INTELLECTUAL PROPERTY

Disclosing patents' secrets

Inventors prefer to disclose know-how before patent grant

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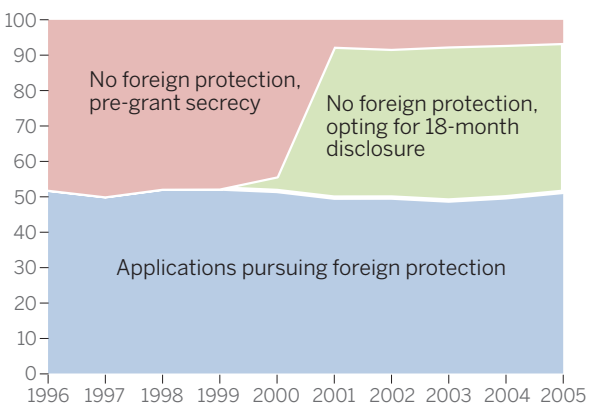
POLICY

The patent system is built on a grand bargain: To gain exclusive rights to practice their inventions, inventors must disclose their proprietary knowledge publicly. Economists have studied incentive benefits of exclusivity while implicitly assuming that disclosure of know-how in patent applications is costly for inventors. Yet, apart from facilitating diffusion of knowledge, disclosing know-how in a patent may privately benefit inventors by deterring rivals' duplicative research and development (R&D), preempting competitors' efforts to patent similar technology, and reducing informational asymmetries between patentees and potential investors [supplementary materials (SM)]. Understanding to what extent disclosure is viewed as a cost or a benefit by patenting inventors provides insights into our complex patent system and allows better policy-making to advance the diffusion of technical knowledge.

Whereas, historically, applications for U.S. patents were kept secret until grant, Congress in 1999 sought to harmonize the United States with virtually all other nations by requiring publication 18 months after first filing (*1*). This sparked disagreement, including from 26 Nobel laureates who warned that the legislation, which included the pregrant publication provision, "will prove very damaging to American small inventors and thereby discourage the flow of new inventions that have contributed so much to America's superior performance" (*2*). Congress adopted the change in the American Inventors Protection Act ("AIPA" or "Act"), but allowed applicants seeking no foreign patents on the same invention to opt out of publication, preserving secrecy until patent grant (*3*, *4*) (SM).

This bifurcated choice—to disclose or not—presents a quasi-natural experiment. Inventors make choices to maximize private value. We investigate these "revealed preferences" using data on all 1.81 million applications filed with the U.S. Patent & Trademark Office (USPTO) in 1996–2005 and granted by mid-2012. Our focus on preferences, conditioned on the decision to patent, cannot measure benefits or costs of secrecy in general. Our findings are relevant to recent legislative proposals seeking to restrict pregrant publication (*5*) and to recommendations to eliminate the secrecy loophole altogether (*6*, *7*). Disclosure provisions are a sticking point in international patent-system harmonization; thus, our findings inform ongoing negotiations [e.g., Trans-Pacific Partnership (*8*)].



Disclosure status of all 1,809,932 patent applications filed at the USPTO between 1996 and 2005 for which patents were granted through mid-2012. Applicants shifted toward disclosing know-how after AIPA became effective 29 November 2000.

SMALL AND IMPORTANT. Before AIPA, the United States published only at patent grant, yet applications with a parallel foreign filing were published elsewhere. Beginning after 28 November 2000, AIPA requires the USPTO to publish all U.S. applications, with or without parallel foreign applications, 18 months from the first filing date. Applicants without a parallel foreign filing may opt out of 18-month publication at the time of application. Filing-to-grant lags averaged about 38 months in 2001, thus AIPA accelerated disclosure by about 20 months on average.

About 50% of U.S. granted patents, before and after AIPA, have parallel foreign patenting. Conditional on choosing against (the 50% likely) foreign protection, about 85% of inventors choose pregrant disclosure (*9*) (SM) (see the first chart). In every technology field—drugs and medical, chemistry, mechanical, or electrical and electronics—a large majority of patentees choose disclosure over secrecy (SM). Opponents of pregrant disclosure argued that small U.S. inventors of important inventions would be particularly harmed by 18-month publication, and the opt-out was included to "protect" such inventors (*10*). We use USPTO data to classify applicants into four ownership and size types (*11*): (i) large U.S. (corporate; 34.2% of patents in our data); (ii) small U.S. (company and individual; 9.5%); (iii) foreign large (corporate; 38.2%); and (iv) others (18%) (*12*).

All inventor types are much more likely to choose pregrant disclosure over secrecy (SM). Conditional on U.S.-only patenting, small U.S. inventors prefer pregrant disclosure, and are no more likely than large U.S. entities to select secrecy (16.9% versus 16.4%; not significant at $P < 0.01$) (*13*). Secrecy is requested twice as often in "complex product" industries like "Computers and Communication" compared with "discrete product" industries like "Chemicals," but among large and small U.S. patentees alike, pregrant disclosure is preferred overwhelmingly in every technology sector (SM).

We compare choices made by applicants as a function of inventions' importance. As prior research has done, we use three different measures of "importance" (or "value" or "impact"): (i) the number of patent claims; (ii) periodic patent maintenance fee payments; and (iii) "forward" patent citation counts. Even if each measure has limitations, we find all three point in the same direction, which suggests that our results are not likely due to measurement errors.

Claims. Patent claims are the written descriptions of the invention indicating scope; more claims correlate with higher patent value and impact (*14*). Although our data show inconsistent results among other types of applicants (SM), average claim counts of patents from small U.S. inventors rank (from highest to lowest): those with foreign patent filings (24.4), U.S.-only patents published at 18 months (22.2), and patents selected into pregrant secrecy (20.6); all differences are significant at $P < 0.01$. These differences suggest that U.S. small inventors choosing secrecy produce patents having the narrowest scope and smallest economic impact.

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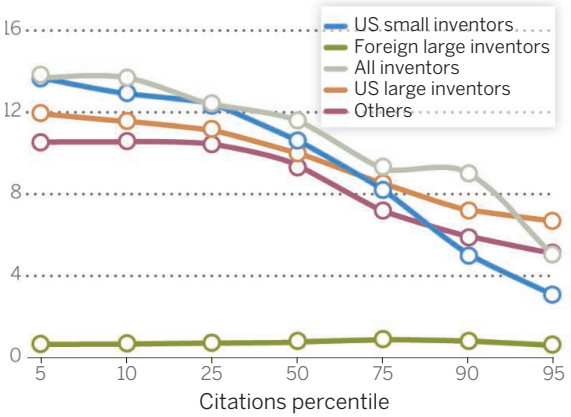
Disclosure choices by citation's percentile, across patentee types

Patents granted after pre-grant secrecy (share, %)



Share of patents filed in 2001 opting for pregrant secrecy. Scaled by citation percentiles for the different patent applicants in our data set. Higher percentiles indicate patents receiving higher numbers of citations. Larger invention impact is inversely correlated with opting for pregrant secrecy.

Maintenance fees. U.S. patentees must pay postgrant maintenance fees at 3.5, 7.5, and 11.5 years. These payments escalate over time, providing a proxy for the economic value of patents to their owners (*15*, *16*). We can observe 3.5- and 7.5-year renewal rates, finding them highest for U.S. patents with parallel foreign filings. Among large U.S. inventors, renewal rates are higher for patents issuing from pregrant secrecy. But among small U.S. inventors, both 3.5- and 7.5-year renewal rates are lowest for patents issuing from pregrant secrecy (significant at $P < 0.01$), which suggests that these patents are the least valuable and have the least impact particularly for U.S. small inventors (SM).

Citations. Increasing numbers of citations of a patent by other patents indicate more follow-on invention and private value (*17*). As 90% of citations arrive within 10 years (*18*), we minimize truncation bias by analyzing citations to post-AIPA patents filed in 2001, and accumulated over the 10 years from application date. Patents issuing from pregrant secrecy collect, on average, the least citations (7.8), with U.S.-only published patents (11.0) and foreign-filed patents (8.7) collecting more (significant at $P < 0.01$) (SM). Patents issuing from pregrant secrecy collected the least average number of citations for all inventor types (SM).

