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ALICE'S AFTERMATH: CHANGES IN PATENTEE BEHAVIOR SINCE ALICE V. CLS BANK

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Introduction

In 2013, a sharply divided en banc Federal Circuit decided in *CLS Bank Int'l v. Alice Corp.* that a computerized platform for conducting certain kinds of financial transactions was an abstract idea and thus not the kind of invention that could be patented.¹ Judge Moore, in partial dissent, asserted that “this case is the death of hundreds of thousands of patents, including all business method, financial system, and software patents as well as many computer implemented and telecommunications patents.”² At a low estimate, Judge Moore explained, this included the 320,799 patents granted in the “Electrical Computers, Digital Processing Systems, Information Security, Error/Fault Handling” technology area between 1998 and 2011.³ The Federal Circuit’s judgment was unanimously affirmed on appeal to the United States Supreme Court in *Alice Corp. v. CLS*

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¹ *CLS Bank Int'l v. Alice Corp.*, 717 F.3d 1269 (Fed. Cir. 2013) (en banc) (per curiam). The case was notable for producing seven opinions and no majority opinion.

² *Id.* at 1313 (Moore, J., dissenting in part).

³ *Id.* at 1274, n.1.

Bank.⁴ In the wake of the decision the United States Patent and Trademark Office (PTO) has issued several pieces of guidance to examiners regarding the application of *Alice*. The first was issued a week after the Supreme Court decision and the fourth and most recent in May 2016.⁵

The Supreme Court's decision in *Alice* was the most recent in a line of cases that have generally restricted patentable subject matter.⁶ The first of these cases, decided in 2010, was the first significant Supreme Court statement on this issue since 1981.⁷ Thus, this line of cases represents a potentially significant shift in the law of patentable subject matter.

Much has been written—and continues to be written—about the appropriate breadth of patentable subject matter and the most efficient use of patentable subject matter as a screen or filter during patent examination and litigation.⁸ For my own part, I have previously argued that patentable subject matter should have a

⁴ *Alice Corp. v. CLS Bank Int'l*, 134 S.Ct. 2347 (2014) (9-0 decision) (Sotomajor, J., concurring).

⁵ Memorandum from Andrew H. Hirshfield, Deputy Commissioner on Patent Examination Policy on Examination Instructions in View of the Supreme Court Decision in *Alice Corp. Pty. Ltd. v. CLS Bank Int'l* (Jun. 25, 2014), https://www.uspto.gov/sites/default/files/patents/announce/alice_pec_25jun2014.pdf [<https://perma.cc/855L-P2YJ>]; 2014 Interim Guidance on Patent Subject Matter Eligibility, 79 Fed. Reg. 74,618 (Dec. 16, 2014) (to be codified at 37 C.F.R. pt. 1), <https://www.gpo.gov/fdsys/pkg/FR-2014-12-16/pdf/2014-29414.pdf> [<https://perma.cc/952A-UB5H>]; *July 2015 Update: Subject Matter Eligibility*, U.S. PATENT AND TRADEMARK OFFICE (2015), <https://www.uspto.gov/sites/default/files/documents/ieg-july-2015-update.pdf> [<https://perma.cc/9AWQ-DVYJ>]; Memorandum from Robert W. Bahr, Deputy Commissioner for Patent Examination Policy on Formulating a Subject Matter Eligibility Rejection and Evaluating Applicant's Response to a Subject Matter Eligibility Rejection (May 4, 2016), <https://www.uspto.gov/sites/default/files/documents/ieg-may-2016-memo.pdf> [<https://perma.cc/C8CT-Q2JY>].

⁶ *Ass'n for Molecular Pathology v. Myriad*, 133 S.Ct. 2107 (2013) (holding that a naturally occurring DNA segment is a product of nature and not patent eligible); *Mayo Collaborative v. Prometheus Labs*, 132 S.Ct. 1289 (2012) (holding that patent claims based on a natural law or phenomenon must “add *enough* to their statements of the correlations to allow the processes they describe to qualify as patent-eligible processes that *apply* natural laws”) (emphasis in original); *Bilski v. Kappos*, 561 U.S. 593 (2010) (holding that the machine-or-transformation test is a “useful and important clue” but “not the sole test for deciding whether an invention is a patent-eligible ‘process’”).

⁷ *Diamond v. Diehr*, 450 U.S. 175 (1981).

⁸ See, e.g., PERSPECTIVES ON PATENTABLE SUBJECT MATTER (Michael Abramowicz, James E. Daily & F. Scott Kieff eds., 2014) (collecting thirteen articles on patentable subject matter); Dennis Crouch & Robert P. Merges, *Operating Efficiently Post-Bilski by Ordering Patent Doctrine Decision-Making*, 25 BERKELEY TECH. L.J. 1673 (2010) (arguing that patentable subject matter is most efficiently employed after first testing patents for novelty, nonobviousness, and an adequate written description).

broad scope.⁹ But this Article is not concerned with whether *Alice* or its predecessors were rightly or wrongly decided or what the proper scope of patentable subject matter should be. Rather, this Article is an empirical study of *Alice*'s effects, for good or ill. In particular, this Article seeks to determine whether Judge Moore's prediction has been borne out and what that might mean for the future.

Background and Prior Work

The substantial effects of *Alice* on litigation in the federal courts and at the Patent Trial and Appeal Board (PTAB) have already been noted.¹⁰ *Alice*'s effects on patent applications, particularly in the finance arts, have also been observed.¹¹ But as Judge Moore implied, the greatest potential impact would be on the millions of already-issued patents, since only about 1.5% of patents are ever subject to litigation or administrative review and perhaps a tenth of those receive a decision on the merits of their validity.¹² Thus, although *Alice* appears to have had a substantial impact on litigated patents and patents subject to administrative review, that is a small fraction of the patents potentially affected by *Alice*. Further, as a class, litigated patents are known to be different from the general population—and patents that reach a decision on the merits are different still—and so it is possible that *Alice*'s effect would be felt differently between litigated and non-litigated patents.¹³

⁹ See generally James E. Daily & F. Scott Kieff, *Anything Under the Sun Made by Humans: Patent Law Doctrines as Endogenous Institutions for Commercializing Innovation*, 62 EMORY L.J. 967 (2013).

