

Examiner Citations, Applicant Citations, and the Private Value of Patents

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ABSTRACT

Patent citation based measures are commonly used as proxies for spillovers and for the private value of patented innovations. Previous research suggests that a significant share of citations come from examiners rather than applicants and this may complicate the use of citations to measure spillovers. This paper assesses how the number of examiner- and applicant- citations to a patent relate to one commonly used measure of the *private value* of innovations: whether a patent is maintained in force by the payment of renewal fees. We use data on the source of citations between the years 2001-2005 and find that the number of times a patent is cited by examiners has a much stronger relationship with this measure of private value than the number of applicant citations. This finding may reflect differences in the incentives faced by applicants and examiners in citing previous patents.

Keywords: Innovation, Patents, Citations, Spillovers

JEL Classifications: O30, O34, K11

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1 Introduction

The applied economics literature on technological change increasingly employs patent citation based measures as economic indicators. One line of research uses the number of times a patent is cited in subsequent patents, or “forward” citations, as a proxy for its “private value.”¹ The theory behind this use is that “the very existence of those later patents attests to the fact that the cited patents opened the way to a technologically successful line of innovation” (Trajtenberg 1990, p 174). Forward citations are also used as measures of “knowledge spillovers” under the assumption that “a citation of Patent X by Patent Y means that X represents a piece of previously existing knowledge upon which Y builds” (Jaffe *et al* 1993).²

Recent studies exploit the post-2001 distinction made by the USPTO between examiner and applicant citations in patents and show that a substantial share of citations (41 percent, overall) are inserted by examiners rather than applicants (Sampat 2008, Alcacer & Gittleman 2006). This may undermine the theory that citations reflect knowledge spillovers or flows, since the inventor may not have been aware of the patents cited by examiners at the time of invention (Thompson 2006).

The effect of examiner-inserted citations on the use of citations as measures of the private value of patents, however, have not yet been investigated. In this paper, we assesses how examiner- and applicant- citations to a patent relate to one commonly used measure of private value –whether a patent is renewed or allowed to expire -- by linking information on patent renewals and citations data for all patents issued in 1992, 1996, and 2000. We find that examiner citations have a significantly stronger relationship with renewal probability than the number of applicant citations. This empirical relationship may reflect differences in applicant and examiner incentives to cite prior art, as we discuss in the conclusion below.

¹ The private value of a patent is the incremental economic value to the owner from possessing a patent for her invention.

² Knowledge spillovers are the social value of an invention net of the value captured by its inventor.

2 Data

2.1 Patterns in forward citations

We investigate whether examiner and applicant forward citations are different by constructing standard forward citation based “importance” measures (cf. Jaffe & Trajtenberg 2002) for the 97,444 patents issued in 1992, the 109,645 patents issued in 1996, and the 157,594 patents issued in 2000. For each of these patents, we create four measures of importance:

1. The total number of times the patent was cited in patents issued before December 31, 2000.
2. The total number of times the patent was cited in patents issued between January 1, 2001 and December 31, 2005
3. The total number of times the patent was cited by examiners in patents issued between January 1, 2001 and December 31, 2005
4. The total number of times the patent was cited by applicants in patents issued between January 1, 2001 and December 31, 2005

Table 1 shows that the distribution of each of the four citation variables is highly skewed, with most patents receiving zero or few citations but a handful of patents generating a large number of citations. Column 1 shows that patents issued in 1992 generate the most cumulative citations by December 2000, followed by patents issued in 1996 and those issued in 2000. This reflects right-hand censoring of citations data: for later cohorts, we observe fewer citing years and thus fewer citations. Columns 2 through 4 show the means of overall, applicant, and examiner citations in citing patents issued between 2001 and 2005. Because examiners tend to cite newer patents, the mean number of applicant citations (in patents issued between 2001 and 2005) is 70% as large as mean overall citations (over the same period) for the 1992 cohort, 66% as large in for patents issued in 1996, and 46% as large as mean overall citations in the 2000 cohort.

2.2 Patent renewal data

U.S. patent owners face three renewal decisions during the life time of their patents. Renewal or maintenance fees are due at the end of the 4th, 8th, and 12th year after the issue date of the patent. If the owners decide not to pay the maintenance fee at one of these points, the patent protection lapses and cannot be reinstated. The maintenance fees generally start at very low levels but increase monotonically as the patent ages (Schankerman 1998).

We collect renewal data for each of the patents in our sample as of 2004. For the 1992 cohort, we have information on whether the patent was renewed at 4 years, at 8 years, and at 12 years from issue. For the 1996 cohort, we have information on 4 year and 8 year renewals, and for the 2000 cohort, we have information on 4 year renewals. Table 2 shows the share of patents renewed at each maintenance fee payment window. Multiplying the per-period probabilities shows that only 43 percent of patents issued in 1992 were renewed to their full term.

3 Patent renewals and forward citations from examiners and applicants

Do citations to a patent from applicants and examiners differentially predict whether the patent will be renewed? To address this, we estimated linear probability models of the effects of citations on the probability of renewal (for patents which are unexpired at a given point in time).³ We pooled the 1992, 1996, and 2000 cohorts, and included as explanatory variables cohort dummies, all citations to 2000 to the patents, examiner and applicant citations from 2001-5 interacted with each of the cohort dummies, and 3-digit patent class dummies.

Table 4 shows the results. Column 1 shows that for the first renewal period (4 years). For each of the cohorts, citations to 2000 are positively and significantly related to probability of renewal, consistent with previous research (Putnam et al. 1998). For the 1992 cohort, examiner citations between 2000 and

³ Probit models yielded results similar to LPM estimates, and are available from the authors on request.

