: The claims in a patent define in formal language the novel technical features of the invention, and delineate the breadth of its "scope" or the technological space being protected. Controlling for technology class, the number of claims in a patent is correlated with its economic value (Lanjouw & Schankerman 2004). Lanjouw & Schankerman (2001) also found that litigated patents had a significantly higher average number of claims than did a control group of non-litigated patents. For this study, we use the number of claims for patents granted between 1981 and 1997.

(ii) Backward citations: Inventors are required to be assiduous in their identification of relevant prior art in their applications. The patent examiner further verifies that all appropriate previous patents have been cited. These "backward citations," along with claims, delineate novelty in the applicant's invention and the rights granted in the patent. Backward citations reveal various aspects of the technological lineage of inventions. A patent with a large number of backward citations to patents assigned to other entities indicates that the inventor is operating in a crowded technological area with a number of "nearby" patents and competitors.[17] Patents that include a large share of "self citations," *i.e.* citations to an assignee's own patents in these backward citations, are more heavily based upon the inventor's own prior inventive work,

[17] Citing a number of backward references also makes a patent harder to challenge in court.

rather than those of competitors, and may not indicate a crowded inventive landscape. Patents with a large number of backward citations that are dispersed across different patent classes arguably span a broader spectrum of prior art, and scholars characterize patents with more broadly dispersed backward citations as representing more “original” inventions than patents that draw mainly on prior art within the same class (Jaffe & Trajtenberg 2002).

We obtained the number of prior patents cited by each patent in our study, the percentage of these references that were self-citations, and the technology classes of the cited patents. From the latter, we calculated a Herfindahl index of backward reference concentration which is 0 when all backward citations are to patents from a single class (low “originality”) and 1 for the case of perfect dispersion.

Beginning with patents applied for in 2001, the USPTO distinguished between applicant- and examiner- inserted citations in patents on the wrapper of the issued patent. Data on post-2001 patents reveal that the PTO is responsible for as much as 40% of all prior patent references in an “average” patent, potentially reflecting the different incentives of applicants and examiners in representing “prior art.” Indeed, if applicants use the continuations procedure to strengthen their applications (either by redefining claims in CAPs or by inserting new ones in CIPs), then the resulting patent should contain a higher proportion of citations inserted by applicants than is true for a non-continuation patent.

(iii) Forward citations: Citations to a patent made in subsequent patents indicate that the invention or information in the cited patent contributed to the development of later inventions. Forward citations are commonly used in empirical analysis as indicators of the technological importance of patents. Since citations arrive after a patent has been granted, they can arrive at any point of time in the patent's life, and it is likely that older patents will accumulate more citations. This truncation problem means that patents granted in more recent years will appear to be less technologically important, on average. Restricting forward citations to those appearing in patents issuing within four years after the issue of the cited patent addresses this problem, while allowing us to examine forward citations for patents granted as late as 2002.

(iv) Patent Renewals: Patent renewal fees were introduced in the United States in 1982 for patents applied for after that year. Patentholders are required to pay renewal fees to maintain their patents at 4, 8, and 12 years after the grant date. Patent renewals are used as indicators of the private value of patents, based on the premise that owners are willing to renew their patents only when the expected value of the patents exceeds the cost of maintaining them (Lanjouw *et al.* 1998). We collected patent expiration data through 2005 that covers the renewal decisions of patentees four years after the issue of the patent for all patents between 1981 and 2001.

3.2.1 Descriptive statistics on continuations and patent characteristics

Table 2 displays differences in the mean number of claims, backward citations, the share of backward references that are self-cites, the technology-class dispersion of backward citations ("originality"), forward citations, and 4-year nonrenewal rates for patents subject to continuations. In all of these cases, patents assigned to U.S. corporations that did not undergo continuations ("ordinary" patents) are the reference group.

Table 2 here

The first two columns compare "ordinary" patents with patents that were subject to continuation applications. The next four columns distinguish among different types of continuation patents. Patents issuing from continuations contain higher numbers of backward citations, on average, and these backward citations are drawn from a broader set of technology classes, suggesting that continued patents may indeed be more "original" (all of the above differences are by comparison with "ordinary" patents, and are significant at $p<0.001$).[18] Patents issued during 2001- 2004 to corporate assignees that resulted from continuations also have smaller shares of examiner-inserted citations to prior art (20%) than do continued patents (55%). Table A2.1 in the Appendix tabulates the median number of all backward citations for 291,482 U.S. corporate utility patents issued between 2001 and the median percentage of citations originating from examiners.[19]

Patents resulting from CIPs contain significantly more backward self-citations (relative to ordinary and CAP patents), suggesting that they are used in patents that disproportionately build upon the assignees' prior work. CIPs produce patents with 26% more claims than "ordinary" patents, reflecting their use by applicants to bring in additional material in the form of new claims. CIPs also receive the highest number of forward citations within four years of their issue (a mean of 2.7 citations per patent, as

[18] The originality measure tends to be highly directly correlated with the number of backward references. Our "originality" result holds, even on controlling for the number of backward citations.

[19] While examiners insert more citations on average in certain technologies (accounting for 46% of all backward citations for all patents in Computers and Communications, but only 19.5% in Drugs and Medicine) our result regarding differences between continuation and ordinary patents is robust to technology-specific differences.

compared to 2.3 citations/patent in the control sample, $p<0.001$) , and are less likely to expire after 4 years of issue as compared to “ordinary” patents. These results suggest that patents emerging from the CIP are of higher private and technological “value.”

The average CAP patent has a significantly larger average number of backward citations and claims, but does not differ significantly from the mean “ordinary” patent in its proportion of backward self-cites. Divisional patents have significantly fewer forward citations, fewer claims, and lower renewal rates by comparison with the reference group patents. This result may reflect a tendency for Divisions to be carved out of parent applications (mostly in response to an examiner’s restriction requirement), and claims in Divisions may not have been considered sufficiently important by the applicant to warrant a separate application in the first place.

The remainder of our discussion focuses on CAPs and CIPs (these are the two most frequently used types of continuation applications and are the focus of recent proposals for continuations reforms), rather than on Divisions and Combinations. We exclude Divisions and Combinations from our analysis because Divisions are filed at the behest of the PTO (in response to “restriction requirements”) and are less likely to be used strategically by applicants. “Combination” continuations are difficult to interpret, since by definition this heterogeneous class of continuations could involve multiple motives.

3.3 Technological differences

The economic value and importance of patents vary considerably among technologies, and these differences are widely asserted to influence the patenting strategies of firms (Cohen, Nelson & Walsh 2001; Levin, Nelson, Klevorick, & Winter

1987). Pharmaceutical and chemicals-related patents are typically rated by industry executives as indispensable for capturing the returns to innovations, but patents in semiconductors and electronics are rated as far less important for manufacturers (Hall & Ziedonis 2001). Since continuations are an important element of firms' patent strategies, the next few paragraphs examine differences in the intensity, trends, and characteristics of continued patents across technological sectors.

Table 3 lists the share of "ordinary" patents and of the four different types of continuations for each of the 36-class and the 6-category technology groupings.

Table 3 here

Patents in the "Drugs and Medicine" and the "Chemicals" technology classes are among the most intensive users of continuations. Continuations overall accounted for 46% of the patents issued in "Drugs and Medicine" for priority years 1981-2000, and 36% of those issued in "Chemicals" during the same period. CIPs (30% of patents issuing from continuations) and Combinations (30% for Drugs and Medicine and 22% in Chemicals) account for the majority of continuations in these two technology classes. The intensive use of CIPs in these classes contrasts with the Computers and Communications sector, where CAPs account for 50% of all continuations. Semiconductor patents differ from other technology classes in their high Divisional propensity (40% of all continuations in this technology are divisions). This considerable variation among technological fields in the use of different continuation types and trends nevertheless does not preclude significant interfirm differences in the use of continuations, the focus of the following section.

4. Continuations and corporate-assignee characteristics

Continuation applications produce patents that differ from "ordinary" patents, and the nature of these differences depends on the type of continuation. In this section, we combine our findings regarding differences in the characteristics of continued patents with an analysis of the influence of observable elements of firm structure and their patent portfolios on continuations activity, by utilizing Compustat data on publicly traded U.S.-owned corporations.

4.1 Data on assignee characteristics

A challenge in linking patent-level information with Compustat's variables is the fact that firms patent under various names, and assignee names may not accurately reflect the ownership of patents. We used the NBER PTO-Compustat correspondence file to assemble a set of unique patenting entities by identifying firm acquisitions, mergers, name changes, and majority-owned subsidiaries between 1981 and 2000.[20] This yielded matches for 2,263 patent assignees to 1,273 unique Compustat firms that collectively owned 363,308 patents, representing 38% of all patents assigned to U.S.-owned businesses between 1981 and 2000. Since firms enter and exit the data during the period of observation, with some instances of multiple entry and exit, our sample is an unbalanced panel.

[20] Note that the NBER file is not current and reflects the ownership status captured in 1989. The file was constructed by assembling U.S. patents assigned to unique firms by identifying name changes, subsidiaries, and merger and acquisition information from a variety of sources (Lexis/Nexis business directories, 10-K filings, and the Directory of Corporate Affiliations).

The continuations behavior of publicly traded large firms represented in Compustat (and hence our analysis) differs from that of privately held firms. For instance, our "in-sample" patents assigned to public companies were more likely to have issued from CAPs and Divisions, but less likely to have used CIPs and combinations of continuations than the "out of sample" patents assigned to non-publicly listed U.S. owned entities. These differences are statistically significant, *i.e.* we can reject the null hypothesis of equality of sample means (based on a t-test that assumed unequal variances) at conservatively defined significance levels.[21] The results of our Compustat analysis accordingly may not be representative of the broader corporate patent assignee population's continuations behavior.

4.2 Variables

What observable attributes of firms affect their continuations behavior? Lacking direct evidence on corporate motives, we test the influence on corporate assignees' continuations behavior of firm-level variables such as R&D intensity, capital intensity and patent intensity.

Continuations raise the legal and patent-prosecution expenses of patent applicants, and therefore should be more common among firms for which patents are relatively important as a means of appropriating the returns to innovation or for strategic purposes. The patenting intensity of firms therefore should be positively related to their propensity to pursue continuations. We measure the patent intensity (*PATINT*) of a firm as the ratio of its patent applications that issue to R&D expenditures for each year in our sample and hypothesize that more patent-intensive firms are likely to rely on continuations.

[21] Table A4 of the Appendix compares the frequency of continuation types of our in-sample patenting entities and those omitted because of the lack of Compustat data.

How does patent intensity affect choice among continuations? Predicting continuations choice as a function of patent intensity requires a more precise characterization of motives than our data currently support. Nonetheless, we consider (and test) two broad views of the motives for continuations use by corporate assignees.

One interpretation of continuations (as represented by the Biotechnology Industry Organization 2006, for example) portrays them as associated with the innovative activities of firms that specialize in R&D, relying on strong patent rights to trade their technologies (Arora 1995, Merges 1998). According to Arora *et al.* (2001), these specialist firms ("technology traders") include design firms in semiconductors (a group emphasized in Hall and Ziedonis, 2001), specialized chemical or biomedical R&D firms, or suppliers of intermediate technological inputs (common in aerospace and instruments). We define technology traders or specialists as firms for which patents are important and R&D investment is high. If technology specialists favor a particular type of continuation, *ceteris paribus*, we should observe a positive coefficient for the interaction of patent-intensity and R&D-intensity (*RDINT*, defined as R&D expenditures normalized by employment)[22] in predicting the choice of that continuation type.

We further test whether the "pioneering" inventions of technology specialists are more likely to issue from continuations by including an interaction term that captures the multiplicative effect of patent importance (proxied by the forward citations received by a firm's patents within four years of issue), R&D-intensity, and patent-intensity. A finding that continuations use is positively correlated with the combined effect of R&D intensity,

[22] Alternative estimations that normalized capital-intensity and R&D intensity by sales rather than employment did not change our results.

patenting intensity, and the quality of firms' patents supports the "pioneering inventor" characterization of continuations users.