¹⁰ Jasper L. Tran, *Two Years after Alice v. CLS Bank*, 98 J. PAT. TRADEMARK. SOC'Y 354 (2016) (cataloging the invalidation of 378 patents in the courts and 186 by the PTAB in cases citing *Alice*).

¹¹ Mark Nowotarski, *Surviving Alice in the Finance Arts*, FENWICK & WEST: BILSKI BLOG (Jan. 30, 2017), <http://www.bilskiblog.com/blog/2017/01/surviving-alice-in-the-finance-arts-1.html> (noting an increase in abandonments and appeals and a decrease in allowances among financial arts applications since *Alice*) [<https://perma.cc/8QDK-DDAN>]; Robert R. Sachs, *Two Years after Alice: A Survey of the Impact of a "Minor Case" (Part 2)*, FENWICK & WEST: BILSKI BLOG (June 20, 2016), <http://www.bilskiblog.com/blog/2016/06/two-years-after-alice-a-survey-of-the-impact-of-a-minor-case-part-2.html> (noting a substantially decreased allowance rate in Technology Center 3600 and a substantial increase in rejections based on patentable subject matter since *Alice*) [<https://perma.cc/34FM-3A3F>].

¹² Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1507 (2001) (noting that only 1.5% of patents become the subject of district court litigation); John R. Allison, Mark A. Lemley & David L. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1780 (2013) (noting that only about 10% of patent cases reach any kind of decision on the merits).

¹³ John R. Allison, Mark A. Lemley, Kimberly A. Moore & R. Derek Trunkey, *Valuable*

One way to estimate the number of patents potentially affected by *Alice* is to essentially multiply the number of software and business method patents by the invalidation rate.¹⁴ Jasper L. Tran's analysis using that method produced an estimate of 199,000 invalid software patents out of a population of 240,000, following a PTAB, district court, and Federal Circuit average invalidation rate of 82.9%.¹⁵ However, as Tran acknowledges, this approach may be susceptible to the selection biases discussed above.¹⁶

Another route is to apply machine learning methods to the large body of rejections based on *Alice* and from there estimate the total number of patents that—were they subject to review of some kind—would likely be invalidated under *Alice*.¹⁷ Ben Dugan has concluded that approximately 14% of all patents issued between 2001 and 2013 (inclusive) would likely be invalid under *Alice*, including about 70% of software patents issued in the same period.¹⁸ Dugan's analysis, although less susceptible to selection bias since it was based on data from examination rather than litigation, was somewhat error-prone, having both precision and recall of about 75%.¹⁹

Rather than considering rejections or invalidations, Mark Summerfield looked directly at the patent grant rate from 2007-2015.²⁰ Under that analysis he found that *Alice* “killed about 75% of all [business method] patent applications stone dead”, with the surviving 25% now having about the same issue rate as the general patent population.²¹ However, Summerfield's results did not show a corresponding decrease in the grant rate for software patents, at least as he defined them.

All of these results broadly agree with each other and generally support Judge Moore's prediction, although it seems clear that something less than “all business method, financial system, and software patents” have been invalidated by

Patents, 92 GEO. L.J. 435 (2004) (comparing litigated patents to patents in general and finding several differences).

¹⁴ Tran, *supra* note 10, at 355.

¹⁵ *Id.*

¹⁶ *Id.*

¹⁷ Ben Dugan, *Estimating the Impact of Alice v. CLS Bank Based on a Statistical Analysis of Patent Office Subject Matter Rejections*, pg. 1 (Feb. 23, 2016) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2730803 [<https://perma.cc/Q6BN-QVGR>].

¹⁸ *Id.* at 34-35.

¹⁹ *Id.* at 35.

²⁰ Mark Summerfield, *How the Fate of Software and Business Method Patents has Turned on USPTO Directors and the Courts*, PATENTOLOGY (Jan. 8, 2017), <http://blog.patentology.com.au/2017/01/how-fate-of-software-and-business.html> [<https://perma.cc/PBJ8-GWUL>].

²¹ *Id.*

Alice.²² However, although notable for being comprehensive within their scope, these analyses also suffer from a common flaw: they are estimates of hypothetical validity determinations that will likely never occur. This motivated a different approach based on directly observing changes in the most common cause of death for patents: abandonment for failure to pay maintenance fees.

After a patent issues, its owner must pay a series of increasingly expensive maintenance fees due three and a half, seven and a half, and eleven and a half years after the issue date.²³ Failure to pay the maintenance fee generally results in abandonment or expiration of the patent.²⁴ Because maintenance fees are due approximately every four years, one would expect that *Alice*'s effect, if any, would largely be felt within four years of the decision.²⁵ Now almost three years after *Alice*, there would seem to be enough data to determine the size of its actual impact.

It should be noted that this approach does not consider those patents for which the third maintenance fee had already been paid before *Alice* but for which the patent owner would not have paid the fee had it been due afterward. Although a patentee may voluntarily abandon a patent by filing a disclaimer under 35 USC § 253, these were assumed to be rare because a disclaimer requires the payment of a fee whereas allowing a patent to lapse is free.²⁶ Thus, this analysis necessarily undercounts older patents that are considered invalid by their owners but which technically remain in force or that were abandoned by disclaimer rather than a failure to pay the maintenance fee.

Methodology

Data was collected from the PTO's 2015 Patent Examination Research Dataset (PatEx), the Patent Maintenance Fee Event dataset, and the Patent Application Information Retrieval (PAIR) Bulk Data system, which was used to bring the 2015 data up to date.²⁷ The dataset, while generally accurate and comprehensive, is not completely error-free. There are misspellings, miscodings, and

²² CLS Bank Int'l v. Alice Corp., 717 F.3d 1269, 1313 (Fed. Cir. 2013) (en banc) (per curiam) (Moore, J., dissenting in part).

²³ 35 U.S.C. § 41(b)(1) (2012); 37 C.F.R. § 1.20(e)-(g) (2013).

²⁴ 35 U.S.C. § 41(c) (2012).

²⁵ Although maintenance fees are due six months short of every four years, there is a six-month grace period during which the fee may be paid along with a negligible late fee. 35 U.S.C. § 41(b)(2) (2012); 37 CFR § 1.20(g)-(h) (2012).