For robustness, we also measure citations from the disclosure date (18-month publication date versus grant date for "opt-out" patents). To avoid bias introduced by possible "strategic" citation behavior by industry applicants, we also restrict analysis to the ~35% of patent citations in our sample inserted only by patent examiners. With the exception of those held by non-U.S. large entities, we find that U.S. patents issuing from pregrant secrecy receive significantly fewer citations than those published at 18 months (SM).

Given the skew in patent value (*19*), we investigated patents in the most valuable tail of the citations distribution. We find an inverse correlation between citation percentile and probability of using pregrant secrecy (see the second chart) (Fig. 2). This pattern holds for all inventor types, barring foreign large patentees, and into the extreme tail: among the 198 small U.S. inventor patents in the 99th citations percentile, only 0.5%, or 1 of 198 patents, issued from pregrant secrecy. When U.S. inventors make a disclosure choice for their patents with the greatest impact, they are much more likely to select early disclosure. Because the USPTO frames the choice between pregrant publication and secrecy saliently in patent applications and also because inventors likely monitor their valuable inventions most closely, our findings are at odds with any notion that the result is an artifact of 18-month publication (SM).

Maximum-likelihood logistic regressions reveal that U.S. small inventors' inventions with the most impact are systematically less likely than large inventors' to issue from pregrant secrecy in the overall population of patents, as well as in every technology field except "mechanical" and "other" (SM).

POLICY IMPLICATIONS. Although our analysis cannot unravel mechanisms, we speculate that patent disclosure confers private benefits to inventors, such as by credibly publicizing an invention's existence, quality, and scope to competitors, external investors, and licensees (*20*). Publication after 18 months offers patentees the provisional right to claim royalties from licensees from publication date. These benefits may be particularly salient for individuals and small firms, because they often depend on external observers to commercialize their important inventions.

Regardless of their motives, our finding suggests that patent publication may not only benefit society by accelerating the diffusion of scientific knowledge but also confers private benefits to patentees. Thus, recent arguments that pregrant disclosure should be limited to patent abstracts because they harm small U.S. inventors appear to have no empirical basis. Because small U.S. inventors are not choosing pregrant secrecy to protect their most important inventions, AIPA's "opt out" may be imposing avoidable costs on society by delaying cumulative innovation and encouraging duplicative R&D investments, while standing in the way of an internationally harmonized patent system. Our results challenge us to reconsider and focus more scientific inquiry on the benefits societies—and patentees themselves—are receiving from nondisclosure, even the 18 months now available as the worldwide standard for all types of patents, and patentees. ■

REFERENCES AND NOTES

1. U.S. applicants (applications) include USPTO filings from any country, unless otherwise stated.
2. F. Modigliani, An open letter to the U.S. Senate (1999); www.eagleforum.org/patent/nobel_letter.html.
3. P.L. 106-113.
4. Other AIPA provisions were relatively minor changes.
5. H.R. 5980, 111th Congress 2nd Session (2010); https://www.govtrack.us/congress/bills/111/hr5980/text.
6. S. A. Merrill, R. C. Levin, M. B. Myers, Eds., *A Patent System for the 21st Century* (National Academy of Sciences, Washington, DC, 2004).
7. Federal Trade Commission, *The Evolving IP Marketplace: Aligning Patent Notice and Remedies with Competition* (FTC, Washington, DC, 2011).
8. R. Chen, *Japanese IP Practice II: IP Considerations with Japan's Entry into the Trans-Pacific Partnership* (American Bar Association, 2013); http://sugi.pat.co.jp/ABA_YLD_IP/JP_Trans-pacific_Partnership.pdf.
9. Separately, we obtained data on the 514,397 U.S. patent applications filed 11/29/2000–12/31/2005 that were abandoned prior to grant, finding that 34.1% filed for foreign protection, 56.6% chose U.S.-only publication, and only 9.3% chose pregrant secrecy.
10. E. Ergenzinger Jr., *Wake Forest Intell. Property Law J.* **7**, 146 (2002).
11. Based on disclosures to the USPTO at or before grant. USPTO defines "small entity" as fewer than 500 employees.
12. Governments, nonprofits, and foreign small entities and individuals.
13. The probability of secrecy conditional on not seeking foreign protection is $Ps/(1 - Pf)$ where Ps is the unconditional probability of pregrant secrecy and Pf is the unconditional probability of seeking foreign protection for a post-AIPA patent.
14. J. Lanjouw, M. Schankerman, *Rand J. Econ.* **32**, 129 (2001).
15. M. Schankerman, A. Pakes, *Econ. J.* **96**, 1052 (1986).
16. Current USPTO fees are $1130, $2850, and $4730 respectively for 3.5-, 7.5-, and 11.5-year renewal, discounted 50% for small firms and individuals.
17. M. Trajtenberg, *Rand J. Econ.* **21**, 172 (1990).
18. B. Hall, A. Jaffe, M. Trajtenberg, *The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools* (Working paper 8498, NBER, Cambridge, MA, 2001).
19. D. Harhoff, F. Narin, F. Scherer, K. Vopel, *Rev. Econ. Stat.* **81**, 511 (1999).
20. D. Hegde, H. Luo, *Imperfect Information, Patent Publication, and the Market for Ideas* (Working paper 14-019, Harvard Business School, Cambridge, MA, 2013).

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/347/6219/236/suppl/DC1

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Supplementary Materials for

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This PDF file includes

Other Supplementary Material for this manuscript includes the following:
(available at www.sciencemag.org/content/347/6219/236/suppl/DC1)

Patent Disclosure Data and Code as a zipped archive

Supplementary Materials

Materials and Methods

Data required to reproduce all results in this paper are available for download in Stata format as "patentdisclosure_datafile_gh_submit.dta." The Stata code used to produce each table and figure, in the main manuscript and these supplementary materials (SM), is available in the file titled "descriptives." The code used to estimate the regressions reported here is available in the file titled "regressions." All files are packaged into the zip folder named "Patent Disclosure Data and Code" and can be downloaded from this site.

Note no. 9 of the manuscript provides aggregate statistics on the percentage of U.S. patent applications that chose pregrant secrecy and were abandoned before grant. Data on unpublished applications are generally not made available by the U.S. Patent and Trademark Office (USPTO) in order to protect the trade secrets of applicants who may abandon their applications before the 18-month publication date. The USPTO approved the authors to use suitably anonymized and aggregated statistics on unpublished applications as reported in Footnote no. 9 for the purpose of this project. Users can obtain this data from the USPTO by submitting a *Freedom of Information Act* request.