A second characterization of the motives for continuations associates their use with the "defensive" patent strategies of firms in industries in which patents have been characterized as less important mechanisms for appropriating the returns to R&D (Hall & Ziedonis 2001 in semiconductors, Bessen & Hunt 2004 in software).[23] One "defensive" patenting strategy relies on the accumulation of large patent portfolios for exchange with other firms through cross-licensing as a means of avoiding costly litigation and potentially, the shutdown of manufacturing capacity. According to Hall and Ziedonis (2001), the patenting behavior of U.S. semiconductor firms since the mid-1980s is consistent with this interpretation. Firms with large investments in manufacturing facilities are more likely to adopt a defensive patenting strategy, in this view, as a means of avoiding "holdup" through litigation. We test the importance and influence on continuations choice of this form of defensive patenting by including a variable that interacts sunk costs and patent intensity. Sunk costs are proxied by firms' capital intensity (*CAPINT*), *i.e.* capital investments (measured as the book value of a firm's property, plant, and equipment) normalized by employment. With suitable controls, we can interpret a positive coefficient on this interaction term as supporting a prediction that continuations are used by defensive patenters.

Since these "defensive patenters" are more concerned with the quantity rather than the quality of their patent portfolio, this form of defensive patenting should be associated with lower average patent quality. We therefore include another multiplicative

[23] The Quillen & Webster (2001) assertion that continuations are used by certain applicants to acquire a large number of "junk patents" is consistent with this less benign view of continuations.

interaction of patent importance, capital-intensity and patent-intensity. A negative coefficient for this interaction variable is consistent with the use of continuations by defensive patenters to acquire patents of lower average value (see Gallini 2002 or Shapiro 2001). A positive coefficient suggests that continuations are used in the more important inventions of these firms. Table 4 summarizes the interpretation of our key interaction variables and the implications of their coefficient signs for our competing interpretations of the motives for continuations.

Table 4 here

Our earlier discussion of the characteristics of patents issuing from the different types of continuations suggests that CAPs will be associated with "defensive patenting" strategies. That is, we expect the interaction of capital-intensity and patent-intensity to have a positive and significant coefficient, and the interaction of this variable with patent value should have a negative coefficient in explaining the probability of CAP filings. The data presented earlier on the characteristics of patents issued from CIPs, however, lead us to expect their use to be correlated with characteristics of "pioneering inventions" (high-value patents) and use by "technology traders" (high levels of R&D- and patent-intensity).[24]

[24]The characteristics of "submarine" patenters are more difficult to statistically pinpoint, although anecdotes suggest that firms following submarine strategies are more likely to be small and use all three types of continuations. Jerome Lemelson's famous "submarine" U.S. patent 5,283,641 covering "Apparatus and methods for automated analysis" used all three types of continuations. We therefore make no predictions about corporate characteristics and continuations use by "submarine" patenters.

Our analysis of corporate characteristics and continuations behavior includes two other variables that capture differences in the position of individual patents within firms' patent portfolios. We measure the "centrality" of a patent to a firm's portfolio by computing the share of the patent's technology class in the "flow" of patents issuing to a firm each year. The value of *TECHSHARE* is bounded above at one, e.g., when a firm's patents are all assigned to the same technology class within our 36-category taxonomy. *TECHSHARE* controls for the differential use of continuations by firms in patents that are more (or less) common in firms' current portfolios. We also capture a time dimension of firms' technological focus by computing the difference in years between the year of a given patent's application year and the year in our dataset in which the firm was first assigned a patent in the same class. Hence, *TECHTIME* measures the patenting experience of firms in different technology areas, which may be imperfectly correlated with the age of firms.

We control for other attributes that may influence continuations behavior. Firm size is measured as the log of employment (*EMP*) and can affect continuations behavior because of economies of scale and fixed costs associated with patent activity (e.g., the cost of maintaining an in-house staff of patent attorneys). Industry-, technology- and time-specific dummies control for unobserved variation in technological opportunity and other factors (*e.g.* changes in patent law, technological, and economic trends) that affect applicants' decisions to file continuations. The *age* of firms (*AGE*) is also included to distinguish effects due to experience and learning that are not captured by firm size.

In summary, we are testing the influence of the following explanatory variables on the continuations choice of a patent:

(i) the patenting intensity of firms, calculated as annual log number of patents/ M$ of annual R&D

(ii) the capital intensity of firms (log book value of plant, property and equipment in M$/1000 employees)

(iii) the R&D intensity of firms (log annual R&D expenditure in M$/1000 employees)

(iv) the quality of the invention, measured by forward citations received within 4 years of its issue.

(v) multiplicative interaction of (i) & (ii).

(vi) multiplicative interaction of (i) & (iii).

(vii) multiplicative interaction of (i), (ii) & (iv).

(viii) multiplicative interaction of (i), (iii) & (v).

Our control variables include:

(i) the technological relevance of a firm’s application to its current focus captured by the share of its technology class in the firm’s patent portfolio.

(ii) the patenting experience of a firm in a particular technological area, calculated as the difference between a patent’s application year and the year of the firm’s first application in that class.

(iii) the size of firms measured by log employment.

(iv) log of firm age.

(v) industry-specific dummies (13 categories, based on 2-digit SIC class).

(vi) technology-specific dummies (26 categories, based on NBER technology classification).

(vii) application-year dummies.

Table 5 summarizes descriptive statistics for the variables in our analysis. The median Compustat firm in our sample has about 4,000 employees, spends $14.5 million annually on R&D, has capital assets totaling $ 250 million, and successfully applies for 6 patents a year.

Table 5 here

4.3 Model specification and results

We analyze the choice of continuation (j = {0, 1,2,3,4} representing choices of "no continuation", CAP, CIP, Divisional or a "combination") as being determined by a mix of invention- and firm-level attributes ('**x**' represents the vector of these factors). The conditional probability 'y' of each continuation type can be estimated by specifying a multinomial logit (MNL) choice model. Note that since the probabilities sum to unity, P(y = 0 | **x**) is determined once we know the probabilities for j = 1,…, 4. The conditional response probability for continuation type 'j' is given by (Wooldridge 2004):

$$P(y = j \mid \mathbf{x}) = \frac{\exp(\mathbf{x}\boldsymbol{\beta}_j)}{\left[1 + \sum_{h=1}^{4} \exp(\mathbf{x}\boldsymbol{\beta}_h)\right]} \quad , \; j = 1,\ldots\ldots,4$$

The effect of each '*x*' on P(y = j), that is, the conditional probability of the type of continuation '*j*', is given by the corresponding β_j. The estimations are carried out by maximum likelihood methods and results are reported in Table 6.

Table 6 here

The absolute values of the estimates are not particularly meaningful, and we accordingly focus on the relative size, signs, and statistical significance of coefficients for the independent variables in Table 6. All coefficients convey *ceteris paribus* effects and should be interpreted as reflecting the effects of the relevant independent variable relative to patents that did not undergo any continuation (*j*=0). Since this is a nonlinear model, the effect of any independent variable depends on the values at which the other independent variables are held constant. Table A5 in the Appendix reports changes in choice probabilities when a particular '*x*' changes from ½ of one standard deviation below its mean to ½ of one standard deviation above, with the values of all other independent variables held at their means (we also report changes in probability when the '*x*' of interest changes from its minimum value in our sample to its maximum).[25]

The interaction terms significantly influence the choice among continuation types in ways that are broadly consistent with our priors. Firms that perform R&D and patent intensively --- traits that are characteristic of technology specialists --- are the most likely to use CIPs, but this interaction term is negatively associated with CAPs and Divisions. As expected, the interaction of capital-intensity and patent-intensity (defining defensive patenters) positively affects the probability that CAPs (and Divisions) are used, but is negatively related to CIP filings. The "value" of a patent affects continuation choice, as

[25] It is also important to note that computing the exact interaction effects require taking the cross-derivative of the expected value of '*y*' with respect to the interacted variables. These issues mean that interpreting interaction terms is not a straightforward exercise here, and that the interaction effect may even have different signs for different values of covariates.

CIPs are associated with high-value patents and CAPs associated with patents that receive a below-average number of forward citations. This effect is mediated by the capital- and patent-intensity of firms. A combined increase in the levels of the two variables (associated with defensive patenters and captured by the triple interaction of *FCITES*, ln*CAPINT* and ln*PATINT* on CAP probability) reduces the quality of associated CAP patents even further.

The uniformly negative sign on *TECHTIME* means that for all types of continuations, the longer the time elapsed between the application and a firm's first patent in the same technological area, the less likely it is to be continued. In other words, the more recently a firm has become active in patenting within a given technology class, the more likely that it uses any of the four types of continuations (at 99% confidence levels). Patents in areas central to a firm's annual flow of patents (*TECHSHARE*) also are associated with a higher likelihood of using any of the available continuations procedures. The size of firms (employment) is inversely related to CIP filings, but positively correlated with the probability of CAPs and Divisions. These results are broadly consistent with the view that CIPs are more likely to be used by small, technology specialist firms, while CAPs are used by large corporate patentees in defensive strategies.

In regressions that are not reported here, we estimated the continuation choice probabilities for patents in each of the five major technology classes (we omitted "Others" because of the vast heterogeneity in this class). The effects of explanatory variables were comparable to the combined technologies fixed-effects model, with the following noteworthy differences. The interaction of sunk costs and patenting intensity had a greater positive influence on CAP probabilities in Computers and Communication, Electrical and Electronics, but was negligible for Chemicals, Drugs and Medicine patents. The computers and electronic sectors also provided considerable support for the "defensive patenting" characterization of CAP use.

5. The effects of the 1995 change in patent term on continuations behavior

As we noted earlier, legislation passed in December 1994 changed the term for patents issuing after June 1995 to twenty years from application date, from the former term of 17 years from issue date. Here, we probe the effects of the law on the practice of continuations by asking three questions: (a) did the law reduce the use by corporate assignees of continuations?; (b) given that one motive for the 1995 change was curbing the "strategic" use of continuations, did the "quality" or "value" of the average patent resulting from continuations change after 1995?; and (c) how if at all did the 1995 change in patent term affect the characteristics of the corporate assignees using continuations?

The time trends depicted in Figure 1 are similar for all four classes of continuations -- the use of all continuation types grew through 1994 and decreased thereafter.[26] We find that the frequency of CAPs increased for patents in all major technology categories with a priority date between 1988 and 1993 (See Figures A2.1-2.3 in the Appendix for charts depicting the use of different continuation types in each of our

[26] The truncation problem (see Footnote number 17) does impact calculations regarding the exact magnitude of decline post-1995. However, since we know from the distribution of pendency lags that priority year 1996 under-represents continuations by 6%, PY1997 by 10% and so on, we are confident that the post-1995 drop persists even after accounting for truncation.

five major technology classes), followed by a sharp decline after 1994. This pattern is especially pronounced for patents in the Computers and Communications industry -- nearly 25% of all patents first applied for in 1993 in this technology class were subject to CAPs, a share that drops to 9% in 1996. The share of CIPs and that of Divisions for all main technology categories, however, are more stable during the period.[27]

Other changes in patent application procedures after 1995 make it difficult to conclude that the 1995 change in patent term is the sole cause of the observed decline in CAPs. Conversations with patent attorneys revealed that the patent term change in 1995 was accompanied by the introduction of a new procedure called the "Continued Prosecution Application" (this *CPA* was superseded for utility patents by the Request for Continued Examination or RCE in 2003) that allowed applicants to keep the prosecution of an application alive even after "final rejection" by the examiner. Before 1995, an applicant facing a "final rejection" from the Patent Office was required to abandon the application before filing what was called a "File Wrapper Continuation" (FWC) for continued prosecution. The USPTO treated the FWC identically to the Continuation Application (CAP) and as a consequence, our pre-1995 CAP patents may include those issuing from FWCs, a group that after 1995 is excluded by virtue of being included in the CPAs. Without controlling for the FWC/CPA/RCE conflation, it is difficult to ascribe the decline in CAPs entirely to the change in patent term. Nonetheless, comparing the average "importance" of patents issuing from continuations, and their corporate owners before and after 1995 can yield valuable insights on the changed use/abuse of the

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[27] We investigated the decline in use and quality of patents issuing from continuations more formally. The results are in Table A6 of the Appendix.

practice, and provide a benchmark for current "continuations reform" proposals (Federal Register 2006).

5.1 Changes in corporate characteristics for post-1995 users of continuations

We use our Compustat sample and the continuations choice model described in Section 4.1 to investigate changes in the attributes of corporate users of continuations after 1995. To estimate the effects of the policy change, we divide our Compustat sample into a pre-1995 panel that excludes patents with priority year 1995 and a post-1995 panel, and compare differences in the coefficients of independent variables across the two sets of estimates.[28] Table 7 presents the results.