²⁶ 35 USC § 253 (2011).

²⁷ U.S. PATENT AND TRADEMARK OFFICE, PATENT EXAMINATION RESEARCH DATASET (PUBLIC PAIR), <https://www.uspto.gov/learning-and-resources/electronic-data-products/patent-examination-research-dataset-public-pair> (last visited Apr. 5, 2017) [<https://perma.cc/F4SB-LBPH>]; U.S. PATENT AND TRADEMARK OFFICE, BULK DATA STORAGE

omissions, but these errors were assumed to be randomly distributed.

Because of the large number of records (approximately 50 million rows across several tables in the subset used for this analysis), the data was imported into a MySQL relational database for more efficient querying.²⁸ In general, the analysis was limited to utility patents granted on applications filed on or after June 8th, 1995.²⁹ The study window was January 1st, 2006 to April 30th, 2017, chosen to start a year before the Supreme Court's modern § 101 cases began with *Bilski v. Kappos* and ending with the most complete PTO data available at the time the analysis was performed.³⁰

Several of the analyses in this Article differentiate between *software* and *business method* patents and all other patents. Unfortunately, there is no agreed-upon definition for such patents, and any feasible definition will tend to be both under- and over-inclusive.³¹ With those risks in mind, I broadly followed the definition used by Graham and Vishnubhakat in their 2013 work on software patents in the smartphone litigation context.³² Their definition leverages the Patent Office's preexisting classification of patents according to the United States Patent Classification (USPC) system, which divides patents into about 450 technology classes, which are further subdivided into over 150,000 subclasses, which delineate "processes, structural features, and functional features" of the technology encompassed by the class.³³

I defined software and business method patents to be those patents classified as belonging to USPC classes 235-36, 250, 257, 307, 315, 320, 323-24, 326-27,

SYSTEM (BDSS), <https://bulkdata.uspto.gov/data2/patent/maintenancefee/> (last visited Apr. 5, 2017) [<https://perma.cc/Z8JL-XJQX>]; U.S. PATENT AND TRADEMARK OFFICE, PAIR BULK DATA, <https://pairbulkdata.uspto.gov/> (last visited Apr. 5, 2017) [<https://perma.cc/8XS3-JTXB>].

²⁸ MySQL, <https://www.mysql.com>. (last visited Apr. 5, 2017) [<https://perma.cc/U9CN-LWJD>]. The precise datasets and queries used are available from the author on request.

²⁹ This date was chosen somewhat arbitrarily, but it is distant enough that it should encompass more or less all patents in force during the study window, and it avoids complications from patents filed before the Uruguay Round Agreements Act changed the basis of the calculation of the patent term from seventeen years after the date of issue to twenty years after the date of filing. Uruguay Rounds Agreements Act, Pub.L. 103-465, 108 Stat. 4809 (repealed in part).

³⁰ *Bilski v. Kappos*, 561 U.S. 593 (2010).

³¹ See generally Anne Layne-Farrar, *Defining Software Patents: A Research Field Guide* (Feb. 15, 2006) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1818025 [<https://perma.cc/2SYX-PW5N>].

³² Stuart Graham & Saurabh Vishnubhakat, *Of Smart Phone Wars and Software Patents*, 27 J. ECON. PERSP. 67, 74-76 (2013).

³³ *Overview of the U.S. Patent Classification System (USPC)*, U.S. PATENT AND TRADEMARK OFFICE 1.4.1 (Dec. 2012), <https://www.uspto.gov/sites/default/files/patents/resources/classification/overview.pdf> [<https://perma.cc/9MS8-5J58>].

330-31, 341, 343, 345, 348, 353, 355, 363, 365, 368, 370, 374-75, 380-86, 398, 455, 700-19, 725-26, and 901-02. These include the classes for coded data, computer graphics, data processing, financial and business methods, information security, and electronic funds transfer.³⁴ This represents all of the complete classes used by Graham and Vishnubhakat, plus four classes of which Graham and Vishnubhakat used only a significant subset.³⁵ This tradeoff was chosen as a reasonable compromise between accuracy and ease of implementation.³⁶

Several of the analyses in this Article are based on the *abandonment rate* of issued patents. I define the abandonment rate for a given period of time and population of patents as:

$$\text{Abandonment Rate} = \frac{\text{Patents}_{\text{abandoned}}}{\text{Patents}_{\text{abandoned}} + \text{Patents}_{\text{maintained}}}$$

Where $\text{Patents}_{\text{abandoned}}$ is the number of patents abandoned for failure to pay a maintenance fee and $\text{Patents}_{\text{maintained}}$ the number of patents for which a maintenance fee was paid.

The intuition behind this measure is that it implicitly answers the question “how often are patentees abandoning patents rather than paying the maintenance fee?” In addition to controlling for changes in the size of the patent population over time, this measure has the added benefit of being more straightforward to calculate than the percentage of patents-in-force abandoned in a given year.

To determine the effect of the Court’s decision, I used the CausalImpact package for the R statistical analysis program.³⁷ CausalImpact uses a Markov chain Monte Carlo algorithm to estimate the causal effect of a designed intervention on a time series.³⁸ The algorithm relies on certain assumptions, most importantly

³⁴ U.S. PATENT AND TRADEMARK OFFICE, US CLASSES BY NUMBER WITH TITLE MENU, <https://www.uspto.gov/web/patents/classification/selectnumwithtitle.htm> (last visited Apr. 5, 2017) [<https://perma.cc/K7SL-XKYV>].

³⁵ See Graham & Vishnubhakat, *supra* note 32 at 75-76.

³⁶ Layne-Farrar, *supra* note 31, at 31 (noting that a purely class-based definition, while somewhat over-inclusive of pure-hardware patents, was likely less risky than a keyword-based definition).

³⁷ Kay H. Brodersen, et al., *Inferring Causal Impact Using Bayesian Structural Time-Series Models*, 9 ANNALS OF APPLIED STATS. 247 (2015), <https://research.google.com/pubs/pub41854.html> [<https://perma.cc/3KFZ-HBAQ>]; THE R FOUNDATION, THE R PROJECT FOR STATISTICAL COMPUTING, <https://www.r-project.org/> (last visited Apr. 5, 2017) [<https://perma.cc/A4AV-ZC76>].