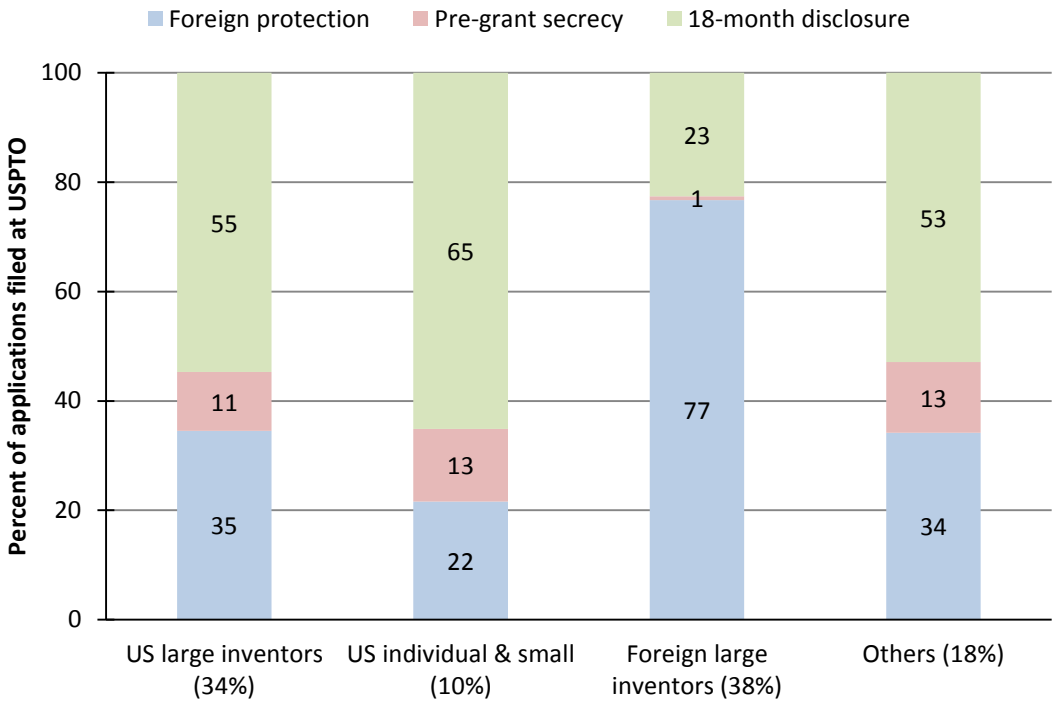

Figure S1. Post-AIPA disclosure choices by patentee type. The percentage of successful U.S. patent applications by their disclosure choices for applications filed from 11/29/2000 through the end of 2005 (and subsequently granted by mid-2012) for three primary types of applicants and a miscellaneous "Others" category. The percentages under each category indicate the share of all U.S. patent applications filed by the corresponding type of applicant during our study period. The three available disclosure choices are (i) to pursue foreign applications and disclose pregrant (at 18 months from application date); (ii) to not pursue foreign applications and disclose at 18 months from application date; and (iii) to not pursue foreign applications and maintain pregrant secrecy.

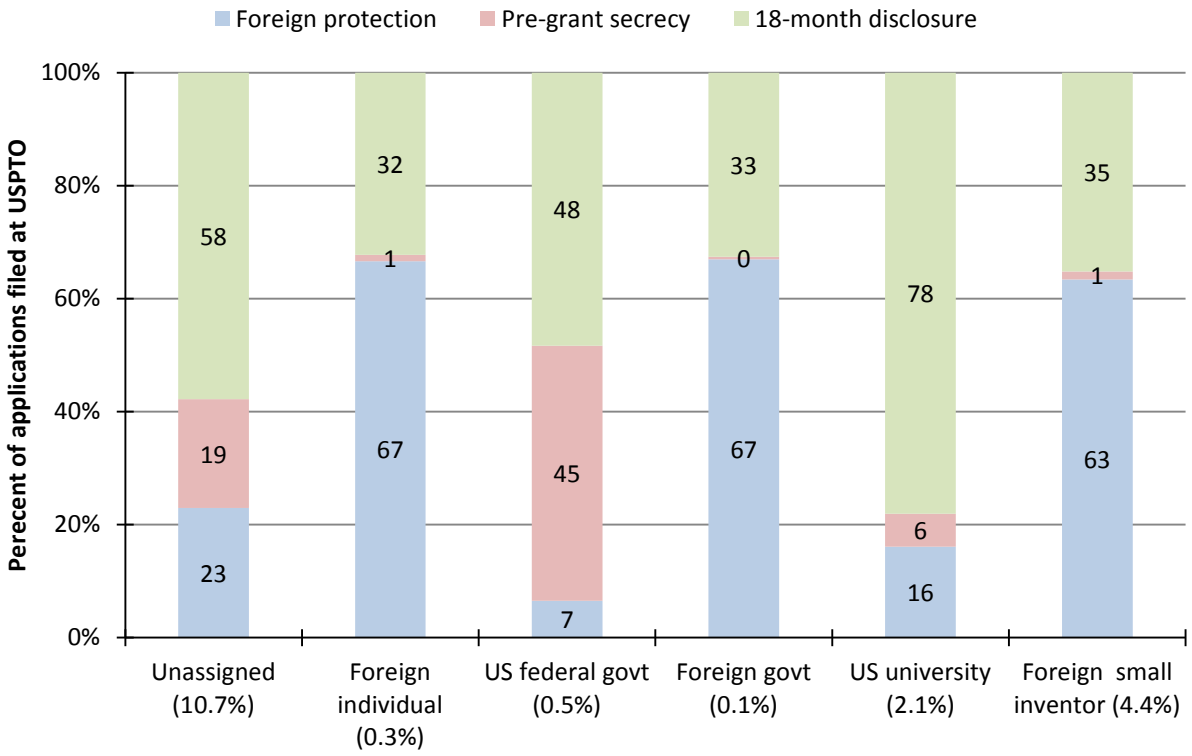

Figure S2. Post-AIPA disclosure choices by patentee type for "others" category. The percentage of successful U.S. patent applications by their disclosure choices for applications filed from 11/29/2000 through the end of 2005 (and subsequently granted by mid-2012) for the six types of applicants that comprise the "Others" category. The percentages below each category indicate the share of all U.S. patent applications filed by the corresponding type of applicant during our study period. We do not know the ownership characteristics of patents in the "unassigned"—oftentimes, patentees in this category are known to reassign their patents to corporate entities, but such reassignments are not part of our present data.

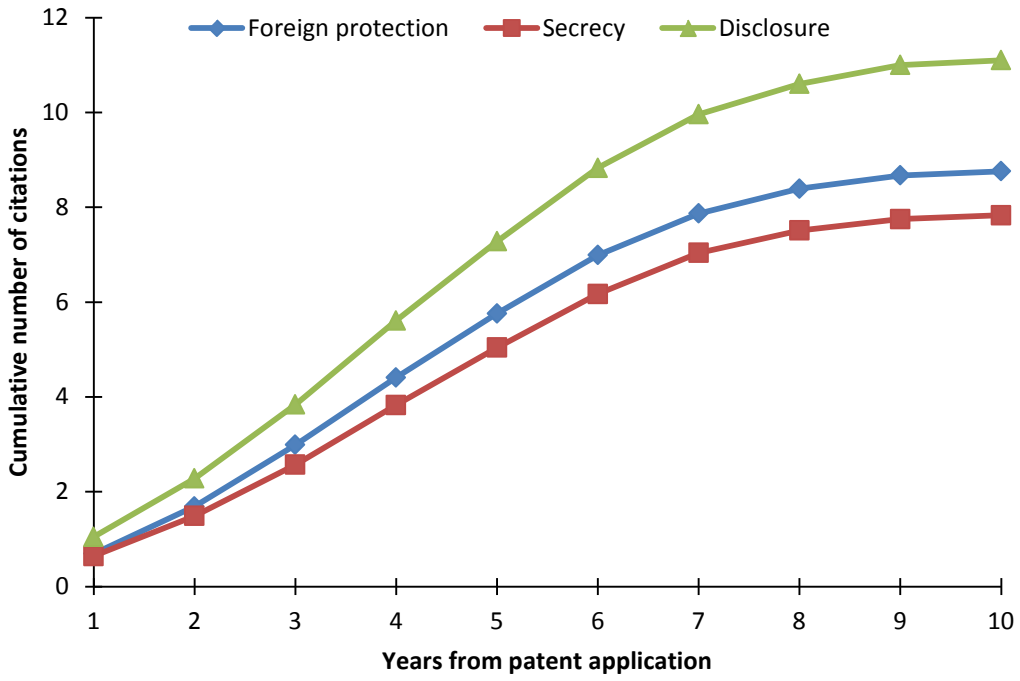

Figure S3. Cumulative citations to small-entity U.S. 2001 application year patents by disclosure status. The figure shows the average cumulative number of citations received by the 19,608 patents belonging to U.S. individuals and entities claiming small-entity fee discounts in the USPTO each year in a 10-year forward window after their application filing in 2001.