Table 7 here

The coefficients on *FCITES* show that patents issuing from CAPs are cited less frequently than "ordinary" patents after 1995, in contrast to pre-1995 CAP patents, which are not statistically different from ordinary patents.[29] This decline in the importance of post-1995 CAPs is not affected by the FWC/CPA/RCE problem described earlier. Applicants that might have resorted to a CAP in response to a "final rejection" of an application (arguably covering claims of questionable technological value) are present in

[28] An alternate approach interacting application year dummies with each of the right hand variables was estimated with similar results, but we do not report them here.
[29] Patents applied for between 1981 and 2000 appear in this analysis only if they were granted by 2002. To negate biases due to truncation, we have employed a 4-year "window" for forward citations for all patents in the dataset in order to minimize truncation bias. The "4-year window" includes forward citations from the same year as the issue of a patent and three subsequent years. The last year for citing patents in this analysis (for patents issued in 2002) is hence 2005.

the pre-1995 panel, but are excluded from post-1995 observations.[30] The 1995 change in patent term may have reduced the willingness of applicants with more valuable inventions to accept a curtailed patent term in exchange for the benefits of continued prosecution. We also find a striking increase in the direct effect of the interaction of capital- and patent-intensity ($\beta_{(CAPINT \times PATINT)}$) on the likelihood of CAP filings during the 1995-2000 period. R&D-intensive firms that patent heavily (the relevant coefficient here is $\beta_{(RDINT \times PATINT)}$) are less likely to use CAP and CIP filings after 1995.[31]

The above results suggest that post-1995 CAPs are more likely than pre-1995 CAPs to be used for relatively unimportant patents, and to be used by defensive patenters. Examining the extent of self-citations in backward citations for post-1995 patents issuing from continuations provides additional evidence on the post-1995 use of CAPs in the "defensive" patenting strategies of firms. This is because, a high proportion of backward self-cites may be one consequence of a patenting strategy that seeks to accumulate "thickets" of patents that overlap each other and hence cite each other. Figure 2 shows that patents issuing from post-1995 CAPs contain a significantly higher proportion of backward *self*-citations than any other group of patents, while CAPs prior to 1995 cited their own patents *less* frequently than patents issuing from any other type of continuation.[32]

[30] This drop in quality of post-1995 CAPs holds for the larger sample of U.S.owned businesses as can be seen in Table A6 of the Appendix.
[31] We also examined the effects of firm-attributes on continuations choice for each of the five major patent technology classes (corresponding MLNM estimates are presented in Tables A7.1 - 7.5 of the Appendix). Defensive patenters (coefficient on the interaction of patent intensity and capital intensity) are more likely, and technology traders (coefficient on the interaction of research intensity and capital intensity) are less likely to choose CAPs in their patents after 1995 in all sectors.
[32] We examined this result in an OLS specification with the percentage of backward citations that are self-citations as the dependent variable before and after 1995, and the 4 different continuation

Figure 2 here

6. Conclusion

The continuations procedure allows applicants to alter the timing and scope of their issued patents in response to technological developments and the patenting activity of competitors. Despite their widespread use in the U.S. by corporate assignees (nearly 30% of all issued patents during 1981-2004 can be attributed to continuations), and despite the various patent policy reforms addressing the use and abuse of continuations, the procedure has received little attention from scholars of patent strategy. By examining the characteristics of patents resulting from the three types of continuations between 1981 and 2004, and their U.S. owners, we have tried to provide some preliminary evidence on the role of continuations in U.S. firms' patenting behavior.

Continued patents pend for twice as long as patents without continuations in their review history, and contain 50% more references to patented prior art (mostly attributable to applicants). Our findings on the differences in the various characteristics of patents issuing from the three types of continuations are consistent with the procedural differences among the types. The "Continuation in Part" allows inventors to insert additional material to a pending patent application and produces patents with the highest number of claims, forward citations, and renewal probability. Patents in Drugs, Medicine, and Chemicals --- industries in which patents are widely rated as important mechanisms for capturing value from innovation --- are relatively frequent users of CIPs.

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types as regressors. The estimates (in TableA9 of the Appendix) which included technology-class controls confirmed the statistical significance of the increased selfcitations of CAP patents in backward cites post-1995.

CIPs are also more likely to be filed by the smaller firms in our sample and are associated with patents of high value.

One view of continuations argues that the procedure supports “pioneering” inventors, allowing them to secure an early priority date while revising their claims during review of their applications in technologies where patents are important to appropriate the returns to R&D. Our results on CIPs appear consistent with this view. But the economic and technological significance of patents resulting from CIPs, as well as the tendency for these continuations to be used by smaller R&D-intensive firms, also could be associated with the use by applicants of CIPs in submarine patenting strategies. Our statistical tests are unable to distinguish the motives of applicants, and further research with data on the composition of firms’ R&D, licensing, and litigation activity (to identify pioneering inventors and submariners) is needed.

The “Continuation Application” is a second application for the same invention claimed in a prior application, and produces patents that are qualitatively indistinguishable from “ordinary” patents. The CAP extends the pendency period of an application without providing for substantial changes, and is the most common type of continuation within the Computers, Communication, and Semiconductor patents that utilize the procedure (accounting for nearly half of all continuations filed in these technologies during 1981-2000). These technologies are characterized by rapid change, short technology cycle times, and the relative unimportance of patents as a means of recouping R&D investments. CAP applicants, particularly those filing applications after 1995, disproportionately cite their own previous patents as prior art. These observations, combined with our findings that CAPs are frequent among the low-value patents of firms that patent intensively and have large sunk costs, can be interpreted as supporting various forms of the "defensive patenting" interpretation of CAPs' role in patent strategy.[33]

What implications do our analyses have for the patent and continuation reforms recently discussed by the Patent Office and the U.S. Congress? Our results do not support a definite characterization of the CIP as prone to abuse before or after 1995, but they do suggest that skepticism concerning the benefits of the CAP is warranted.[34] Hence, reform of the continuations process can benefit from a reexamination of the purported benefits of the CAP, combined with more careful monitoring of the links among patent value, firm characteristics, and litigation for patents issuing from CIPs.

[33] This characterization is consistent with the views of a number of members of the patent bar and rationalizes applicants' use of continuations in accumulating low value or "junk" patents.

[34] One element of these reform proposals is a rule that would require second or subsequent continuations of an application to "include a showing as to why the amendment, argument, or evidence presented could not have been previously submitted" (Official Gazette of the USPTO 2006). Although such petitions might impose significant additional burdens on the patent office, they could aid patent examiners to evaluate CIPs more effectively. Our results do, however, undermine the case for the "Continuation Application."

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Tables and Figures

TABLE 1: CONTINUATIONS AND TYPES OF CONTINUATIONS BY GRANT YEAR (1981-2004)

Grant Year	All Continuations	CAP (% of Continued patents)	CIP (% of Continued patents)	Divisional (% of Continued patents)	Combination (% of Continued patents)
1981	77.17	22.17	31.61	30.03	16.19
1982	77.09	23.87	30.55	29.42	16.16
1983	77.75	26.66	30.25	27.61	15.48
1984	79.06	26.66	30.96	28.13	14.25
1985	79.89	26.11	33.8	26.51	13.57
1986	79.24	27.76	33.33	25.5	13.41
1987	77.82	30.57	33.36	22.22	13.85
1988	76.3	30.81	33.49	21.49	14.2
1989	75.48	32.41	31.08	21.22	15.28
1990	75.11	30.65	30.86	22.31	16.19
1991	74.98	29.13	31.5	22.43	16.94
1992	71.65	30.45	29.77	21.57	18.22
1993	69.81	31.67	28.76	20.35	19.22
1994	68.71	33.85	28.41	17.92	19.82
1995	66.77	35.28	27.48	16.96	20.27
1996	63.72	32.73	24.42	19.82	23.03
1997	61.66	31.68	23.18	19.07	26.07
1998	66.87	33.75	24.34	17.35	24.56
1999	70.88	29.01	26.46	21.18	23.35
2000	73.16	25.61	28.65	24.04	21.69
2001	72.66	25.65	27.62	25.89	20.84
2002	72.43	26.99	25.1	27.03	20.87
2003	73.39	26.49	25.8	26.73	20.98
2004	74.96	26.51	25.97	27.56	19.96
Total (1,122,935 patents)	72.41	29.34	27.79	22.85	20.02

TABLE 2: CONTINUATIONS AND PATENT CHARACTERISTICS

	"Ordinary"	Continuation	CAP	CIP	DIV	COMB.
Claims	14.72	15.14	14.75	18.73	10.40	15.49
	[11.11]	[13.8]	[12.12]	[16.15]	[9.39]	[14.97]
Backward Citations	11.10	17.64	16.02	16.82	15.05	24.01
	[13.82]	[25.5]	[21.16]	[24.73]	[21.03]	[34.39]
% Selfcites (Backward)	12.97	14.92	13.31	14.24	16.7	16.29
	[23.71]	[24.2]	[22.17]	[24.36]	[26.05]	[24.57]
"Originality"	0.39	0.45	0.44	0.43	0.46	0.48
	[0.28]	[0.27]	[0.28]	[0.28]	[0.28]	[0.27]
Forward Citations	2.34	2.22	2.37	2.67	1.57	2.12
	[3.68]	[3.79]	[3.78]	[4.30]	[3.00]	[3.78]
Pr. of expiry at 4 yrs.	0.13	0.11	0.11	0.11	0.12	0.09
	[0.33]	[0.31]	[0.31]	[0.32]	[0.33]	[0.29]

Note: Standard errors in brackets

TABLE 3: CONTINUATIONS USAGE AND TECHNOLOGIES (PRIORITY YEARS 1981-2000)

CATEGORY	SUBCATEGORY	NO CONTS.	CAP	CIP	DIV	COMB.
Chemical	Agriculture,Food,Textiles	61.33	7.52	12.75	8.66	9.75
	Coating	64.5	8.06	9.19	11.54	6.7
	Gas	75.36	6.92	8.89	4.55	4.29
	Organic Compounds	59.04	6.59	10.58	13.04	10.75
	Resins	59.06	7.95	11.32	11.84	9.83
	Miscellaneous-chemical	66.91	7.81	10.22	8.55	6.51
Computers & Communications	Communications	80	8.89	5.68	2.7	2.74
	Computer Hard- & Software	76.75	12.42	4.68	3.11	3.04
	Computer Peripherials	74.65	13.16	5.44	3.21	3.54
	Information Storage	73.67	13.01	3.85	5.32	4.15
Drugs & Medical	Drugs	48.94	10.48	14.68	9.51	16.39
	Surgery & Med Inst.	61.13	11.77	12.05	5.46	9.59
	Biotechnology	49.24	12.36	15.08	7.18	16.14
	Miscellaneous-Drgs&Med	60.84	12.19	11.03	5.8	10.14
Electrical & Electronic	Electrical Devices	83.11	7.07	4.37	3.34	2.1
	Electrical Lighting	79.09	6.92	6.23	4.33	3.43
	Measuring & Testing	77.95	6.75	6.71	5.1	3.49
	Nuclear & X-rays	80.88	5.84	7.32	3.26	2.69
	Power Systems	80.37	7.12	5.75	4.13	2.63
	Semiconductor Devices	64.79	10.63	3.85	14.25	6.47
	Miscellaneous-Elec	80.12	7.66	5.97	3.25	2.99
Mechanical	Mat. Proc & Handling	71.78	7.62	6.63	8.64	5.33
	Metal Working	67.42	6.26	6.18	14.61	5.53
	Motors & Engines + Parts	82.94	5.48	5.79	3.67	2.13
	Optics	80.89	5.99	5.66	4.08	3.38
	Transportation	81.62	6.19	6.92	2.75	2.53
	Miscellaneous-Mechanical	76.45	7.8	7.11	4.2	4.45
Others	Agriculture,Husbandry,Food	69.79	8.5	9.92	5.24	6.56
	Amusement Devices	72.15	8.07	9.96	3.07	6.75
	Apparel & Textile	76.84	7.1	8.14	4.45	3.46
	Earth Working & Wells	77.34	5.47	9.13	4.7	3.36
	Furniture,House Fixtures	78.24	7.34	7.62	3.11	3.69
	Heating	79.56	5.69	6.47	5.22	3.05
	Pipes & Joints	79.54	6.68	6.95	3.84	2.99
	Receptacles	74.94	7.51	7.95	4.33	5.27
	Miscellaneous-Others	73.4	6.98	8.33	6.47	4.82