³⁸ Brodersen, *supra* note 37; THE R FOUNDATION, *supra* note 38. Whether the effect was

that “the outcome time series can be explained in terms of a set of control time series that were themselves not affected by the intervention.”³⁹ In this case the outcome time series consisted of measurements for software and business method patents, while the control time series consisted of measurements for all other patents. Excerpts of some of the data are shown in Tables 1 and 2. Critical to this analysis is the assumption that *Alice* would primarily or exclusively affect software and business method patents. Although patent maintenance fee payments and non-payments do not include any explicit statement of intent by the patent owner, evidence from the patent prosecution and litigation contexts show that *Alice* is cited far more often against software and business method patents and applications than other types of patents and applications.

month	software aban- doned	soft- ware paid	software abandon- ment rate	non-soft- ware aban- doned	non-soft- ware paid	non-soft- ware abandon- ment rate
2006-01-01	329	4553	0.067390414	2261	13449	0.143921069
2006-02-01	315	5413	0.054993017	2164	16614	0.11524124
2006-03-01	409	5160	0.07344227	3134	16738	0.15770934
2006-04-01	424	5090	0.076895176	2633	15055	0.148857983
2006-05-01	571	4336	0.116364377	3441	14276	0.19422024

Table 1. An excerpt of data used for the analysis shown in Figure 2. The response variable is the absolute number of software patents abandoned each month.

month	software abandonment rate	non-software abandonment rate
2006-01-01	0.067390414	0.143921069
2006-02-01	0.054993017	0.11524124
2006-03-01	0.07344227	0.15770934

in fact caused by the intervention or merely correlated with it depends on several assumptions, but the evidence suggests they are satisfied in this case.

³⁹ KAY H. BRODERSEN ET AL., CAUSALIMPACT: AN R PACKAGE FOR CAUSAL INFERENCE IN TIME SERIES, <https://google.github.io/CausalImpact/> (last visited Apr. 5, 2017) [<https://perma.cc/Q9XL-2U7Z>].

2006-04-01	0.076895176	0.148857983
2006-05-01	0.116364377	0.19422024

Table 2. An excerpt of data used to validate the model.

The intervention period for the analysis was defined to be the period between the Federal Circuit's en banc decision on May 10, 2013 and the Supreme Court's decision on June 19, 2014.⁴⁰ The model's assumptions were validated by running analyses on the pre-intervention period using an imaginary intervention on June 1st, 2009, roughly the mid-point of the pre-intervention period. Analyses using both absolute and relative measures found no statistically significant effect from this imaginary intervention (Bayesian one-sided tail-area probabilities $p = 0.094$ and $p = 0.352$, respectively), confirming that software patentee behavior was well-correlated with non-software patentee behavior prior to *Alice* (see Figure 1 and Table 3). This correlation broke down in the post-intervention period (see Table 3), as would be expected if *Alice* had an effect on the outcome time series.

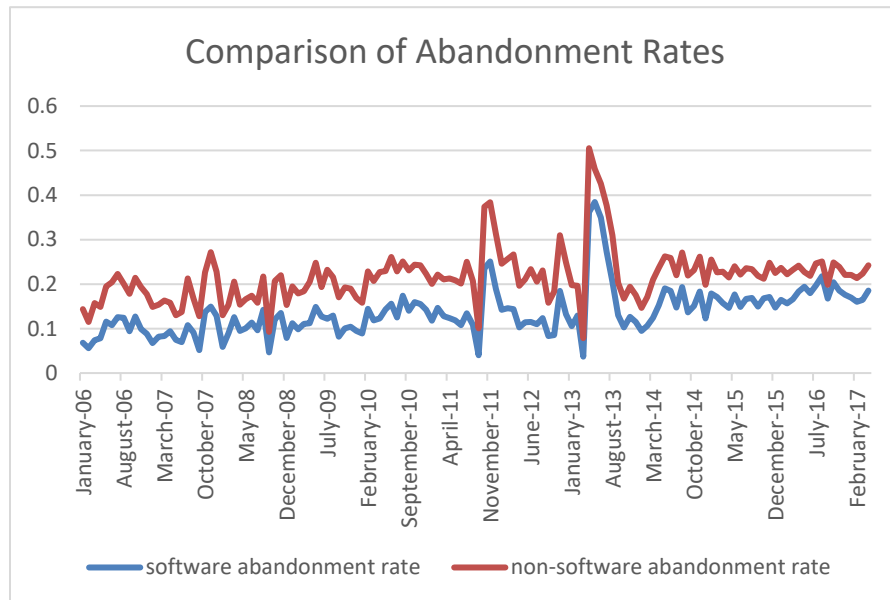


Figure 1. A comparison of software and non-software patent abandonment

⁴⁰ More precisely the intervention period was May 2013-June 2014 because the data was aggregated by month.

rates from January 2006 to April 2017. The two rates are closely correlated in the pre-intervention period. The variability from September 2011 to November 2011 and March 2013 to July 2013 may correspond to America Invents Act effective dates.

	Correlation	95% CI
Entire study period	0.9379695	[0.9139395, 0.9554460]
Pre-intervention period	0.9733552	[0.9595230, 0.9825028]
Post-intervention period	0.6773192	[0.4399142, 0.8262383]

Table 3. Correlations between monthly software and non-software abandonment rates, as shown in Figure 1.

Results

The Supreme Court's decision appears to have had a positive effect on the absolute number of software patents abandoned each month (Figure 2). Table 4 summarizes the result. The absolute and relative effect sizes were substantial, amounting to a 72-83% increase in the number of abandoned software patents and 50,000 – 56,000 total 'excess' abandoned patents. This effect is unlikely to be due to chance (Bayesian one-sided tail-area probability $p = 0.001$). For scale, there were approximately 1 million software and business method patents based on applications filed after June 8th, 1995 and still in force as of June 19th, 2014.