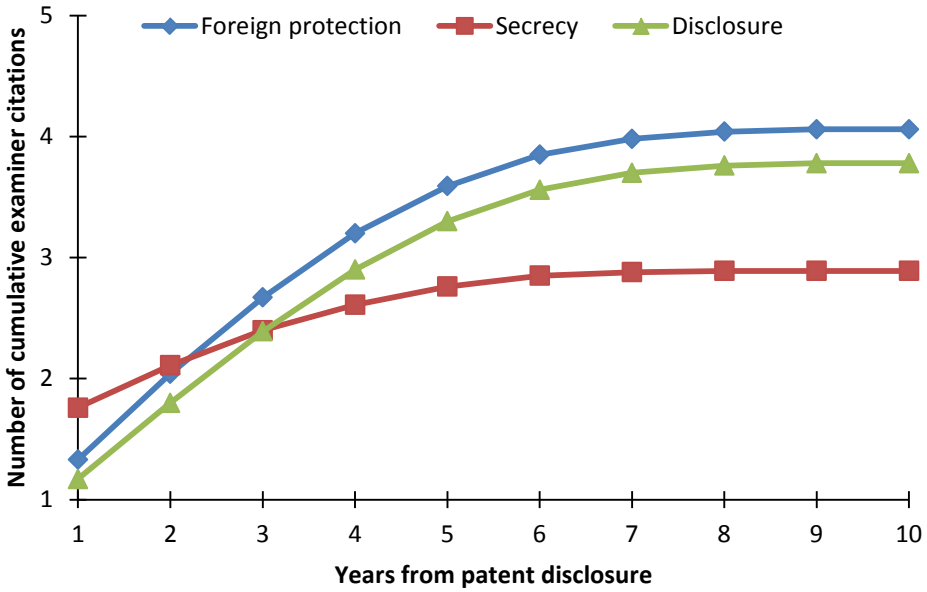

Figure S4. Cumulative USPTO examiner citations to small-entity U.S. 2001 application year patents by disclosure status. The average cumulative number of examiner-inserted citations received by the 19,608 patent applications filed in 2001 by U.S. individuals and entities claiming small-entity fee discounts in the USPTO each year in a 10-year forward window after their disclosure. For patents choosing pregrant secrecy, disclosure is at issue (about 36 months, on average, for applications filed in 2001), and for patents choosing foreign protection or pregrant disclosure, disclosure is at 18 months from application date. Although secret patents collect on average more citations in year 1, this result may be the effect of pent-up demand for information or the comparative added maturity (on average 18 months) of the technology environment when the secret patents are first at hazard of being cited (at grant). Nevertheless, the cumulative 10-year cumulative count for secret patents is clearly dominated by those granting from the other two choice categories.

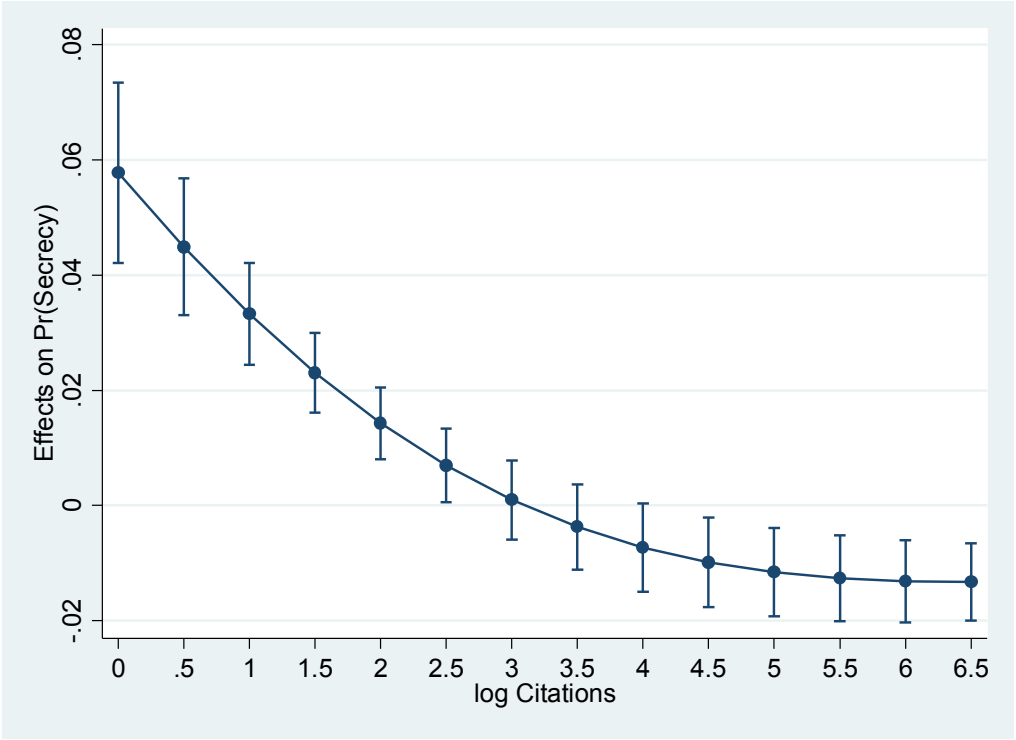

Figure S5. Relation between citations and the probability of choosing pregrant secrecy for U.S. small inventors. The estimated interaction effect of logged forward citations (we log citations after adding one, because many patents have zero citations) and a variable indicating "U.S. Small Inventor" on the probability of choosing pregrant secrecy. The interaction effect is calculated from the logistic regression estimates reported in column 1 of Table S3. The 95% CIs are indicated by the vertical lines around the interaction effect estimates. The graph shows that the probability of choosing pregrant secrecy (over 18-month disclosure) decreases for patents with a higher number of citations at a higher rate for U.S. small inventors (relative to U.S. larger inventors).

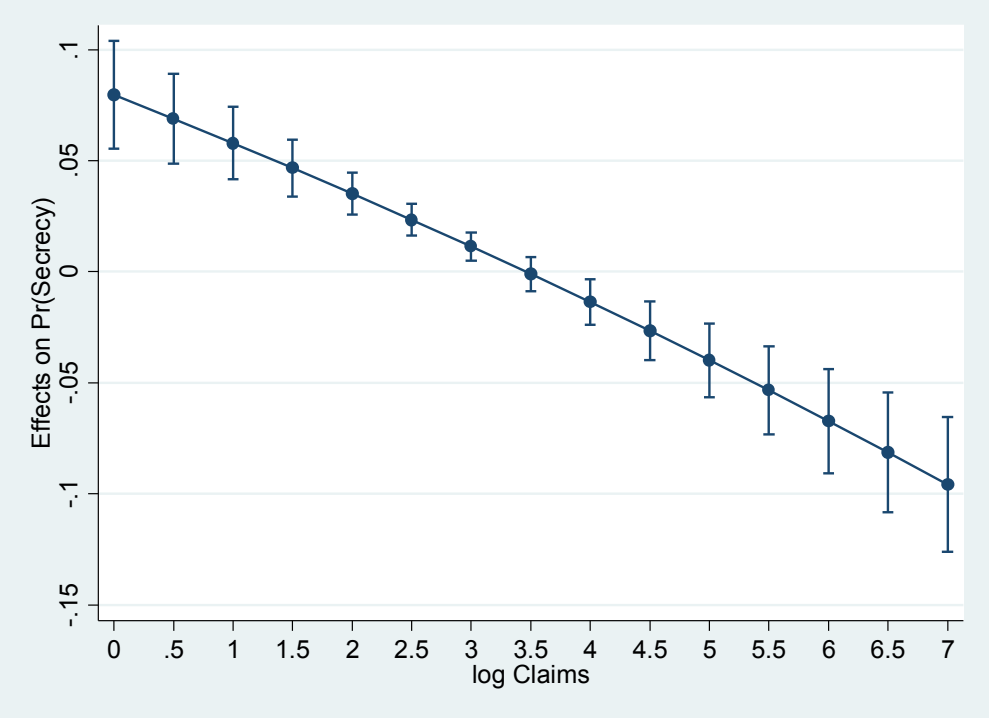

Figure S6. Relation between the number of claims and the probability of choosing pregrant secrecy for U.S. small inventors. The estimated interaction effect of logged number of claims and a variable indicating "U.S. small inventor" on the probability of choosing pregrant secrecy. The interaction effect is calculated from the logistic regression estimates reported in column 2 of Table S3. The 95% CIs are indicated by the vertical lines around the interaction effect estimates. The graph shows that the probability of choosing pregrant secrecy (over 18-month disclosure) decreases for patents with a higher number of claims at a higher rate for U.S. small inventors (relative to U.S. larger inventors).