TABLE 4: INTERPRETATION OF INTERACTION TERMS AND IMPLICATIONS

Coefficient	*Sign*	*Continuation used by:*	*Implications*
$\beta_{(RDINT \times PATINT)}$	+	Technology traders	
$\beta_{(CAPINT \times PATINT)}$	+	Defensive patenters	
$\beta_{(FCITES \times RDINT \times PATINT)}$	+	Technology specialists for "important" patents	Support for "Pioneering inventors" hypothesis
	-	Technology specialists for "less valuable" patents	
$\beta_{(FCITES \times CAPINT \times PATINT)}$	+	Defensive patenters for more "important" patents	
	-	Defensive patenters for less "important" patents	Support for "defensive patenting" hypothesis

TABLE 5: DESCRIPTIVE STATISTICS (BASED ON 9096 COMPUSTAT FIRM-YEAR OBSERVATIONS)

Variables	Median	Mean	SD	Min	Max
Employment (in 1000s)	4.21	17.86	45.33	0.01	876.80
Capital Assets (M$ of property, plant, & equipment)	249.15	1986.56	6392.52	0.05	171895.80
Capital Int. (M$ of property, plant, & eqp/1000 emp)	59.75	88.13	99.95	0.06	1983.62
R&D (M $)	14.53	119.79	392.68	0.00	5227.00
R&D Intensity (M $ / 1000 emp)	3.65	9.38	19.67	0.00	426.18
Number of patents	6.00	39.34	135.49	1.00	3873.00
Patent Intensity (Patents/M $ R&D)	0.48	1.10	2.80	0.00	100.00
Tech Share (Share of patents from primary class)	0.57	0.50	0.35	0.00	1.00
Tech Time (Priority year - first P. year in tech class)	5.90	5.00	5.47	0.00	19.00
Age	19.00	18.68	10.53	1.00	41.00

TABE 6: MULTINOMIAL LOGIT ESTIMATES OF CONTINUATIONS DECISIONS (PRIORITY YEARS 1981-2000)

Dependent variable: Continuation type				
Explanatory variables	*CAP* *(j=1)*	*CIP* *(j=2)*	*DIV* *(j=3)*	*COMB.* *(j=4)*
log patenting intensity (patents/M$ RD)	-0.545	0.258	-0.693	-0.052
	[0.041]*	[0.046]*	[0.049]*	[0.052]
log R&D intensity (M$/1000 employees)	0.167	0.071	0.269	0.408
	[0.011]*	[0.013]*	[0.013]*	[0.015]*
log capital intensity (M$/1000 employees)	0.146	-0.004	-0.012	-0.028
	[0.014]*	[0.017]	[0.017]	[0.019]
lnRDINT*lnPATINT	-0.016	0.058	-0.032	0.08
	[0.009]	[0.009]*	[0.010]*	[0.011]*
lnCAPINT*lnPATINT	0.164	-0.064	0.205	0.054
	[0.011]*	[0.011]*	[0.012]*	[0.013]*
FCITES*lnRDINT*lnPATINT	0.005	0.003	-0.006	-0.006
	[0.002]	[0.002]	[0.003]	[0.003]
FCITES*lnCAPINT*lnPATINT	-0.005	-0.003	0.006	0.002
	[0.001]*	[0.001]	[0.002]*	[0.002]
TECHSHARE(share of patents in subcat)	0.517	0.489	0.192	0.915
	[0.036]*	[0.042]*	[0.043]*	[0.048]*
TECHTIME (technology lag)	-0.063	-0.033	-0.053	-0.095
	[0.003]*	[0.004]*	[0.003]*	[0.004]*
forward cites	-0.029	0.032	-0.09	-0.036
	[0.002]*	[0.002]*	[0.003]*	[0.003]*
log employment	0.02	-0.056	0.025	0.023
	[0.007]*	[0.008]*	[0.008]*	[0.009]
log age	-0.058	-0.002	0.034	-0.038
	[0.011]*	[0.012]	[0.012]*	[0.015]*
Constant	-3.037	-1.952	-1.991	-2.943
	[0.157]*	[0.177]*	[0.180]*	[0.207]*
Observations	356753			
Model chi-square	58102.01			
df	312			
Loglikelihood	-306334			
Pseudo R2	0.09			
N of observations	356753			

Note: Standard errors in brackets; * significant at 1%;
Base class: no continuation (j=0); Industry-, Tech- & Patent vintage- effects included

TABLE 7: 1995-POLICY CHANGE & MLNM ESTIMATES OF CONTINUATION CHOICES
(PY1981-1994 & PY1995-2000)

	PANEL-A (Patents with PY1981-1994)				PANEL-B (Patents with PY1995-2000)			
Explanatory variables	*CAP (j=1)*	*CIP (j=2)*	*DIV (j=3)*	*COMB. (j=4)*	*CAP (j=1)*	*CIP (j=2)*	*DIV (j=3)*	*COMB. (j=4)*
lnPATINT	0.502	0.518	-0.325	0.735	-1.779	0.485	-1.187	-0.976
	[0.051]*	[0.059]*	[0.068]*	[0.060]*	[0.111]*	[0.121]*	[0.110]*	[0.185]*
lnRDINT	0.195	0.156	0.279	0.421	0.173	-0.14	0.247	0.308
	[0.013]*	[0.016]*	[0.017]*	[0.017]*	[0.022]*	[0.023]*	[0.022]*	[0.036]*
lnCAPINT	-0.133	0	-0.21	-0.226	0.538	-0.026	0.27	0.455
	[0.018]*	[0.021]	[0.023]*	[0.022]*	[0.032]*	[0.037]	[0.032]*	[0.053]*
lnRDINT*lnPATINT	0.017	0.028	0.004	0.075	-0.127	0.006	-0.074	-0.097
	[0.010]	[0.011]	[0.014]	[0.012]*	[0.017]*	[0.016]	[0.016]*	[0.025]*
lnCAPINT*lnPATINT	-0.118	-0.113	0.104	-0.163	0.502	-0.095	0.324	0.397
	[0.014]*	[0.015]*	[0.017]*	[0.015]*	[0.023]*	[0.026]*	[0.022]*	[0.039]*
FCITES*lnRDINT*lnPATINT	-0.001	0.01	-0.007	-0.005	0.002	-0.002	-0.016	-0.011
	[0.002]	[0.003]*	[0.005]	[0.003]	[0.004]	[0.003]	[0.005]*	[0.006]
FCITES*lnCAPINT*lnPATINT	0	-0.003	0.004	0.006	-0.004	0	0.013	0
	[0.001]	[0.001]	[0.003]	[0.002]*	[0.002]	[0.002]	[0.003]*	[0.004]
TECHSHARE	0.361	0.577	0.135	0.699	0.813	0.351	0.262	1.343
	[0.044]*	[0.052]*	[0.059]	[0.055]*	[0.068]*	[0.074]*	[0.069]*	[0.117]*
TECHTIME	-0.03	-0.048	-0.022	-0.061	-0.059	-0.014	-0.06	-0.094
	[0.004]*	[0.005]*	[0.006]*	[0.005]*	[0.004]*	[0.005]*	[0.004]*	[0.007]*
FCITES	-0.003	0.054	-0.075	0.002	-0.075	0.013	-0.124	-0.11
	[0.003]	[0.003]*	[0.005]*	[0.003]	[0.004]*	[0.003]*	[0.004]*	[0.007]*
lnEMP	-0.007	-0.028	-0.009	-0.021	-0.005	-0.138	0.065	0.013
	[0.008]	[0.010]*	[0.011]	[0.010]	[0.013]	[0.014]*	[0.013]*	[0.021]
lnAGE	-0.039	0.025	0.084	-0.02	0.039	-0.022	-0.002	0.093
	[0.013]*	[0.016]	[0.017]*	[0.017]	[0.021]	[0.020]	[0.018]	[0.035]*
Constant	-0.334	-1.544	-0.755	0.121	-4.143	-0.108	-2.787	-4.893
	[0.177]	[0.209]*	[0.233]*	[0.197]	[0.421]*	[0.338]	[0.326]*	[0.810]*
Observations	223047				133706			
Model chi-square	33506.82				23286.7			
df	288				256			
Loglikelihood	-210694.85				-92891.79			
Pseudo R2	0.07				0.11			
N of observations	223047				133706			

Note: Standard errors in brackets; * significant at 1%;
Base class: no continuation (j=0); Industry-, Tech- & Patent vintage- effects included

Figure 1: Continuation Types by priority year (1981-2000)

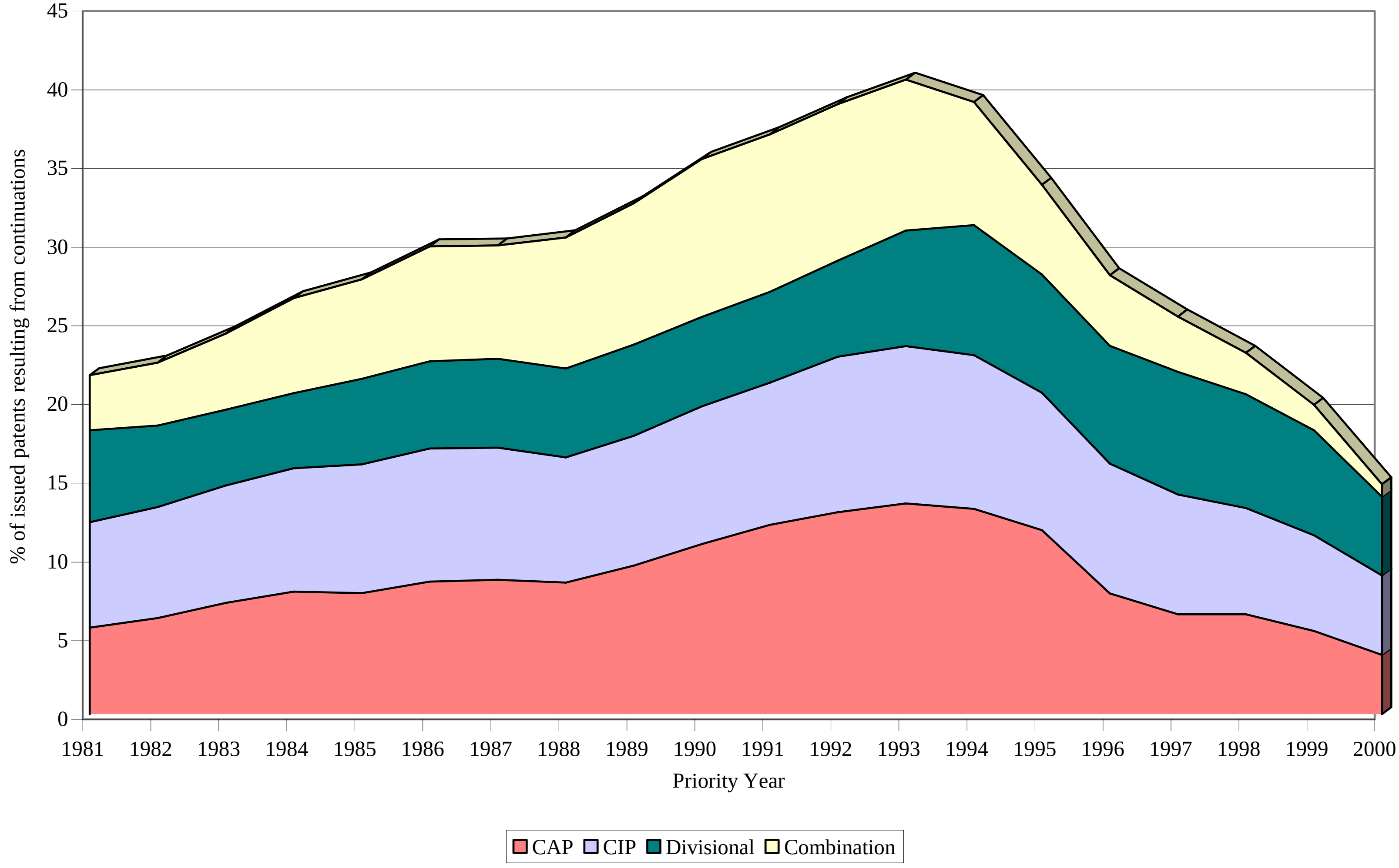
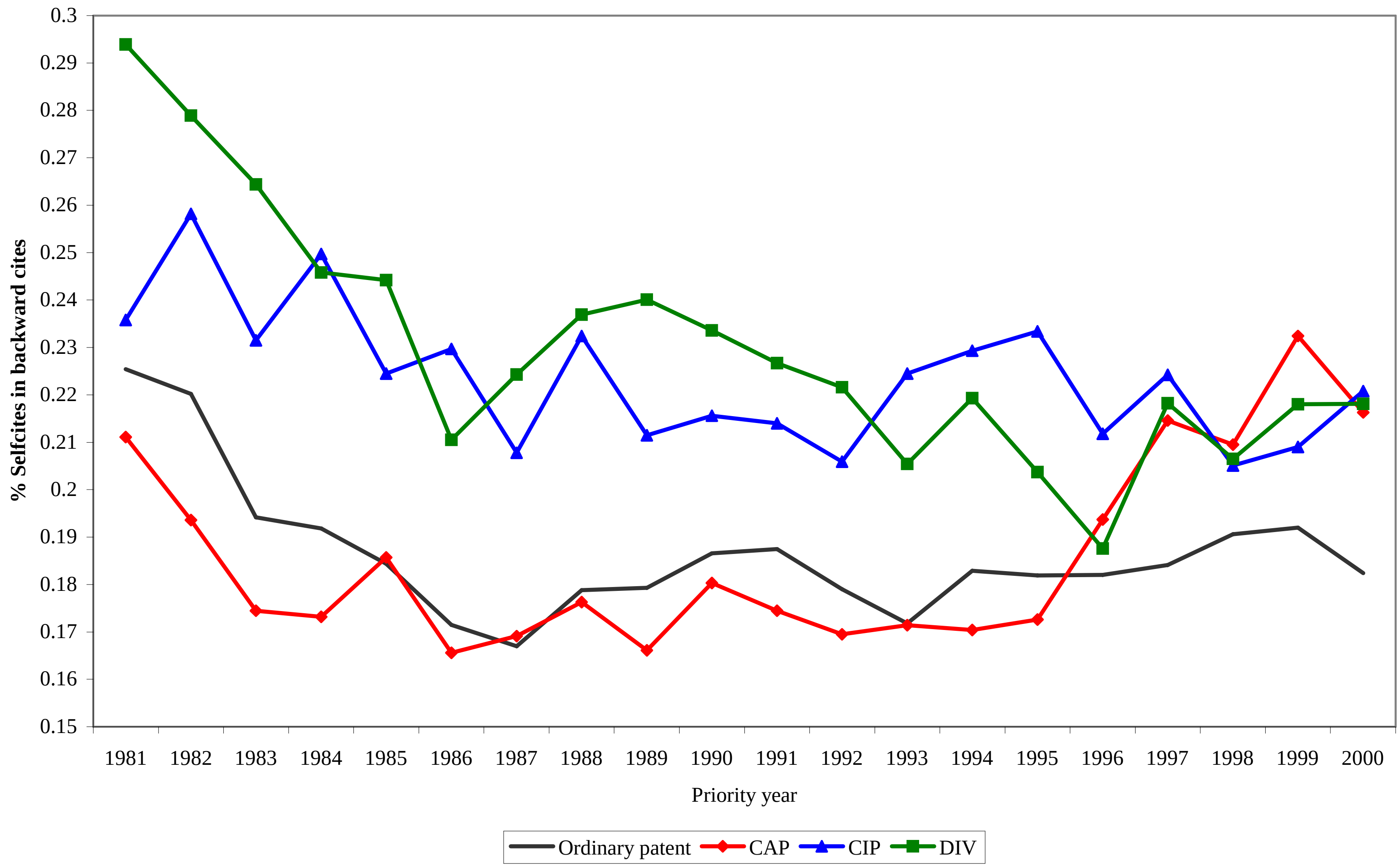