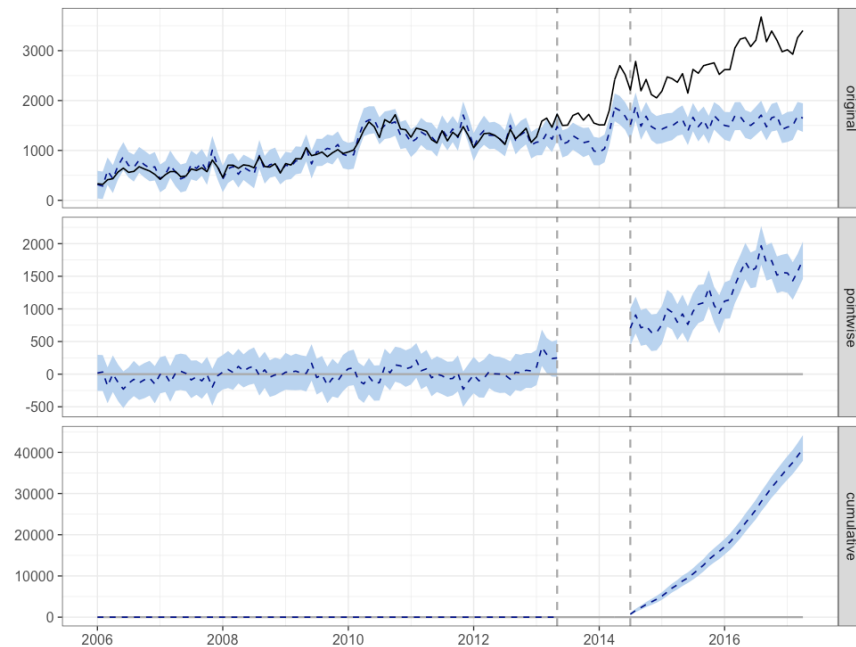


Figure 2. Plot of the CausalImpact analysis of the number of software patents abandoned each month, as predicted by the number of software patent maintenance fee payments, the number of non-software patent abandonments, the number of non-software patent maintenance fee payments, the software patent abandonment rate, and the non-software patent abandonment rate.

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	Average Number of Software Patents Abandoned Per Month	Cumulative Number of Abandoned Software Patents
Actual	2763	93940
Prediction (s.d.)	1561 (47)	53076 (1598)
95% CI	[1463, 1646]	[49758, 55976]
Absolute effect (s.d.)	1202 (47)	40864 (1598)
95% CI	[1117, 1299]	[37964, 44182]
Relative effect (s.d.)	77% (3%)	77% (3%)
95% CI	[72%, 83%]	[72%, 83%]

Table 4. Summary of the CausalImpact analysis, showing an increase in the number of software patents abandoned each month following the May 2013 – June 2014 intervention period.

Limiting the intervention period to June 2014 produced a smaller but still likely significant effect ($p = 0.001$). This result (summarized in Table 5) suggests that patentees had already begun to change their behavior following the Federal Circuit's en banc decision, perhaps reflecting a belief that the Supreme Court was unlikely to significantly narrow the lower court's decision or reverse the course the Court had established in other recent patentable subject matter cases.

	Average Number of Software Patents Abandoned Per Month	Cumulative Number of Abandoned Software Patents
Actual	2763	93940
Prediction (s.d.)	1956 (114)	66518 (3893)
95% CI	[1743, 2183]	[59263, 74235]
Absolute effect (s.d.)	807 (114)	27422 (3893)
95% CI	[580, 1020]	[19705, 34677]
Relative effect (s.d.)	41% (5.9%)	41% (5.9%)
95% CI	[30%, 52%]	[30%, 52%]

Table 5. Summary of the CausalImpact analysis using a narrow intervention

period of June 2014.

So far the analyses have considered software and business method patents as a unified bloc. Considering the USPC classes separately shows that they generally moved together (see Figure 3). No class exhibited a consistent negative trend in the period after *Alice*.

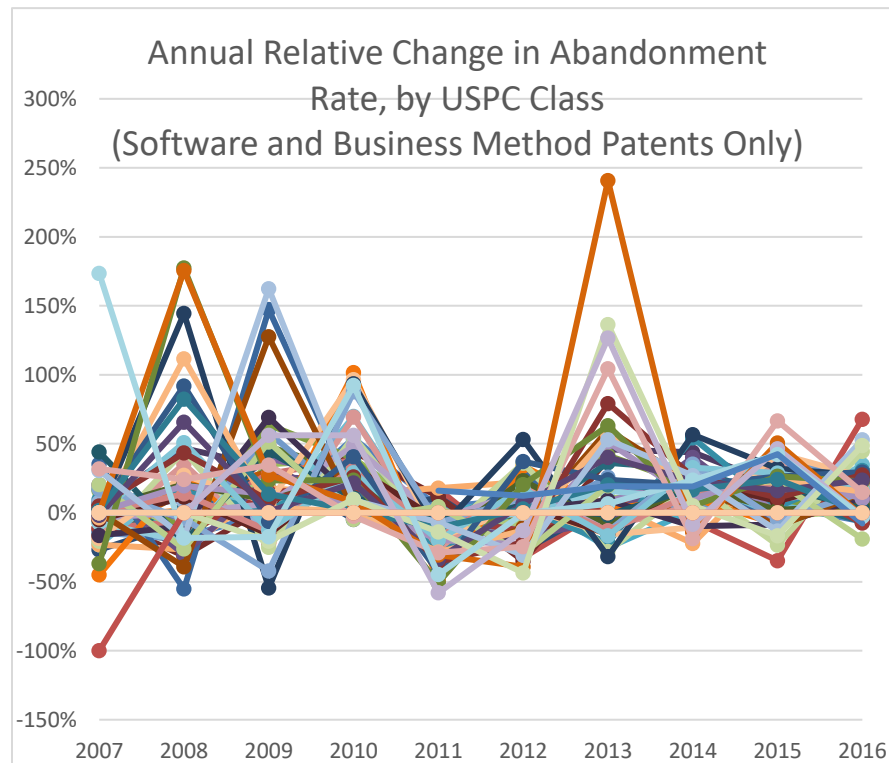


Figure 3. Annual relative change in abandonment rate, by USPC class, showing software and business method patents only. Several classes contain very few patents, leading to high volatility. An extremely high value for class 726 (information security) was removed for clarity, as the class went from one abandoned patent in 2009 to twenty-two in 2010. Classes 901 and 902 were likewise removed for having extremely small sample sizes.