Table S1. Disclosure choices of different applicant types after AIPA, by technology field. The percentage of each type of inventor's patents that opted for the different types of disclosure in each of the six broad technology fields specified in Hall *et al*. (*1*) after AIPA, that is, U.S. patents filed between 29 November 2000 and the end of 2005, and subsequently granted by mid-2012.

	Foreign protection (%)	Pregrant secrecy (%)	18-month disclosure (%)
Chemical			
U.S. Large inventors	42.9	3.4	53.7
U.S. small inventors	23.6	9.4	67.0
Foreign large inventors	75.3	0.2	24.6
Others	39.0	9.1	52.0
Total	53.9	3.5	42.6
Computers and communication			
U.S. Large inventors	28.5	16.6	55.0
U.S. small inventors	19.0	17.1	64.0
Foreign large inventors	75.1	1.3	23.6
Others	34.7	12.2	53.1
Total	47.3	10.0	42.7
Drugs and medical instruments			
U.S. Large inventors	32.5	5.3	62.2
U.S. small inventors	28.3	5.3	66.4
Foreign large inventors	63.5	0.4	36.1
Others	34.4	6.0	59.6
Total	39.6	4.3	56.1
Electrical and electronics			
U.S. Large inventors	33.6	12.2	54.2
U.S. small inventors	20.4	15.1	64.4
Foreign large inventors	77.8	0.7	21.5
Others	36.7	10.8	52.5
Total	55.3	6.5	38.3
Mechanical			
U.S. Large inventors	41.0	6.4	52.6
U.S. small inventors	20.0	15.2	64.9
Foreign large inventors	81.6	0.3	18.2
Others	35.3	15.5	49.3
Total	55.1	6.6	38.4
Other technologies			
U.S. Large inventors	43.4	4.6	52.0
U.S. small inventors	19.5	15.4	65.1
Foreign large inventors	80.8	0.3	18.9
Others	29.5	18.4	52.2
Total	45.1	9.6	45.3

Table S2. Patent value by disclosure choice and applicant type. Descriptive statistics of three measures commonly cited in the literature as being correlated with patent value, importance, and impact. (**Top**) The average number of claims per U.S. patent associated with the disclosure choices of different types of inventors. The numbers in the table are calculated from the 978,139 U.S. utility patent applications filed between 29 November 2000 (AIPA's effective date) and the end of 2005, and subsequently granted through mid-2012. (**Middle**) Renewal rates for U.S. patents by disclosure choice and applicant type. 3.5-year renewal rates are based on patents filed in 2001 and granted by the end of 2008. The 7.5-year renewal rates are based on filed in 2001 and granted by the end of 2004. (**Bottom**) The average number of U.S. patent citations, within a 10-year window, received by patents belonging to different inventor types after their filing in 2001. It also reports the average number of examiner-inserted citations received by the applications filed in 2001, 10 years after their disclosure such that for patents choosing pregrant secrecy, disclosure is at issue (about 36 months, on average, for applications filed in 2001), and for patents choosing foreign protection or pregrant disclosure, disclosure is at 18 months from application date.

	Foreign protection	Pregrant secrecy	Pregrant disclosure	Foreign protection	Pregrant secrecy	Pregrant disclosure
Claims						
U.S. Large inventors	21.7	22.7	21.3			
U.S. small inventors	24.4	20.6	22.2			
Foreign large inventors	15.2	29	16.2			
Others	16.2	15	16.8			
All inventors	17.2	20.3	19.5			
Renewal rate	*3.5-year renewal rate(%)*			*7.5-year renewal rate(%)*		
U.S. Large inventors	92.2	95.5	90.3	77.7	86.1	75.6
U.S. small inventors	90.7	85.0	86.8	72.6	62.0	65.7
Foreign large inventors	88.1	93.9	90.4	68.2	85.9	72.5
Others	81.9	72.0	78.7	55.2	36.4	47.8
All inventors	88.4	86.8	87.3	68.7	63.7	66.7
Citations (in 10 years)	*10-year citations*			*10-year examiner citations from disclosure date*		
U.S. large inventors	12.6	9.04	12.8	3.8	3.28	3.73
U.S. small inventors	16.6	8.08	14.5	4.06	2.89	3.78
Foreign large inventors	6.96	7.98	8.1	3.12	3.71	3.02
Others	6.74	5.01	8.01	2.34	1.99	2.7
All inventors	8.7	7.83	11	3.22	2.91	3.36

Table S3. Relation between choice of secrecy and invention characteristics. Logistic regression estimates (marginal effects) of the probability of choosing pregrant secrecy over 18-month disclosure in U.S.-only patents as a function of patent importance (measured by 10-year citations, claims, and 4-year renewal), inventor type, and technology field. The estimation sample consists of all U.S. patent applications that did not have corresponding foreign patent applications filed in 2001 (post-AIPA) and granted by mid-2012. For the regression with 4-year renewals, we consider only those applications granted before 2009, because our renewal data end at 31 December 2012. Large U.S. inventors and "others" are omitted references categories for inventor type and technology-field category, respectively.

Dependent Variable = Secrecy (0/1)	1	2	3
U.S. Small × Ln Citations	–0.012**		
	[0.002]		
Ln Citations	–0.031**		
	[0.001]		
U.S. Small × Ln Claims		–0.196**	
		[0.030]	
Ln Claims		0.136**	
		[0.014]	
U.S. Small × 4-year Renewal			–0.277**
			[0.071]
4-year Renewal			0.136**
			[0.032]
U.S. Small	0.040**	0.678**	0.362**
	[0.006]	[0.091]	[0.067]
Foreign Large	–0.138**	–1.868**	–1.927**
	[0.002]	[0.046]	[0.047]
Other Inventors	0.001	0.105**	0.093**
	[0.002]	[0.023]	[0.023]
Chemical	–0.059**	–0.619**	–0.615**
	[0.003]	[0.042]	[0.042]
Computers & Communication	0.071**	0.429**	0.436**
	[0.004]	[0.028]	[0.028]
Drugs & Medical Devices	–0.068**	–0.822**	–0.804**
	[0.003]	[0.041]	[0.041]
Electrical & Electronics	0.042**	0.254**	0.262**
	[0.004]	[0.030]	[0.031]
Mechanical	–0.013**	–0.122**	–0.129**
	[0.003]	[0.034]	[0.035]
Constant	–1.19	–2.02	–1.757
Observations	99,404	99,404	96,951
Log-likelihood	–38915	–39502	–38349
Chi-sq	4582	4018	3663
Pr>Chi-sq	0	0	0

Robust standard errors are in brackets; $^{**}P < 0.01$, $^{*}P < 0.05$, †$P < 0.1$.

Table S4. Relation between choice of secrecy and patent citations by technology field. Logistic regression estimates (marginal effects) of the probability of choosing pregrant secrecy over 18-month disclosure in U.S.-only patents as a function of patent importance (measured by 10-year citations, claims and 4-year renewal), inventor type, and technology field. The estimation sample consists of all U.S. patent applications that did not have corresponding foreign patent applications filed in 2001 (post-AIPA) and granted by mid-2012. For the regression with 4-year renewals, we consider only those applications granted before 2009, because our renewal data ends at 31 December 2012. Large U.S. inventors and "others" are omitted references categories for inventor type and technology-field category, respectively.