Figure 2: Backward Selfcites and Continuations (Priority Year 1981-2000)



Appendix (Supplementary Results)

TABLE A1: PENDENCIES AND NO. OF CONTINUATION FILINGS
(PRIORITY YEARS: 1981-2000)

	Pendency period		N of continuation filings	
	Mean	Median	Mean	Median
"Ordinary" patent	2.17	2	0.00	0
	[1.09]		[0.01]	
CAP	4.22	4	1.27	1
	[1.96]		[0.70]	
CIP	3.72	3	1.29	1
	[1.66]		[0.77]	
DIV	3.66	3	1.11	1
	[1.53]		[0.41]	
COMBINATION	6.43	6	3.11	3
	[2.72]		[1.64]	

Note: Standard errors in brackets

TABLE A2.1: EXAMINEE-INSERTED BACKWARD CITATIONS
(IN PATENTS ISSUED 2001-2004)

	Median Cites	Median % of examiner cites
"Ordinary" patent	9	55.55
Continued patent	14	20.58
CAP	14	22.20
CIP	13	25.00
DIV	12	25.00
COMBINATION	20	11.10

TABLE A2.2: PATENT CHARACTERISTICS OF CONTINUATIONS, WITH TIME & TECHNOLOGY FIXED-EFFECTS

	CLAIMS	BCITES	% B-SELFCITE	ORIGINAL	FCITES	EXPIRY4
CAP	-0.249	5.465	0.067	0.028	-0.191	-0.017
	[0.054]*	[0.065]*	[0.089]	[0.001]*	[0.013]*	[0.001]*
CIP	4.025	6.145	0.291	0.025	0.496	-0.017
	[0.057]*	[0.068]*	[0.092]*	[0.001]*	[0.014]*	[0.001]*
DIVISIONAL	-4.15	4.308	2.403	0.047	-0.641	-0.004
	[0.066]*	[0.075]*	[0.102]*	[0.001]*	[0.015]*	[0.002]*
COMBINATION	0.964	14.681	1.419	0.058	-0.037	-0.041
	[0.070]*	[0.079]*	[0.108]*	[0.001]*	[0.016]	[0.002]*
CONSTANT	15.401	5.857	16.354	0.279	1.659	0.118
	[15987]	[0.103]*	[0.145]*	[0.002]*	[0.021]*	[0.003]*
Observations	614215	946294	925394	925389	965922	828858
R-squared	0.04	0.09	0.03	0.14	0.08	0.01
df	6	23	23	24	23	23

Note: Standard errors in brackets ; * significant at 1% ;
Reference group: noncontinued or “ordinary” patents;
“Originality” regression includes significant “backward cites” control;
All regressions include patent vintage- and technology effects.

TABLE A3.1: MEAN NUMBER OF CLAIMS AND CONTINUATIONS (PY1981-PY2002)

Claims	Chemicals	Computers & Communication	Drugs & Medical	Electrical & Electronic	Mechanical
"Ordinary" patent	14.87	16.35	16.08	14.43	13.55
	[11.05]	[12.55]	[12.42]	[10.47]	[10.39]
CAP	14.18	16.56	14.79	14.46	13.57
	[11.09]	[13.94]	[11.83]	[11.49]	[11.5]
CIP	17.71	21.5	19.57	19.38	18.04
	[16.57]	[18.44]	[16.61]	[15.45]	[15.05]
DIV	10.22	12.58	11.17	10.39	9.513
	[9.07]	[11.89]	[10.06]	[8.97]	[8.79]
COMB.	14.02	17.84	16.16	16.14	14.91
	[13.22]	[18.91]	[15.92]	[14.54]	[13.72]

Note: Standard errors in brackets

TABLE A3.2: MEAN BACKWARD CITES AND CONTINUATIONS (PY1981-PY2002)

Backward cites	Chemicals	Computers & Communication	Drugs & Medical	Electrical & Electronic	Mechanical
"Ordinary" patent	10.71	11.05	12.84	9.53	11.2
	[13.62]	[15.46]	[19.67]	[11.43]	[11.41]
CAP	14.49	15.99	16.95	14.52	16.23
	[19.63]	[21.64]	[25.25]	[18.44]	[18.21]
CIP	14.46	19.47	17.34	14.88	17.14
	[23.83]	[29.99]	[27.93]	[19.77]	[20.82]
DIV	12.94	17.13	15	15.01	15.69
	[17.96]	[24.79]	[23.91]	[19.76]	[19.78]
COMB.	19.15	33.53	21.53	23.49	24.18
	[28.9]	[50.03]	[32.78]	[27.7]	[28.08]

Note: Standard errors in brackets

TABLE A3.3: MEAN % BACKWARD SELFCITES AND CONTINUATIONS (PY1981-PY2002)

%Backward self-cites	Chemicals	Computers & Communication	Drugs & Medical	Electrical & Electronic	Mechanical
"Ordinary" patent	18.73	11.46	12.82	12.22	12.8
	[28.92]	[20.48]	[25.51]	[22.7]	[23.39]
CAP	17.35	12.06	14.28	12.78	12.28
	[26.06]	[19.38]	[25.31]	[20.57]	[21.04]
CIP	19.88	11.13	13.37	12.41	12.94
	[28.84]	[20.15]	[25.28]	[21.48]	[22.26]
DIV	22.2	12.7	18.33	14.16	13.6
	[30.81]	[20.09]	[29.25]	[21.15]	[22.55]
COMB.	20.9	11.64	16.4	14.66	14.86
	[28.43]	[18.69]	[26.1]	[20.51]	[22.14]

Note: Standard errors in brackets

TABLE A3.4: MEAN ORIGINALITY AND CONTINUATIONS (PY1981-2002)

Original	Chemicals	Computers & Communication	Drugs & Medical	Electrical & Electronic	Mechanical
"Ordinary" patent	0.42	0.44	0.35	0.37	0.37
	[0.29]	[0.27]	[0.27]	[0.28]	[0.28]
CAP	0.47	0.48	0.38	0.42	0.42
	[0.28]	[0.26]	[0.27]	[0.27]	[0.28]
CIP	0.45	0.49	0.39	0.42	0.42
	[0.29]	[0.27]	[0.27]	[0.28]	[0.28]
DIV	0.48	0.48	0.37	0.48	0.47
	[0.28]	[0.26]	[0.28]	[0.26]	[0.27]
COMB.	0.5	0.53	0.42	0.5	0.49
	[0.27]	[0.26	[0.27]	[0.26]	[0.27]

Note: Standard errors in brackets

TABLE A3.5: MEAN FORWARD CITES AND CONTINUATIONS (PY1981-2002)

Forward Cites	Chemicals	Computers & Communication	Drugs & Medical	Electrical & Electronic	Mechanical
"Ordinary" patent	1.67	3.70	2.29	2.50	1.78
	[2.64]	[5.17]	[3.82]	[3.62]	[2.73]
CAP	1.58	3.83	2.00	2.39	1.70
	[2.65]	[5.16]	[3.65]	[3.37]	[2.60]
CIP	2.03	4.90	2.68	3.06	2.17
	[3.13}	[6.72]	[4.58]	[4.31]	[3.38]
DIV	0.99	3.08	1.46	2.27	1.31
	[1.86]	[4.68]	[3.39]	[3.62]	[2.44]
COMB.	1.48	4.06	1.91	2.81	1.96
	[2.64]	[5.70]	[3.71]	[4.46]	[3.31]

Note: Standard errors in brackets

TABLE A3.6: MEAN EXPIRY PROBABILITY AND CONTINUATIONS (PY1981-2002)

% Expiry	Chemicals	Computers & Communication	Drugs & Medical	Electrical & Electronic	Mechanical
"Ordinary" patent	13.05	8.14	11.51	11.54	14.20
	[33.69]	[27.35]	[31.91]	[31.95]	[34.90]
CAP	12.71	7.50	9.88	9.63	12.72
	[33.31]	[26.33]	[29.83]	[29.50]	[33.32]
CIP	11.49	8.16	9.80	10.88	13.42
	[31.89]	[27.38]	[29.72]	[31.14]	[34.08]
DIV	14.19	7.66	12.15	9.60	12.97
	[34.89]	[26.59]	[32.67]	[29.46]	[33.60]
COMB.	10.90	5.74	7.90	8.68	10.23
	[31.17]	[23.26]	[26.99]	[28.15]	[30.31]

Note: Standard errors in brackets

TABLE A4: TWO-SAMPLE T TEST (WITH UNEQUAL VARIANCE) FOR DIFFERENCES BETWEEN COMPUSTAT AND NON-COMPUSTAT FIRMS

	CAP	CIP	DIV	COMB.	N
Compustat matched patents	0.341	0.225	0.258	0.176	96509
Omitted observations	0.276	0.304	0.204	0.216	181300
Difference	0.065	-0.079	0.054	-0.040	
Pr(|T| > |t|) for Ha: diff != 0	0	0	0	0	