Multiple judges and amici in the *Alice* litigation expressed “concern regarding the proliferation and aggressive enforcement of low quality software patents,”

particularly those owned by non-practicing entities (NPEs).⁴¹ More recently Justice Breyer stated in an unrelated patent case that “there are these things, for better words, let’s call them patent trolls, and [] the Patent Office has been issuing billions of patents that shouldn’t have been issued—I overstate, but only some.”⁴² This raises the question of whether the effects of *Alice* have been more acutely felt by NPEs or patent trolls.

Unfortunately, as with software patents, there is no easy definition of an NPE or patent troll.⁴³ I derived a list of major NPEs and their holding companies from the IP Checkups NPE Tracker.⁴⁴ Together they account for 13,297 software and business method patents in the dataset. Figure 4 shows the abandonment rate for software and business method patents owned by those companies versus such patents owned by other companies, which I used as an admittedly over-inclusive proxy for patents owned by non-NPEs. Although it started from essentially zero, the NPE abandonment rate increased rapidly after *Alice*, growing by approximately a factor of two and substantially exceeding the growth in the abandonment rate among the general patentee population.

A CausalImpact analysis, described in Figure 5 and Table 6 estimates that *Alice* was responsible for 2145 – 2269 NPE-owned software patents being abandoned, amounting to approximately 16.6% of NPE-owned software and business method patents, according to my admittedly limited definition.

⁴¹ CLS Bank Int’l v. Alice Corp., 717 F.3d 1269, 1332 (Fed. Cir. 2013) (en banc) (Linn & O’Malley, JJ., dissenting). See also Brief of Amici Curiae Electronic Frontier Foundation et al. in Support of Appellees and Remand at 4-5, CLS Bank Int’l v. Alice Corp., 717 F.3d 1269 (2012) (No. 2011-1301) (arguing that “the amount of patent litigation has been drastically increasing, particularly cases brought by NPEs and litigation surrounding software patents”).

⁴² Transcript of Oral Argument at 14 ll.8-12, *Cuozzo Speed Techs., L.L.C. v. Lee*, 136 S. Ct. 890 (No. 15-446) (Apr. 25, 2016).

⁴³ Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 629-31 (2008).

⁴⁴ See *PatentCAM*, IP CHECKUPS, <https://www.ipcheckups.com/software-solutions/> [<https://perma.cc/7RPA-UMEZ>]. The derived list includes companies such as Acacia Research and its subsidiaries, Wi-LAN, Intellectual Ventures, Rambus, and Mosaid.

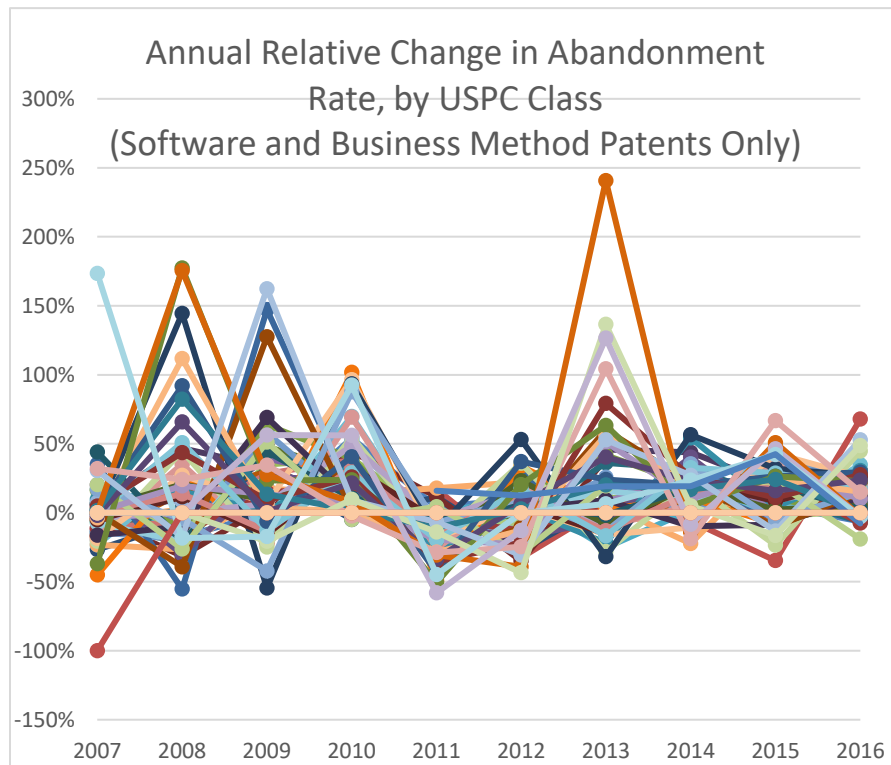


Figure 4. Comparison of the abandonment rate for NPE-owned and non-NPE-owned software and business method patents.

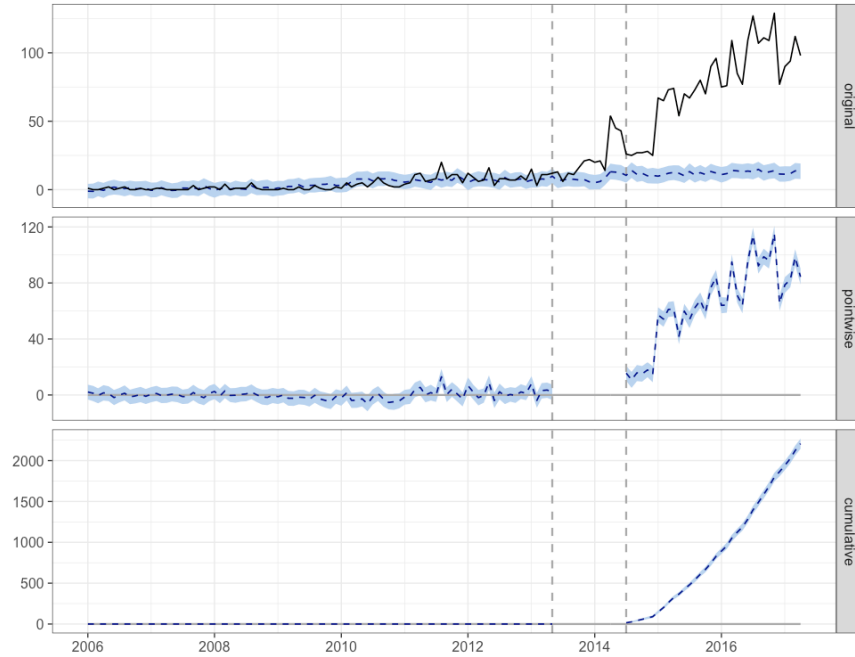


Figure 5. Plot of the CausalImpact study of Alice's effect on NPE-owned software patent abandonments.