Dependent Variable = Secrecy (0/1)	Chemical	Computers & Commn.	Drugs & Medical inst.	Electrical & Electronics	Mechanical	Other tech.
U.S. Small × Ln Citations	–0.23**	–0.14**	–0.20**	–0.11*	0.02	0.02
	[0.085]	[0.038]	[0.058]	[0.055]	[0.063]	[0.062]
Ln Citations	–0.08*	–0.42**	0.01	–0.20**	–0.28**	–0.33**
	[0.038]	[0.016]	[0.030]	[0.021]	[0.032]	[0.028]
U.S. Small	1.01**	0.29**	0.47**	0.11	0.53**	0.57**
	[0.149]	[0.089]	[0.135]	[0.120]	[0.117]	[0.118]
Foreign Large	–2.39**	–2.03**	–2.26**	–1.80**	–2.17**	–2.54**
	[0.236]	[0.070]	[0.267]	[0.076]	[0.170]	[0.275]
Other Inventors	0.48**	–0.53**	0.30**	–0.50**	0.34**	0.66**
	[0.083]	[0.052]	[0.078]	[0.058]	[0.061]	[0.060]
Constant	–2.35	–0.25	–2.52	–0.88	–1.53	–1.56
Observations	11,011	28,885	12,863	18,548	13,367	14,730
Log-likelihood	–2887	–13574	–3282	–7855	–4874	–6072
Chi-sq	222.3	1669	115.6	685.4	390.1	456
Pr>Chi-sq	0	0	0	0	0	0

Robust standard errors are in brackets; $^{**}P < 0.01$, $^{*}P < 0.05$, $\dagger P < 0.1$.

Table S5. Relation between choice of secrecy and number of claims by technology field. Logistic regression estimates (marginal effects) of the probability of choosing pregrant secrecy over 18-month disclosure in U.S.-only patents as a function of patent importance (measured by number of claims) and inventor type for each of the six patent technology fields specified in Hall *et al*. (*1*). The estimation sample consists of all U.S. patent applications that did not have corresponding foreign patent applications filed in 2001 (post-AIPA) and granted by mid-2012. "Large U.S. inventors" is the omitted reference category for inventor type.

Dependent Variable = Secrecy (0/1)	Chemical	Computers & Comm'n.	Drugs & Medical instrum.	Electrical & Electronics	Mechanical	Other tech.
U.S. Small × Ln Claims	–0.19*	–0.28**	–0.21*	–0.31**	0.03	–0.02
	[0.096]	[0.054]	[0.096]	[0.076]	[0.080]	[0.073]
Ln Claims	0.12*	0.25**	0.11*	0.21**	0.06	–0.03
	[0.048]	[0.025]	[0.048]	[0.030]	[0.038]	[0.033]
U.S. Small	1.21**	0.74**	0.69*	0.80**	0.47*	0.71**
	[0.285]	[0.171]	[0.284]	[0.231]	[0.237]	[0.214]
Foreign Large	–2.32**	–1.82**	–2.25**	–1.70**	–2.09**	–2.43**
	[0.237]	[0.070]	[0.266]	[0.077]	[0.171]	[0.274]
Other Inventors	0.51**	–0.43**	0.32**	–0.40**	0.42**	0.77**
	[0.083]	[0.051]	[0.078]	[0.058]	[0.062]	[0.061]
Constant	–2.82	–1.85	–2.85	–1.87	–2.13	–2.04
Observations	11,011	28,885	12,863	18,548	13,367	14,730
Log-likelihood	–2895	–14037	–3285	–7895	–4922	–6154
Chi-sq	206.8	982.9	116.3	717.2	299	302.5
Pr>Chi-sq	0	0	0	0	0	0

Robust standard errors are in brackets; $^{**}P < 0.01$, $^{*}P < 0.05$, †$P < 0.1$.

Table S6. Relation between choice of secrecy and 4-year renewal by technology field. The table presents logistic regression estimates (marginal effects) of the probability of choosing pregrant secrecy over 18-month disclosure in U.S.-only patents as a function of patent importance (measured by whether or not the patent was kept in force by the payment of renewal fees 4 years from grant date) and inventor type for each of the six patent technology fields specified in Hall *et al*. (*1*). The estimation sample consists of all successful U.S. patent applications that did not have corresponding foreign patent applications, filed in 2001 (post-AIPA), and granted before 2013. "Large U.S. inventors" is the omitted reference category for inventor type.

Dependent Variable = Secrecy (0/1)	Chemical	Computers & Commn.	Drugs & Medical inst.	Electrical & Electronics	Mechanical	Other tech.
U.S. Small × 4-year Renewal	–0.05	–0.90**	–0.57*	0.08	0.06	–0.07
	[0.233]	[0.161]	[0.231]	[0.189]	[0.157]	[0.138]
4-year Renewal	0	0.90**	0.17	0.08	–0.1	–0.21**
	[0.111]	[0.081]	[0.121]	[0.081]	[0.074]	[0.061]
U.S. Small	0.73**	0.72**	0.62**	–0.18	0.52**	0.70**
	[0.217]	[0.154]	[0.214]	[0.180]	[0.147]	[0.134]
Foreign Large	–2.40**	–1.93**	–2.23**	–1.77**	–2.18**	–2.48**
	[0.243]	[0.072]	[0.266]	[0.075]	[0.176]	[0.283]
Other Inventors	0.50**	–0.41**	0.32**	–0.45**	0.38**	0.75**
	[0.083]	[0.053]	[0.079]	[0.058]	[0.062]	[0.060]
Constant	–2.47	–1.95	–2.67	–1.33	–1.89	–1.93
Observations	10,904	27,104	12,567	18,452	13,295	14,629
Log-likelihood	–2867	–13016	–3232	–7886	–4884	–6109
Chi-sq	197.9	849.7	106.5	582.2	286.2	316.6
Pr>Chi-sq	0	0	0	0	0	0

Robust standard errors are in brackets; $^{**}P < 0.01$, $^{*}P < 0.05$, $\dagger P < 0.1$.

Supplementary Text

Section S1

This section provides information on the literature relating to inventors' choices over patenting and secrecy. Mirroring the contract embodied in the patent system—the choice inventors must make between patent exclusivity and disclosure—the economics literature has often focused on the costs associated with publication, such as informing rivals about the invention, reducing competitors' costs of "inventing around," and providing rivals with nonroyalty use of the invention after the patent expires. A large body of theoretical work in economics has assumed that inventors value secrecy (nondisclosure) for their inventions, and that they choose among different appropriability mechanisms, such as patents and trade secrecy, on the basis of the costs of disclosure associated with patenting [e.g., (*2*–*6*)].

Although the prior economics literature has generally considered disclosure a cost, a few theoretical and empirical findings demonstrate benefits flowing to inventors from disclosure. For example, Long (*7*) argues that patent publication plays a significant role in mitigating the asymmetric information between patentees and external observers and may particularly benefit small firms. Scotchmer (*8*) shows that publication can notify rivals and licensees about exclusive property rights and thereby provide the inventor with competitive advantage and royalties. Evidence for the latter concept is provided by Gans, Hsu, and Stern (*9*) in the university licensing context and, more recently, by Hegde and Luo (*10*) in a larger sample of corporate licensors and licensees. Because we found theory and evidence on both sides of this question, we take an agnostic approach as to whether disclosure is net beneficial or costly and, instead, allow the revealed preferences of inventors—their disclosure choices exposed in the data—to speak for themselves on the question in our publication. Using data on U.S. patents granted before AIPA's enactment, Johnson and Popp (*11*) provide evidence that early disclosure of patents may benefit society by accelerating the diffusion of technical knowledge.