TABLE A5: MULTINOMIAL LOGIT ESTIMATES OF CONTINUATIONS DECISIONS

	CAP	CIP	DIV	COMB.	"Ordinary"
lnPATINT					
Min->Max	-0.298	0.196	-0.650	0.020	0.731
SD/2 -+	-0.038	0.017	-0.034	0.001	0.055
lnRDINT					
Min->Max	0.083	0.012	0.108	0.109	-0.313
SD/2 -+	0.010	0.001	0.013	0.011	-0.036
lnCAPINT					
Min->Max	0.069	-0.005	-0.008	-0.007	-0.050
SD/2 -+	0.008	-0.001	-0.001	-0.001	-0.006
*lnRDINT*lnPATINT*					
Min->Max	-0.064	0.094	-0.113	0.075	0.008
SD/2 -+	-0.004	0.007	-0.005	0.006	-0.005
*lnCAPINT*lnPATINT*					
Min->Max	0.336	-0.511	0.513	0.013	-0.351
SD/2 -+	0.053	-0.021	0.047	0.004	-0.084
*FCITES*lnRDINT*lnPATINT*					
Min->Max	0.329	0.122	-0.660	-0.322	0.532
SD/2 -+	0.006	0.002	-0.005	-0.003	0.000
*FCITES*lnCAPINT*lnPATINT*					
Min->Max	-0.990	-0.006	0.886	0.012	0.099
SD/2 -+	-0.011	-0.003	0.009	0.001	0.003
FCITES					
Min->Max	-0.085	0.774	-0.069	-0.032	-0.588
SD/2 -+	-0.007	0.008	-0.018	-0.003	0.021
Pr(y|x)	0.081	0.052	0.056	0.030	0.781

<u>Table A5 Notes:</u> Pr(y|x)is the probability of observing each y for specified x values.
Min->Max: change in predicted probability as x changes from its minimum to its maximum.
SD/2 -+: change in predicted probability as x changes from 1/2 standard deviations below base to 1/2 standard deviations above. The base (mean) values and standard deviations of all 'x' are below.

x=	*lnPATINT*	*lnRDINT*	*lnCAPINT*	*lnRDINT* lnPATINT*	*lnCAPINT* lnPATINT*	*FCITES*lnRDINT *lnPATINT*
mean(x)	-0.596	2.146	4.616	-1.536	-2.786	-3.797
sd(x)=	0.976	1.033	0.750	2.571	4.612	14.897

x=	*FCITES*lnCAPINT *lnPATINT*	*TECHSHARE*	*TECHTIME*	*FCITES*	*lnEMP*	*lnAGE*
mean(x)	-6.452	0.235	9.476	2.510	10.592	3.075
sd(x)=	24.857	0.216	5.660	3.856	1.513	0.688

TABLE A6: EFFECTS OF THE 1995 LAW --- PROBIT ESTIMATES

	CAP	*CIP*	*DIV*	*COMB.*
	dF/dx	dF/dx	dF/dx	dF/dx
*Fcites*y8185*	-0.0004	0.0066	-0.008	0.001
	[0.0004]	[0.0003]*	[0.0005]*	[0.0003]*
*Fcites*y8690*	0.0022	0.0047	-0.0053	0.002
	[0.0002]*	[0.0002]*	[0.0004]*	[0.0001]*
*Fcites*y9195*	0.0005	0.0037	-0.0022	0.0011
	[0.0001]*	[0.0001]*	[0.0002]*	[0.0001]*
*Fcites*y9600*	-0.0018	0.0033	-0.0029	0.0007
	[0.0002]*	[0.0001]*	[0.0002]*	[0.0001]*
y8690	0.0259	0.0215	0.0123	0.0308
	[0.0015]*	[0.0014]*	[0.0014]*	[0.0011]*
y9195	0.0643	0.0423	0.033	0.0347
	[0.0015]*	[0.0014]*	[0.0013]*	[0.0011]*
y9600	-0.0439	-0.0171	0.0016	-0.0485
	[0.0012]*	[0.0012]*	[0.0012]	[0.0008]*
Observations	722284	717299	701873	696606
Model chi-square	21657.39	21494.78	20574.81	33835.29
df	42	42	42	42
Loglikelihood	-226588.03	-216147.02	-178480.46	-153361.51
N of observations	722284	717299	701873	696606

Note: Robust standard errors in brackets; * significant at 1%
dF/dx is for discrete change of dummy variables (*y8690*, *y9195* & *y9600*) from 0 to 1;
z and P>|z| correspond to the test of the underlying coefficient being 0

Table A6 Notes: The above are estimates of a model where, the binary dependent variable indicates whether the patent was issued from a CAP or no continuation (for the CAP analysis). The right hand side variables include four-year citations (*fcites*), 32-category technological category (*Class*) and application period (*App*). The coefficient on the interaction term ($App_t * Fcites$) enables us to test for changes in the relationship between patent quality and CAPs during the 1981 – 2002 period. Instead of using dummies for the twenty application years and their corresponding quality interaction terms, we grouped the years into four application periods (1981-85, 1986-90, 1991-95, 1995-2000), after ensuring that this does not affect our key results.

TABLE A7.1: 1995-POLICY CHANGE & MLNM ESTIMATES OF CONTINUATION CHOICES (1981-1994 & 1995-2000) FOR CHEMICAL PATENTS

	PANEL-A (Patents with PY1981-1994)				PANEL-B (Patents with PY1995-2000)			
Explanatory variables	*CAP (j=1)*	*CIP (j=2)*	*DIV (j=3)*	*COMB. (j=4)*	*CAP (j=1)*	*CIP (j=2)*	*DIV (j=3)*	*COMB. (j=4)*
lnPATINT	0.669	1	-0.393	1.07	-1.002	-0.139	-0.951	-0.183
	[0.124]*	[0.118]*	[0.123]*	[0.123]*	[0.351]*	[0.276]	[0.244]*	[0.458]
lnRDINT	0.057	0.193	0.297	0.325	0.163	-0.142	0.302	0.054
	[0.032]	[0.030]*	[0.032]*	[0.032]*	[0.071]	[0.063]	[0.054]*	[0.093]
lnCAPINT	-0.209	-0.057	-0.223	-0.453	0.221	0	0.177	0.21
	[0.043]*	[0.040]	[0.042]*	[0.043]*	[0.106]	[0.089]	[0.080]	[0.145]
lnRDINT*lnPATINT	0.025	0.026	-0.094	-0.002	-0.025	0.029	-0.11	-0.319
	[0.026]	[0.025]	[0.026]*	[0.025]	[0.050]	[0.041]	[0.034]*	[0.059]*
lnCAPINT*lnPATINT	-0.189	-0.22	0.156	-0.248	0.239	0.022	0.264	0.264
	[0.028]*	[0.026]*	[0.027]*	[0.027]*	[0.066]*	[0.053]	[0.045]*	[0.090]*
FCITES*lnRDINT*lnPATINT	0.004	0.016	0.018	0.001	0.04	0.006	-0.002	0.087
	[0.008]	[0.007]	[0.013]	[0.009]	[0.015]*	[0.011]	[0.018]	[0.021]*
FCITES*lnCAPINT*lnPATINT	-0.005	-0.007	-0.012	0	-0.026	-0.004	0.011	-0.059
	[0.004]	[0.003]	[0.007]	[0.004]	[0.008]*	[0.006]	[0.010]	[0.011]*
TECHSHARE	0.342	0.525	-0.035	0.23	0.5	1.145	-0.114	0.879
	[0.107]*	[0.097]*	[0.103]	[0.106]	[0.227]	[0.174]*	[0.176]	[0.305]*
TECHTIME	-0.028	0.003	-0.03	-0.035	-0.048	-0.04	-0.07	-0.096
	[0.012]	[0.014]	[0.013]	[0.013]*	[0.014]*	[0.012]*	[0.010]*	[0.018]*
FCITES	-0.011	0.058	-0.198	-0.026	-0.067	0.01	-0.185	-0.209
	[0.009]	[0.006]*	[0.012]*	[0.009]*	[0.014]*	[0.010]	[0.014]*	[0.032]*
lnEMP	-0.063	0.018	-0.008	-0.053	-0.072	0.014	-0.033	-0.028
	[0.019]*	[0.018]	[0.018]	[0.019]*	[0.035]	[0.029]	[0.027]	[0.050]
lnAGE	-0.04	-0.018	0.12	-0.011	0.152	-0.015	0.032	0.149
	[0.027]	[0.027]	[0.029]*	[0.029]	[0.053]*	[0.039]	[0.034]	[0.076]
Constant	0.393	-2.961	-0.61	0.115	-3.496	-1.144	-1.268	-2.488
	[0.294]	[0.303]*	[0.297]	[0.312]	[1.202]*	[0.656]	[0.633]	[1.175]
Observations	55791				17729			
Model chi-square	3744.16				1897.92			
df	148				116			
Loglikelihood	-63061.2				-15472.5			
Pseudo R2	0.03				0.06			
N of observations	55791				17729			

Note: Standard errors in brackets; * significant at 1%;
Base class is ordinary patents (j=0); Industry (SIC2)- and Patent vintage-effects included

TABLE A7.2: 1995-POLICY CHANGE & MLNM ESTIMATES OF CONTINUATION CHOICES (1981-1994 & 1995-2000) FOR COMPUTERS & COMMUNICATION PATENTS

	PANEL-A (Patents with PY1981-1994)				PANEL-B (Patents with PY1995-2000)			
Explanatory vars.	*CAP*	*CIP*	*DIV*	*COMB.*	*CAP*	*CIP*	*DIV*	*COMB.*
	(j=1)	*(j=2)*	*(j=3)*	*(j=4)*	*(j=1)*	*(j=2)*	*(j=3)*	*(j=4)*
lnPATINT	-0.204	-0.237	-0.804	-0.722	-1.646	1.438	-2.201	-1.138
	[0.123]	[0.197]	[0.260]*	[0.207]*	[0.200]*	[0.254]*	[0.299]*	[0.455]
lnRDINT	0.348	0.159	0.047	0.327	0.221	-0.186	0.332	0.198
	[0.033]*	[0.052]*	[0.062]	[0.055]*	[0.042]*	[0.048]*	[0.069]*	[0.095]
lnCAPINT	0.045	0.017	-0.065	-0.124	0.477	0.017	0.409	0.366
	[0.039]	[0.060]	[0.078]	[0.065]	[0.054]*	[0.071]	[0.079]*	[0.132]*
lnRDINT*lnPATINT	-0.039	0.05	-0.016	-0.009	-0.365	-0.054	-0.094	-0.496
	[0.025]	[0.037]	[0.052]	[0.041]	[0.041]*	[0.049]	[0.062]	[0.081]*
lnCAPINT*lnPATINT	0.096	0.042	0.187	0.244	0.641	-0.268	0.571	0.729
	[0.035]*	[0.052]	[0.071]*	[0.056]*	[0.037]*	[0.059]*	[0.054]*	[0.084]*
FCITES*lnRDINT*lnPATINT	0.007	0.005	0.021	0.014	0.01	0.002	-0.013	0.012
	[0.004]	[0.006]	[0.010]	[0.008]	[0.006]	[0.005]	[0.010]	[0.006]
FCITES*lnCAPINT*lnPATINT	-0.006	-0.001	-0.011	-0.01	-0.008	-0.002	0.009	-0.017
	[0.002]*	[0.004]	[0.006]	[0.005]	[0.004]	[0.003]	[0.007]	[0.004]*
TECHSHARE	0.448	0.171	-0.037	0.666	0.628	0.348	-0.018	1.222
	[0.089]*	[0.166]	[0.183]	[0.163]*	[0.108]*	[0.147]	[0.160]	[0.261]*
TECHTIME	-0.047	-0.018	-0.011	-0.074	-0.035	-0.002	-0.051	-0.053
	[0.009]*	[0.016]	[0.018]	[0.016]*	[0.009]*	[0.012]	[0.012]*	[0.019]*
FCITES	-0.008	0.031	-0.025	-0.015	-0.072	0.013	-0.117	-0.071
	[0.004]	[0.006]*	[0.010]	[0.008]	[0.006]*	[0.005]	[0.010]*	[0.012]*
lnEMP	0.089	-0.197	-0.16	-0.097	-0.047	-0.198	0.047	-0.194
	[0.017]*	[0.029]*	[0.032]*	[0.030]*	[0.023]	[0.031]*	[0.035]	[0.055]*
lnAGE	-0.16	0.101	0.108	0.006	0.01	0.051	-0.106	0.055
	[0.033]*	[0.058]	[0.074]	[0.066]	[0.044]	[0.056]	[0.066]	[0.107]
Constant	-4.396	-0.419	-2.996	-3.124	-4.246	-0.413	-33.491	-2.597
	[0.526]*	[0.477]	[0.864]*	[0.676]*	[0.746]*	[0.713]	[1.192]*	[1.064]
Observations	42369	42369	42369	42369	49899	49899	49899	49899
Model chi-square	4456.22				5680.43			
df	148				116			
Loglikelihood	-36050				-26444			
Pseudo R2	0.06				0.1			
N of observations	42369				49899			