2001 are related to the probability of renewal, but applicant citations over the same period are not. For the 1996 and 2000 cohorts, both examiner and applicant citations are positively and significantly related to renewal, but the magnitude of the effect of examiner citations is twice as large in 1996 and 1.7 times as large in 2000. For each cohort, the point estimate for examiner citations is significantly different from that for applicant citations ($p = 0, 0.05, \text{ and } 0$ respectively for 1992, 1996, and 2000). Recall that for the 1992 and 1996 cohorts, we observe applicant and examiner citations after their 4 year renewal choice. For patents issued in 2000, the bulk of citations between 2001 and 2005 precede their first renewal period. Taken together, these results suggest that not only do examiner citations have a stronger effect on whether a patent was renewed, but also whether it *will be* renewed.⁴

Columns 2 and 3 show similar results for the 8 and 12 year renewal periods, respectively. Note that the 2000 cohort drops out of each of these models (since the 8 and 12 year citation periods for these patents don't occur until 2008 and 2012) and the 1996 cohort drops out of the third model (since the twelve year renewal decision for these patents does not occur until 2008).

4 Conclusions

Our results show that citations from examiners are stronger predictors of whether a patent was renewed, or will be renewed, than applicant citations. That is, examiner citations are more strongly related to a commonly used measure of the private value of patents. While our main aim here is to document the above empirical regularity, we conclude by suggesting that our result may reflect differences in applicant and examiner incentives in citing “prior art.”

⁴ W also calculated the examiner- and applicant- importance measures by excluding “self-citations.” This reduced the absolute effect of examiner and applicant citations on renewal probabilities. However, our substantive result, that examiner citations more strongly predict patent renewals, did not change by excluding self-citations.

Applicants have a duty of candor to reveal previous patents that are related to their inventions. However, applicants may not cite patents that obviously impinge on their claimed inventions but instead narrow their patent claims to avoid such prior art. In this context, the bulk of applicant citations in a may be to previous patents that support, rather than undermine, their claims of patentability. Hence, patents that are cited by many later applicants are likely to be those that facilitated but did not undermine downstream inventions.

On the other hand, the examiner's role in the patent prosecution process is to serve as "both judge and devil's advocate" (Lemley 2001, p. 1502). Examiners conduct searches to locate previous patents (and other prior art) that reject claims or force claim amendments. Applicants can then amend their claims or respond to such rejections. But whether or not examiner citations actually defeat claims, they are listed on the front page of patents. This suggests that examiners cite previous patents which "block" (rather than facilitate) numerous subsequent claims, *i.e.* examiners cite patents of broader scope. The broader scope of patents with numerous examiner citations may also suggest why they are more likely to be renewed: such patents may be more valuable because they protect broader technological domains.

We admit that our interpretation of the reasons for the differential impact of applicant and examiner citations on renewal rates is speculative, and it remains for future research to analyze the relationships between applicant and examiner citations, and other measures of private value of inventions, including market value of inventions, licensing revenues, and survey-based measures of patent value.

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Tables

Table 1: Summary Statistics for Forward Citation Measures, By Issue Year of Cited Patent

Variable	All Citations to 2000	All Citations 2001-05	Applicant Citations 2001-05	Examiner Citations 2001-05
Patents issued in 1992				
Mean	6.4	4.0	2.8	1.2
Std. Dev.	9.4	8.2	7.3	1.9
10th Percentile	0	0	0	0
Median	4	2	1	1
90th Percentile	15	9	7	3
Min	0	0	0	0
Max	366	431	401	70
N	97444	97444	97444	97444
Patents issued in 1996				
Mean	3.6	5.8	3.8	1.9
Std. Dev.	5.5	9.8	8.2	2.8
10th Percentile	0	0	0	0
Median	2	3	1	1
90th Percentile	9	14	10	5
Min	0	0	0	0
Max	280	394	281	137
N	109645	109645	109645	109645
Patents issued in 2000				
Mean	0.0	4.7	2.2	2.5
Std. Dev.	0.2	7.2	5.0	3.5
10th Percentile	0	0	0	0
Median	0	2	1	1
90th Percentile	0	11	5	6
Min	0	0	0	0
Max	7	185	130	122
N	157594	157594	157594	157594

Table 2: Share of Patents Renewed at 4, 8, and 12 Years, By Issue Year

Issue Year	Renewed at 4	Renewed at 8	Renewed at 12
1992	0.81	0.75	0.71
1996	0.86	0.75	
2000	0.86		

Table 3: Linear Probability Models of the Effect of Citations on Renewal

	Renewed at 4?	Renewed at 8? (If renewed at 4)	Renewed at 12? (If renewed at 8)
Y1992 X Citations to 2000	0.003** [0.000]	0.003** [0.000]	0.003** [0.000]
Y1992 X Examiner Citations 2001-05	0.004** [0.001]	0.006** [0.001]	0.006** [0.001]
Y1992 X Applicant Citations 2001-05	0 [0.000]	0.001** [0.000]	0.001** [0.000]
Y1996 X Citations to 2000	0.002** [0.000]	0.003** [0.000]	
Y1996 X Examiner Citations 2001-05	0.002** [0.000]	0.004** [0.001]	
Y1996 X Applicant Citations 2001-05	0.001** [0.000]	0.003** [0.000]	
Y2000 X Examiner Citations 2001-05	0.005** [0.000]		
Y2000 X Applicant Citations 2001-05	0.003** [0.000]		
Y1996	0.050** [0.002]	-0.002 [0.003]	
Y2000	0.044** [0.002]		
Constant	0.788** [0.001]	0.724** [0.002]	0.674** [0.002]
Patent Class effects	Y	Y	Y
Observations	364682	172844	59446
Adjusted R-squared	0.04	0.03	0.03
Standard errors in brackets; * significant at 5%; ** significant at 1%			