	Average Number of NPE-Owned Software Patents Abandoned Per Month	Cumulative Number of Abandoned NPE- Owned Software Pa- tents
Actual	77	2622
Prediction (s.d.)	12 (0.96)	414 (32.52)
95% CI	[10, 14]	[353, 477]
Absolute effect (s.d.)	65 (0.96)	2208 (32.52)
95% CI	[63, 67]	[2145, 2269]
Relative effect (s.d.)	533% (7.8%)	533% (7.8%)
95% CI	[518%, 548%]	[518%, 548%]

Table 6. Summary of the CausalImpact study of Alice's effect on NPE-owned

software patent abandonments.

Analysis

This analysis does not prove a direct causal relationship, but the timing and evidence from district court opinions, examiner rejections, and administrative review decisions citing *Alice* suggest that patentees are taking *Alice*'s effects into account in their maintenance fee payment decisions. The full impact of *Alice* will likely not be known until about 2018, by which time most of the affected patents will have had at least one maintenance fee payment come due. Assuming that the wider intervention period is correct and that the full effects of *Alice* would be felt within four years, then the average of 1117 – 1646 excess abandonments per month would lead to a total of about 53,000 – 79,000 excess abandoned software and business method patents (Table 4). That amounts to 4.8 – 7.2% of the software and business method patents in force when *Alice* was decided. For comparison, the courts invalidated 378 patents under *Alice* in the two years following the decision.⁴⁵

Although a significant number, 53,000 – 79,000 is an order of magnitude lower than the results from Tran, Summerfield, or Dugan would suggest and that Judge Moore predicted. This is a curious result. If *Alice* has been the unstoppable juggernaut that the litigation and patent examination results suggest, why have patentees continued to pay non-trivial maintenance fees to prop up the walking dead?

One possibility is that this result reflects significant differences between litigated and non-litigated patents, although Dugan's result argues against that. Another possibility is that many patentees are either optimistic that the law will change in their favor before their patents are subject to review. Perhaps patentees are engaged in special pleading, assuming that their patents would survive where others have failed. Or perhaps patentees have succumbed to the sunk cost fallacy and continue to throw good money after bad. More charitably, it is possible that the expense of evaluating a patent portfolio for validity in the wake of *Alice* exceeds the potential savings, and so the fees are paid by default.

This last interpretation may be supported by the sharp responsiveness of NPEs to *Alice*. The patent assertion entity-type of NPE that I considered may be more apt to conduct reviews of the validity of the patents in their portfolios than practicing entities, whose patent portfolios may be less closely tied to their business model.

Whatever the explanation for this discrepancy between predicted and actual behavior, *Alice* has had a significant impact, and one that will likely be lasting. Although the Supreme Court's patentable subject matter jurisprudence remains

⁴⁵ Tran, *supra* note 10, at 356.

less than perfectly clear, *Alice* was only the latest in a line of cases generally shrinking rather than expanding the scope of patentable subject matter, and so a reversal seems unlikely. That said, *Cascades Projection v. Epson* presents the possibility of a partial indirect reversal—or at least cabining—of *Alice* and other patentable subject matter cases, arguing that patents are private rights and thus cannot be invalidated or revoked by an administrative agency such as the PTO.⁴⁶

Alternatively, legislation that would reverse these cases has been suggested by the Intellectual Property Owners Association, but even if it were enacted it is unclear whether it would be retroactive.⁴⁷ Certainly it would not resurrect the tens of thousands of patents and patent applications already invalidated or abandoned as a result of *Alice* and the other recent § 101 cases.

One final consideration is the financial impact the case may have on the PTO. Unlike most government agencies, the PTO is funded by user fees.⁴⁸ Most of the fees that the PTO collects are patent fees, and over half of those are issue and maintenance fees.⁴⁹ An abandoned patent represents as much as \$12,600 in lost maintenance fees.⁵⁰ To estimate the excess lost fees due to *Alice*, a Causal-Impact analysis was run using lost software and business method patent maintenance fees as the response variable.⁵¹ The results are summarized in Figure 4 and Table 5. The cumulative estimate is \$77 – 140 million in excess lost fees. Extrapolating from the average monthly loss, this extends to a loss of \$110 – 196 million over four years.

⁴⁶ Petition for Initial Hearing En Banc at 5, *Cascades Projection, L.L.C., v. Epson America et al.*, # REPORTER # (Fed. Cir. 2017) (No. 17-517).

⁴⁷ *Proposed Amendments to Patent Eligible Subject Matter under 35 U.S.C. § 101*, INTELL. PROP. OWNERS ASS'N, 1-2 (Feb. 7, 2017), http://www.ipo.org/wp-content/uploads/2017/02/20170207_IPO-101-TF-Proposed-Amendments-and-Report.pdf [<https://perma.cc/672T-B58T>].

⁴⁸ GLENN J. McLOUGHLIN, CONG. RESEARCH SERVICE., RS20906, U.S. PATENT AND TRADEMARK OFFICE APPROPRIATIONS PROCESS: A BRIEF EXPLANATION 1 (2014).

⁴⁹ *Fiscal Year 2017 Congressional Justification*, U.S. PATENT & TRADEMARK OFFICE 144 (2016), <https://www.uspto.gov/sites/default/files/documents/fy17pbr.pdf> [hereinafter *2017 Justification*, U.S. PATENT & TRADEMARK OFFICE] [<https://perma.cc/XF7B-UA4G>].

⁵⁰ 37 CFR § 1.20(e)-(g) (2016) (summing the first, second, and third maintenance fees).