Note: Standard errors in brackets; * significant at 1%;
Base class is ordinary patents (j=0); Industry(SIC2)- and Patent vintage- effects included

TABLE A7.3: 1995-POLICY CHANGE & MLNM ESTIMATES OF CONTINUATION CHOICES (1981-1994 & 1995-2000) FOR DRUGS & MEDICAL PATENTS

	PANEL-A (Patents with PY1981-1994)				PANEL-B (Patents with PY1995-2000)			
Explanatory vars.	*CAP*	*CIP*	*Div*	*Comb*	*CAP*	*CIP*	*Div*	*Comb*
	(j=1)	*(j=2)*	*(j=3)*	*(j=4)*	*(j=1)*	*(j=2)*	*(j=3)*	*(j=4)*
lnPATINT	0.825	0.41	-0.043	0.969	-0.865	-0.609	0.012	0.176
	[0.128]*	[0.142]*	[0.188]	[0.124]*	[0.400]	[0.459]	[0.421]	[0.527]
lnRDINT	-0.022	0.125	0.101	0.456	-0.026	0.129	0.628	0.094
	[0.044]	[0.046]*	[0.058]	[0.045]*	[0.088]	[0.101]	[0.101]*	[0.111]
lnCAPINT	-0.009	0.013	0.07	-0.074	0.478	-0.103	-0.231	0.057
	[0.054]	[0.056]	[0.069]	[0.051]	[0.152]*	[0.158]	[0.150]	[0.183]
lnRDINT*lnPATINT	0.09	-0.018	0.073	0.151	-0.22	0.127	0.016	-0.196
	[0.031]*	[0.030]	[0.040]	[0.030]*	[0.054]*	[0.064]	[0.053]	[0.067]*
lnCAPINT*lnPATINT	-0.238	-0.05	0.017	-0.254	0.339	0.066	0.022	0.122
	[0.033]*	[0.036]	[0.046]	[0.032]*	[0.083]*	[0.088]	[0.076]	[0.101]
FCITES*lnRDINT*lnPATINT	0.01	0.003	-0.005	-0.007	0.015	0.014	0.03	0.057
	[0.007]	[0.006]	[0.010]	[0.007]	[0.015]	[0.012]	[0.019]	[0.025]
FCITES*lnCAPINT*lnPATINT	-0.005	-0.001	0.007	0.004	-0.005	-0.01	-0.005	-0.019
	[0.004]	[0.003]	[0.005]	[0.004]	[0.010]	[0.008]	[0.013]	[0.016]
TECHSHARE	-0.678	0.218	0.004	-0.317	0.252	-0.446	0.529	0.284
	[0.110]*	[0.111]	[0.139]	[0.107]*	[0.174]	[0.169]*	[0.159]*	[0.234]
TECHTIME	0.049	-0.073	0.013	-0.03	-0.035	-0.053	-0.037	-0.078
	[0.015]*	[0.014]*	[0.019]	[0.014]	[0.017]	[0.016]*	[0.017]	[0.022]*
FCITES	-0.01	0.019	-0.044	-0.053	-0.035	-0.009	-0.052	-0.04
	[0.007]	[0.006]*	[0.011]*	[0.008]*	[0.018]	[0.016]	[0.021]	[0.025]
lnEMP	-0.193	0.032	0.036	-0.031	0.093	0.019	0.189	0.072
	[0.026]*	[0.028]	[0.035]	[0.027]	[0.045]	[0.042]	[0.040]*	[0.058]
lnAGE	-0.073	-0.047	-0.146	-0.138	-0.058	0.038	-0.127	-0.006
	[0.038]	[0.038]	[0.045]*	[0.035]*	[0.053]	[0.054]	[0.044]*	[0.078]
Constant	-20.35	-22.956	-1.662	-1.475	-25.163	-19.431	-23.916	-23.473
	[1.075]*	[0.599]*	[1.193]	[1.151]	[1.556]*	[0.000]	[1.522]*	[1.515]*
Observations	21112	21112	21112	21112	9970	9970	9970	9970
Model chi-square	2432.93				1064.39			
df	148				108			
Loglikelihood	-27776				-9911			
Pseudo R2	0.04				0.05			
N of observations	21112				9970			

Standard errors in brackets
* significant at 1%
Base class is ordinary patents (j=0); Industry(SIC2)- and Patent vintage- effects included

TABLE A7.4: 1995-POLICY CHANGE & MLNM ESTIMATES OF CONTINUATION CHOICES (1981-1994 & 1995-2000) FOR ELECTRICAL & ELECTRONICS PATENTS

	PANEL-A (Patents with PY1981-1994)				PANEL-B (Patents with PY1995-2000)			
Explanatory variables	*CAP* *(j=1)*	*CIP* *(j=2)*	*DIV* *(j=3)*	*COMB.* *(j=4)*	*CAP* *(j=1)*	*CIP* *(j=2)*	*DIV* *(j=3)*	*COMB.* *(j=4)*
lnPATINT	-0.068	-0.165	-0.611	-1.151	-3.025	1.079	-1.798	-2.198
	[0.136]	[0.185]	[0.227]*	[0.244]*	[0.260]*	[0.355]*	[0.265]*	[0.510]*
lnRDINT	0.252	0.013	0.384	0.512	-0.133	-0.27	0.25	0.024
	[0.031]*	[0.042]	[0.047]*	[0.052]*	[0.046]*	[0.056]*	[0.049]*	[0.091]
lnCAPINT	-0.042	0.163	-0.183	0.024	1.021	0.121	0.728	1.246
	[0.044]	[0.062]*	[0.066]*	[0.071]	[0.078]*	[0.092]	[0.070]*	[0.146]*
lnRDINT*lnPATINT	-0.043	-0.02	0.023	0.103	-0.326	0.003	-0.085	-0.202
	[0.029]	[0.038]	[0.048]	[0.049]	[0.046]*	[0.058]	[0.048]	[0.092]
lnCAPINT*lnPATINT	0.06	0.049	0.171	0.281	0.864	-0.229	0.474	0.725
	[0.039]	[0.051]	[0.065]*	[0.068]*	[0.058]*	[0.084]*	[0.057]*	[0.115]*
FCITES*lnRDINT*lnPATINT	0.015	0.029	0.02	-0.012	0.018	0.013	-0.034	0.013
	[0.007]	[0.008]*	[0.013]	[0.010]	[0.012]	[0.011]	[0.010]*	[0.025]
FCITES*lnCAPINT*lnPATINT	-0.008	-0.011	-0.006	0.01	-0.016	-0.009	0.02	-0.017
	[0.004]	[0.004]*	[0.007]	[0.006]	[0.007]	[0.006]	[0.006]*	[0.014]
TECHSHARE	0.505	0.354	0.452	0.861	0.694	0.144	1.496	1.602
	[0.102]*	[0.141]	[0.151]*	[0.145]*	[0.143]*	[0.214]	[0.136]*	[0.219]*
TECHTIME	-0.038	-0.031	-0.003	-0.078	-0.059	-0.002	-0.054	-0.08
	[0.009]*	[0.012]	[0.015]	[0.013]*	[0.009]*	[0.012]	[0.009]*	[0.015]*
FCITES	0	0.066	-0.016	0.026	-0.083	0.018	-0.108	-0.104
	[0.006]	[0.006]*	[0.008]	[0.007]*	[0.009]*	[0.007]*	[0.007]*	[0.017]*
lnEMP	0.045	-0.181	0.048	0.025	-0.019	-0.235	0.299	0.009
	[0.019]	[0.026]*	[0.028]	[0.029]	[0.029]	[0.038]*	[0.028]*	[0.051]
lnAGE	-0.105	0.02	0.119	-0.014	-0.036	-0.142	-0.133	-0.044
	[0.034]*	[0.050]	[0.057]	[0.061]	[0.053]	[0.053]*	[0.046]*	[0.098]
Constant	-2.051	-1.355	-2.933	-2.256	-6.194	-0.348	-31.893	-23.704
	[0.331]*	[0.403]*	[0.476]*	[0.419]*	[1.114]*	[0.886]	[1.121]*	[0.000]
Observations	45435	45435	45435	45435	32049	32049	32049	32049
Model chi-square	3045.44				7798.37			
df	148				116			
Loglikelihood	-34803				-23249			
Pseudo R2	0.04				0.14			
N of observations	45435				32049			

Note: Standard errors in brackets; * significant at 1%

Base class is ordinary patents (j=0); Industry(SIC2)- and Patent vintage effects included

TABLE A7.5: 1995-POLICY CHANGE & MLNM ESTIMATES OF CONTINUATION CHOICES (1981-1994 & 1995-2000) FOR MECHANICAL PATENTS

	PANEL-A (Patents with PY1981-1994)				PANEL-B (Patents with PY1995-2000)			
Explanatory variables	*CAP*	*CIP*	*DIV*	*COMB.*	*CAP*	*CIP*	*DIV*	*COMB.*
	(j=1)	*(j=2)*	*(j=3)*	*(j=4)*	*(j=1)*	*(j=2)*	*(j=3)*	*(j=4)*
lnPATINT	0.737	0.648	-0.041	1.102	-1.887	0.201	-2.131	-2.36
	[0.169]*	[0.196]*	[0.191]	[0.211]*	[0.408]*	[0.399]	[0.319]*	[0.611]*
lnRDINT	0.135	0.091	0.23	0.647	0.281	-0.006	0.037	0.417
	[0.038]*	[0.044]	[0.042]*	[0.049]*	[0.070]*	[0.066]	[0.056]	[0.112]*
lnCAPINT	-0.385	-0.04	-0.214	-0.313	0.133	-0.211	0.501	-0.278
	[0.059]*	[0.067]	[0.062]*	[0.075]*	[0.118]	[0.115]	[0.092]*	[0.185]
lnRDINT*lnPATINT	0.076	0.044	0.022	0.136	0.02	-0.019	-0.086	0.342
	[0.032]	[0.034]	[0.036]	[0.043]*	[0.069]	[0.057]	[0.052]	[0.115]*
lnCAPINT*lnPATINT	-0.191	-0.138	0.016	-0.176	0.462	-0.041	0.497	0.536
	[0.044]*	[0.050]*	[0.049]	[0.054]*	[0.093]*	[0.091]	[0.073]*	[0.147]*
FCITES*lnRDINT*lnPATINT	-0.002	0.014	-0.03	0.018	-0.018	-0.009	0.039	-0.085
	[0.011]	[0.009]	[0.014]	[0.014]	[0.021]	[0.015]	[0.020]	[0.040]
FCITES*lnCAPINT*lnPATINT	0.004	-0.002	0.018	0	0.013	0.006	-0.014	0.051
	[0.005]	[0.004]	[0.006]*	[0.006]	[0.012]	[0.008]	[0.011]	[0.022]
TECHSHARE	0.187	0.63	-1	1.342	0.412	0.015	-0.758	1.186
	[0.144]	[0.161]*	[0.178]*	[0.166]*	[0.268]	[0.238]	[0.235]*	[0.386]*
TECHTIME	-0.031	-0.047	-0.031	-0.07	0.011	0.016	-0.027	0.007
	[0.012]*	[0.013]*	[0.012]	[0.014]*	[0.015]	[0.013]	[0.011]	[0.022]
FCITES	0.019	0.089	-0.081	0.03	-0.064	0.007	-0.134	-0.195
	[0.009]	[0.008]*	[0.014]*	[0.010]*	[0.014]*	[0.012]	[0.013]*	[0.036]*
lnEMP	-0.052	-0.085	-0.13	0.052	-0.228	-0.406	-0.213	-0.366
	[0.025]	[0.030]*	[0.027]*	[0.033]	[0.047]*	[0.044]*	[0.039]*	[0.076]*
lnAGE	0.05	0.056	0.062	-0.046	0.086	0.121	0.131	0.313
	[0.038]	[0.044]	[0.042]	[0.046]	[0.065]	[0.061]	[0.054]	[0.118]*
Constant	0.273	-1.208	0.893	-2.63	-2.036	-19.288	-17.396	-20.149
	[0.407]	[0.482]	[0.430]	[0.728]*	[1.257]	[0.944]*	[0.000]	[0.000]
Observations	33171	33171	33171	33171	14532	14532	14532	14532
Model chi-square	2692.68				2207.54			
df	148				116			
Loglikelihood	-27366				-9841			
Pseudo R2	0.05				0.1			
N of observations	33171				14532			