Section S2

This section provides information on the patent law changes introduced with 18-month pregrant publication in the American Inventors' Protection Act (AIPA) of 1999, to address possible concerns that our findings are the result of substantial shifts in patent applicant behavior associated with other policy changes. We investigated the legislative history and are satisfied that, although there were changes introduced in the AIPA that would tend to change the selection into patenting by inventors, none of these changes appears to us to have enough impact to produce substantial changes in the propensity to patent. For completeness, we reprint those here:

Subtitle B. The Patent and Trademark Fee Fairness Act of 1999: Reduced certain patent fees by relatively small increments: the original filing fee; the reissue fee (a postgrant fee, so not relevant until on average 3 years after initial filing, and then only in rare circumstances); and the international application fee were each reduced from $760 to $690. The initial maintenance fee (due at 3.5 years after grant, so on average 6.5 years after initial filing) was reduced from $940 to $830.

Subtitle C. First Inventor Defense Act of 1999: Provided a limited prior-users defense in the realm of "business method" patents, first made patentable in the *State Street Bank* court decision (*12*). The defense was limited in that it was only available to a person who actually used the method more than 1 year before the patent filing, and anyone asserting the defense in court was given the burden of proving it, and failing to prove prior use, was responsible for paying the other party's attorney fees (fee shifting) upon losing at trial.

Subtitle D. The Patent Term Guarantee Act of 1999: Extended the term of patents to compensate for certain PTO processing delays and for PTO delays in the prosecution of applications; diligent applicants were to be afforded not less than a 17-year term.

Subtitle F. The Optional Inter Partes Reexamination Procedure Act of 1999: Established a reexamination alternative expanding the participation of third-party requesters.

Section S3

This section addresses whether our statistical finding—that patent applicants at the USPTO systematically prefer 18-month publication of their patent applications over pregrant secrecy (nonpublication)—can be explained by how the USPTO frames or presents the default rule.

First, the American Inventors Protection Act (AIPA) makes clear that to benefit from secrecy until grant, the patent applicant must make a conspicuous indication at the time of filing. Reflecting this requirement, the USPTO changed its official patent application form (see 16 in Fig. S7 below which presents a screen shot from a U.S. utility patent application filed in 2002) to make that choice conspicuous and obvious. The requirement of filing another form (PTO/SB/35 referred to under 16 of Fig. S7) is not onerous, because the form requires only a signature and a few text entries, and may be completed by the attorney (see Fig. S8 for an example). Although the choice is made obvious in this 2002-dated form, the form that replaced it by 2005 (the last year in our sample data) made the choice arguably even more obvious, with bolded text (screen shot in Fig. S9), demonstrating that the official USPTO forms have made an obvious choice even more obvious over time. As such, if the effect we find is due to "framing," then this trend would be at odds with the pattern we observe in the data—that fewer nondisclosure requests have been made year-on-year since AIPA was enacted (starting with about 8% in 2001, down to 6.5% in 2005).

Second, the vast majority of patent applications are processed by "experts"—the learned intermediary patent agent or attorney. These agents are specially trained in the patent law and its intricacies, and it is unlikely that they are unaware of the rules or are making poor choices for their (untrained) inventor clients.

Third, the USPTO has a formal process for rescinding nonpublication requests, which primarily consists of filling out a form (Form PTO/SB/36) requesting rescission and transmitting the same to the USPTO. In contrast, the option to withdraw an initial election to publish at 18 months remains available (in case the applicant chooses not to file abroad), but the associated transaction costs are not trivial (ordinarily, it requires abandoning the initial application and filing a type of "reapplication"—a continuation—which requires the payment of an additional filing fee: in 2005, $795, $395 for small entities, plus attorneys' costs for reprocessing).

Finally, the choice of greatest interest to us (and to society) is the choice by inventors concerning their most valuable inventions. Our results show that this choice against secrecy becomes *stronger* as inventions become more valuable. It seems unlikely that if the disclosure choice was being driven by framing that this effect would be exacerbated as private value rises. We would expect the opposite if framing was driving our result, because mistakes driven by inattention would be correlated with low value, not the other way around. For the above reasons, we believe that "framing" or "default rule" biases cannot explain our results.

Fig. S7. Cover Page of U.S. Utility Patent Application in 2002

6-24-02 A

Please type a plus sign (+) inside this box → +

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06/20/02 U.S. PTO

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1 53(b))

Attorney Docket No.	5306P084
First Inventor	Jon R. Degenhardt, et al.
Title	Integrating Related Data From Incompatible Systems for Enhanced Business
Express Mail Label No.	EL867552458US

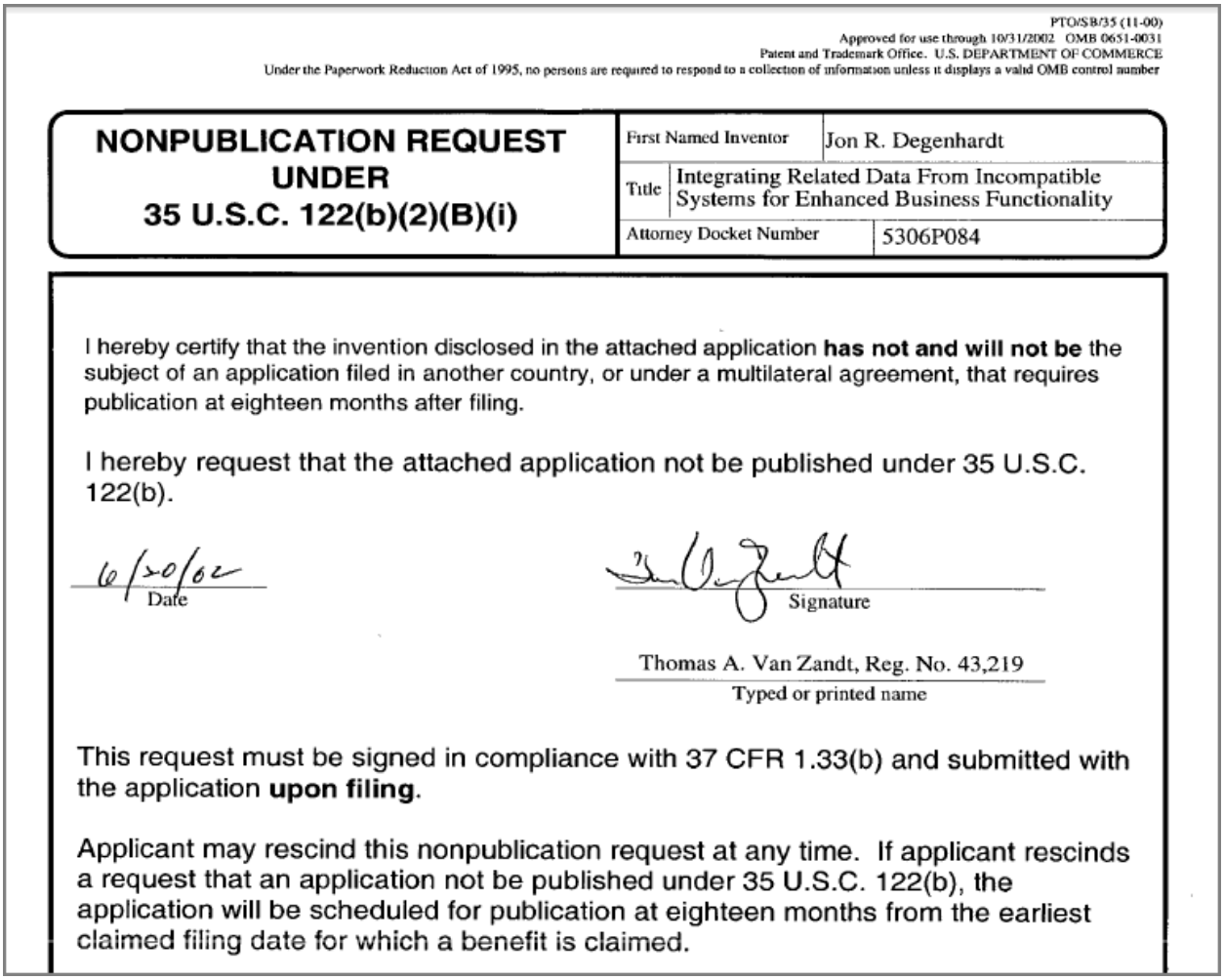
APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. ☒ Fee Transmittal Form (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. ☐ Applicant claims small entity status. See 37 CFR 1.27.
3. ☒ Specification *[Total Pages 21]*
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (*if filed*)
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. ☒ Drawing(s) *(35 U.S.C. 113) [Total Sheets 4]*
5. Oath or Declaration (signed) *[Total Pages 5]*
   a. ☒ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d)) *(for continuation/divisional with Box 18 completed)*
      i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1 63(d)(2) and 1 33(b)
7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program (*Appendix*)
8. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all of the following are necessary)*
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies
9. ☒ Assignment Papers (cover sheet & document(s))
10. ☐ 37 C.F.R. § 3.73(b) Statement *(when there is an assignee)* ☒ Power of Attorney
11. ☐ English Translation Document *(if applicable)*
12. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
13. ☐ Preliminary Amendment
14. ☒ Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. ☒ Nonpublication Request under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. ☐ Other: ______