⁵¹ The indicator variables were lost non-software maintenance fees, the software patent abandonment rate, and the non-software patent abandonment rate.

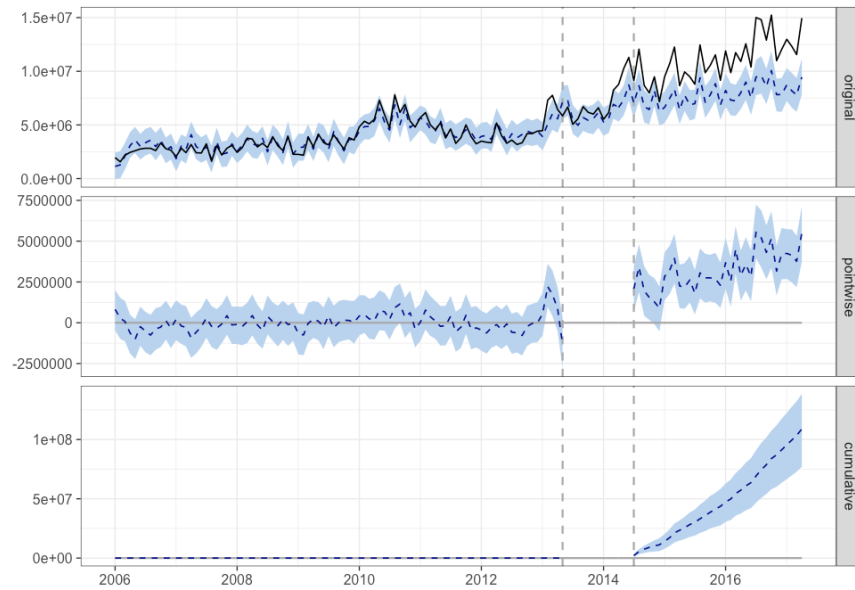


Figure 6. Plot of the CausalImpact study of lost software and business method patent maintenance fees.

	Average Lost Maintenance Fees Per Month	Cumulative Lost Maintenance Fees
Actual	1.1e+07	3.8e+08
Prediction (s.d.)	7.9e+06 (4.7e+05)	2.7e+08 (1.6e+07)
95% CI	[7.0e+06, 8.8e+06]	[2.4e+08, 3.0e+08]
Absolute effect (s.d.)	3.2e+06 (4.7e+05)	1.1e+08 (1.6e+07)
95% CI	[2.3e+06, 4.1e+06]	[7.7e+07, 1.4e+08]
Relative effect (s.d.)	41% (5.9%)	41% (5.9%)
95% CI	[29%, 52%]	[29%, 52%]

Table 5. Summary of the CausalImpact study of lost software and business method patent maintenance fees.

This is a substantial—if not unmanageable—loss, representing perhaps \$150 million in capital expenditures and labor costs that the PTO will have to forgo. Annualized over four years, it amounts to \$37.5 million per year, or 1.1% of the PTO's fiscal year 2017 budget of \$3.3 billion.⁵²

For its part, the Patent Office's budget justifications for fiscal years 2015, 2016, and 2017 do not discuss *Alice's* impact in this regard.⁵³ The 2015 budget justification did include the assumption that "patent maintenance fee payments will continue with some reduced renewal rates," but the 2016 and 2017 justifications assumed that "patent maintenance fee payments will continue with similar renewal rates."⁵⁴ It seems unlikely that the PTO is wholly unaware of these trends, and so I assume that *Alice's* direct financial impact on the PTO—although significant in the software and business method context—is lost among a broader positive maintenance fee collection trend caused by the steadily increasing number of issued patents.

Conclusion

Alice's impact has been significant and lasting, yet smaller than expected. In particular, Judge Moore's prediction has not quite been borne out. It may be that "this case is the death of hundreds of thousands of patents,"⁵⁵ depending on how one defines the death of a patent, but it has certainly not been the death of *all* software and business method patents, even if death is defined as the likely result of hypothetical litigation or administrative review. In terms of actual abandonments and invalidations, *Alice* has been the death of tens of thousands of patents, perhaps 3% of all software and business method patents and twice that in the NPE context. In that regard I concur with Christopher Beauchamp

⁵² See *2017 Justification*, U.S. PATENT & TRADEMARK OFFICE, *supra* note 49, at 14.

⁵³ See *id.*; *Fiscal Year 2016: President's Budget Submission/Congressional Justification*, U.S. PATENT & TRADEMARK OFFICE (2015), <https://www.uspto.gov/sites/default/files/documents/fy16pbr.pdf> [hereinafter *2016 Justification*, U.S. PATENT & TRADEMARK OFFICE [https://perma.cc/AJJ9-3EUM]; *Fiscal Year 2015: President's Budget Submission/Congressional Justification*, U.S. PATENT & TRADEMARK OFFICE (2014), <https://www.uspto.gov/sites/default/files/about/stratplan/budget/fy15pbr.pdf> [hereinafter *2015 Justification*, U.S. PATENT & TRADEMARK OFFICE] [https://perma.cc/BC7S-LVVF].

⁵⁴ *2015 Justification*, U.S. PATENT & TRADEMARK OFFICE, *supra* note 53, at 158; *2016 Justification*, U.S. PATENT & TRADEMARK OFFICE, *supra* note 53, at 138; *2017 Justification*, U.S. PATENT & TRADEMARK OFFICE, *supra* note 49, at 144.

⁵⁵ *CLS Bank Int'l v. Alice Corp.*, 717 F.3d 1269, 1313 (Fed. Cir. 2013) (Moore, J. dissenting in part).

that *Alice* is an “incremental but noticeable judicial move,” though I think more noticeable than most.⁵⁶ The gap between Judge Moore’s prediction and the effects of the decision suggests that the Supreme Court’s “careful treading” in construing the abstract idea exception in *Alice* avoided the complete exclusion of computer-implemented inventions from patentability.⁵⁷ Whether the Court went too far or not far enough is another question.

⁵⁶ Christopher Beauchamp, *The First Patent Litigation Explosion*, 125 YALE L.J. 848, 934 (2016).

⁵⁷ *Alice Corp. v. CLS Bank Int’l*, 134 S. Ct. 2347, 2354 (2014).