Note: Standard errors in brackets; * significant at 1%;
Base class is ordinary patents (j=0); Industry(SIC2)- and Patent vintage - effects included

TABLE A8: % BACKWARD CITES THAT ARE SELF-CITES & CONTINUATIONS (PY1981-1994 & PY1995-2000)

Dependent Variable: % of self-cites in backward cites	1981-1994	1995-2000
CAP	-0.007	0.017
	[0.001]*	[0.002]*
CIP	0.005	0.001
	[0.001]*	[0.002]
DIVISIONAL	0.031	0.016
	[0.002]*	[0.002]*
COMBINATION	0.011	0.021
	[0.001]*	[0.003]*
CONSTANT	0.192	0.115
	[0.002]*	[0.001]*
N of Observations	522858	331542
R-squared	0.04	0.03
df	17	9

Note: Robust standard errors in brackets; * significant at 1%;
Base class is No Continuation;
All estimates include tech class- and patent vintage- effects

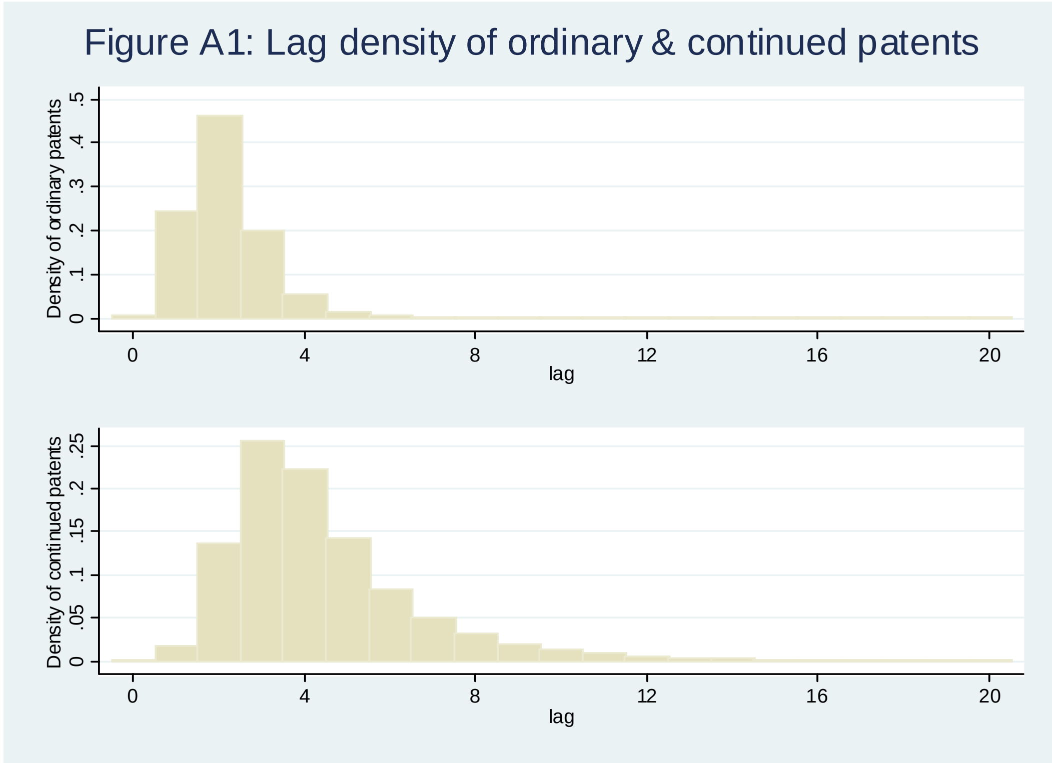


Figure A1: Lag density of ordinary & continued patents
Density of ordinary patents
0
.1
.2
.3
.4
.5
0
4
8
12
16
20
lag
Density of continued patents
0
.05
.1
.15
.2
.25
0
4
8
12
16
20
lag

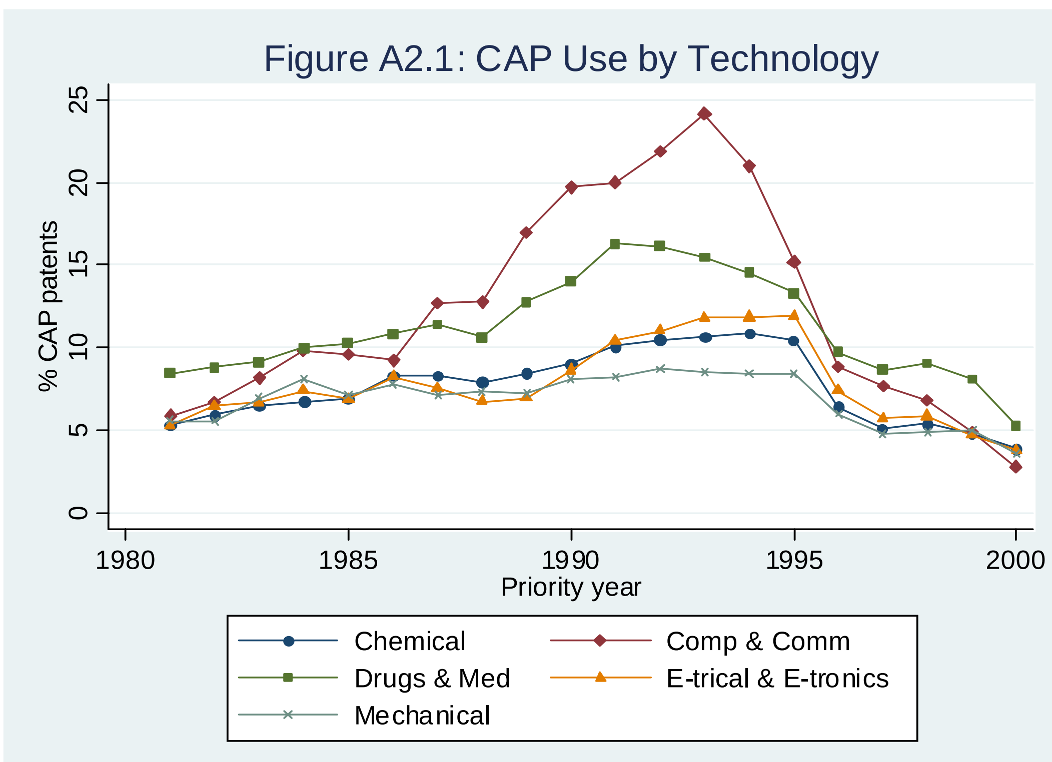


Figure A2.1: CAP Use by Technology
% CAP patents
0
5
10
15
20
25
1980
1985
1990
1995
2000
Priority year
Chemical
Comp & Comm
Drugs & Med
E-trical & E-tronics
Mechanical

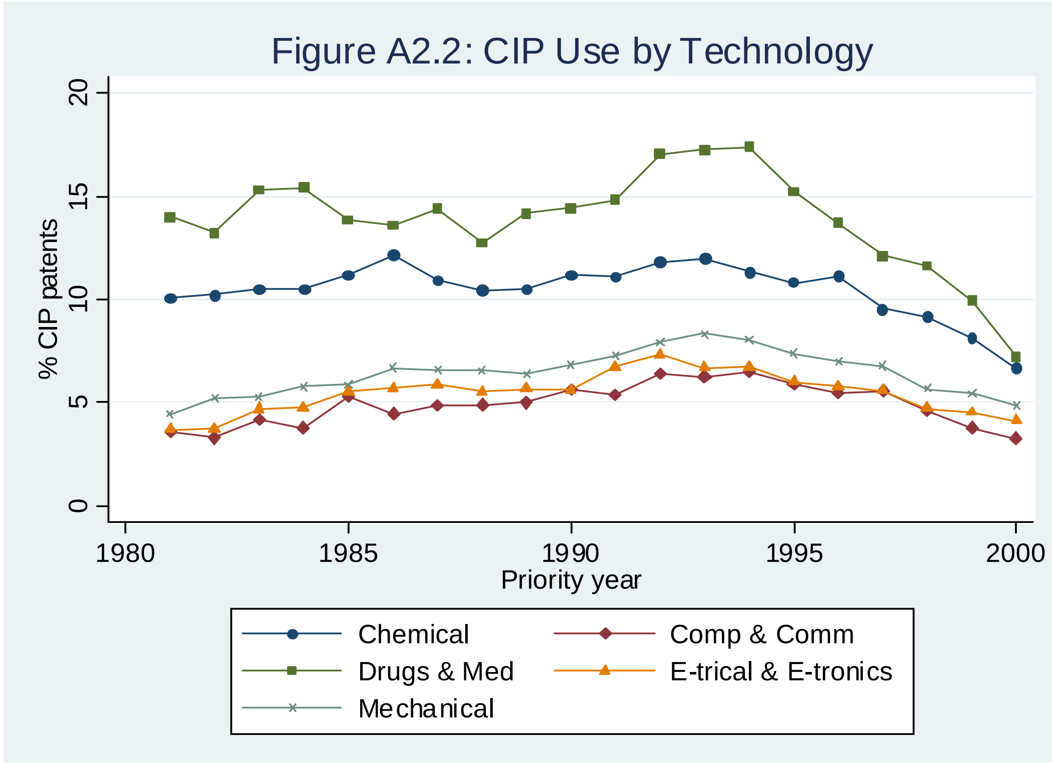


Figure A2.2: CIP Use by Technology
% CIP patents
0
5
10
15
20
1980
1985
1990
1995
2000
Priority year
Chemical
Comp & Comm
Drugs & Med
E-trical & E-tronics
Mechanical

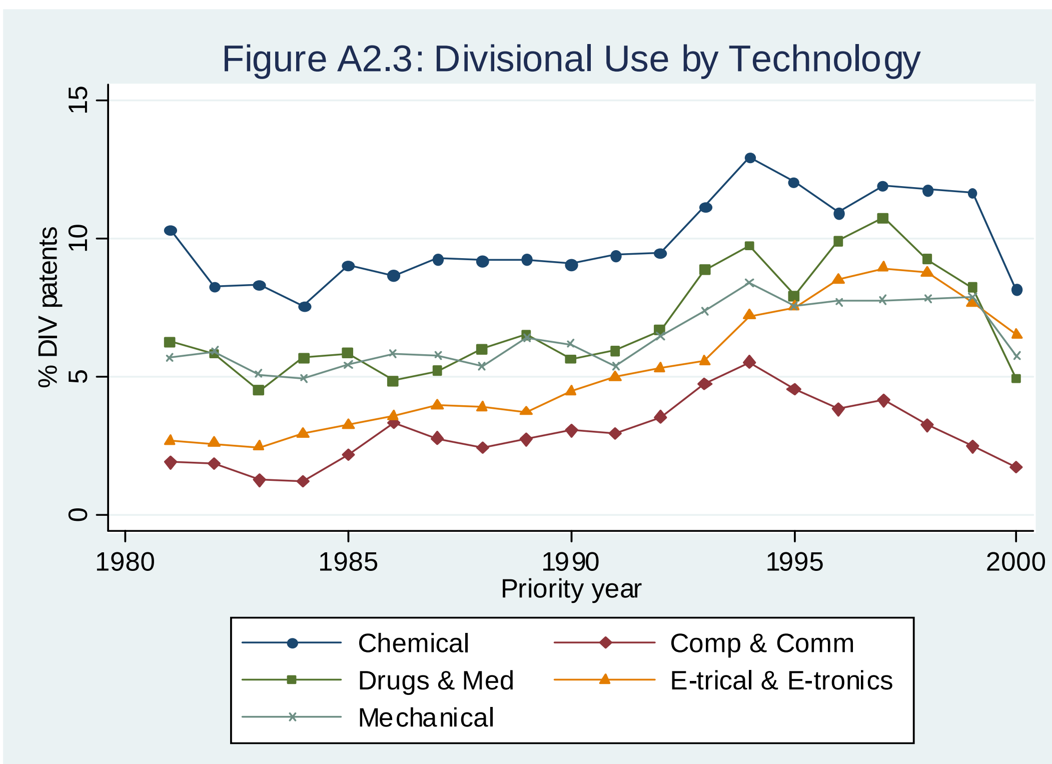


Figure A2.3: Divisional Use by Technology
% DIV patents
0
5
10
15
1980
1985
1990
1995
2000
Priority year
Chemical
Comp & Comm
Drugs & Med
E-trical & E-tronics
Mechanical