Fig. S8. Example of Form PTO/SB/35



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NONPUBLICATION REQUEST UNDER 35 U.S.C. 122(b)(2)(B)(i)

First Named Inventor	Jon R. Degenhardt
Title	Integrating Related Data From Incompatible Systems for Enhanced Business Functionality
Attorney Docket Number	5306P084

I hereby certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing.

I hereby request that the attached application not be published under 35 U.S.C. 122(b).

6/20/02
Date

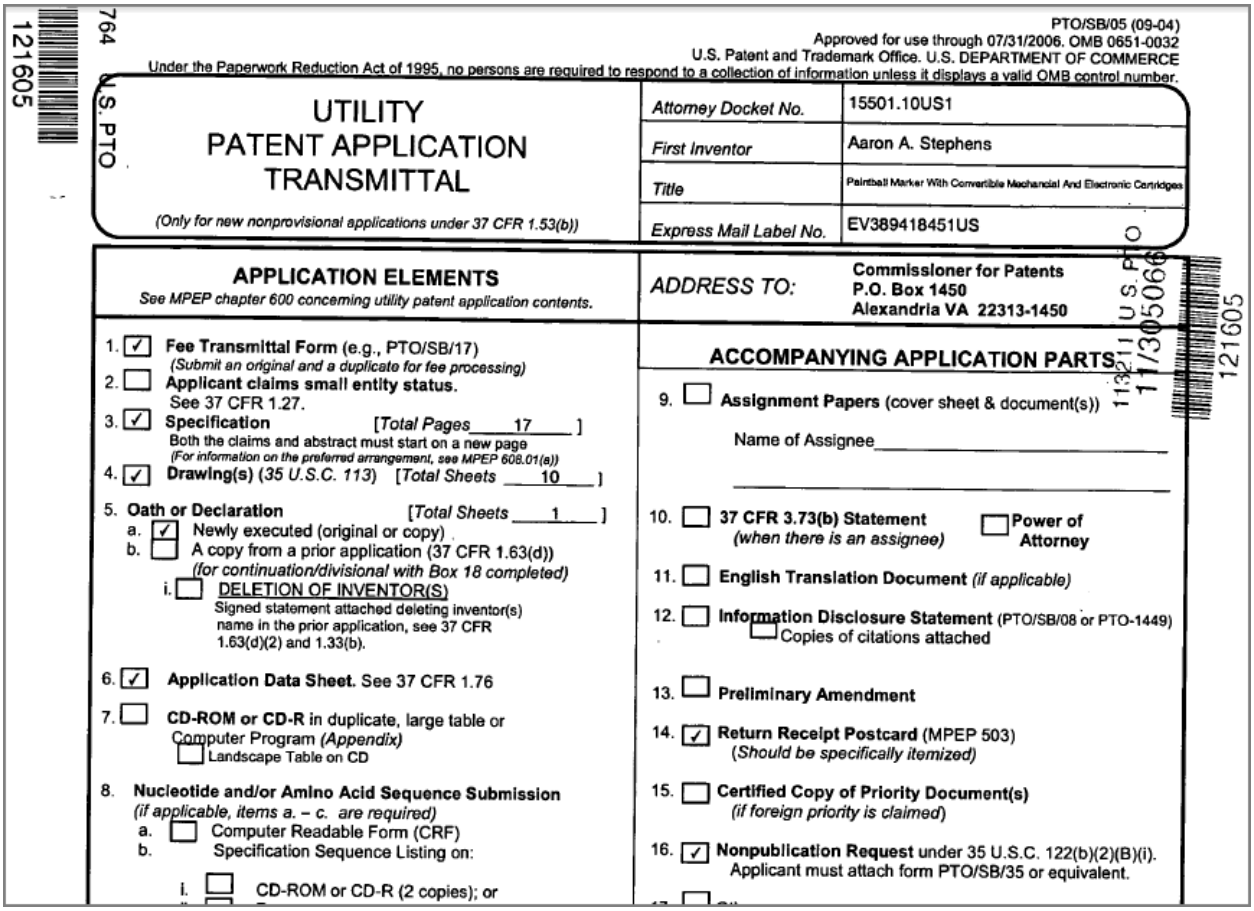
Signature

Thomas A. Van Zandt, Reg. No. 43,219
Typed or printed name

This request must be signed in compliance with 37 CFR 1.33(b) and submitted with the application **upon filing**.

Applicant may rescind this nonpublication request at any time. If applicant rescinds a request that an application not be published under 35 U.S.C. 122(b), the application will be scheduled for publication at eighteen months from the earliest claimed filing date for which a benefit is claimed.

Fig. S9. Cover Page of U.S. Utility Patent Application in 2005



121605

764 U.S. PTO

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	15501.10US1
First Inventor	Aaron A. Stephens
Title	Paintball Marker With Convertible Mechanical And Electronic Cartridges
Express Mail Label No.	EV389418451US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☑ **Fee Transmittal Form** (e.g., PTO/SB/17)
   (Submit an original and a duplicate for fee processing)
2. ☐ **Applicant claims small entity status.**
   See 37 CFR 1.27.
3. ☑ **Specification** [*Total Pages* 17]
   Both the claims and abstract must start on a new page
   (For information on the preferred arrangement, see MPEP 608.01(a))
4. ☑ **Drawing(s)** (*35 U.S.C. 113*) [*Total Sheets* 10]
5. **Oath or Declaration** [*Total Sheets* 1]
   a. ☑ Newly executed (original or copy)
   b. ☐ A copy from a prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 18 completed)
   i. ☐ DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) name in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. ☑ **Application Data Sheet.** See 37 CFR 1.76
7. ☐ **CD-ROM or CD-R** in duplicate, large table or Computer Program *(Appendix)*
   ☐ Landscape Table on CD
8. **Nucleotide and/or Amino Acid Sequence Submission**
   (if applicable, items a. – c. are required)
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or

ADDRESS TO:
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

ACCOMPANYING APPLICATION PARTS

9. ☐ **Assignment Papers** (cover sheet & document(s))
   Name of Assignee_____
10. ☐ **37 CFR 3.73(b) Statement** *(when there is an assignee)* ☐ **Power of Attorney**
11. ☐ **English Translation Document** *(if applicable)*
12. ☐ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☐ Copies of citations attached
13. ☐ **Preliminary Amendment**
14. ☑ **Return Receipt Postcard** (MPEP 503)
    (*Should be specifically itemized*)
15. ☐ **Certified Copy of Priority Document(s)**
    (if foreign priority is claimed)
16. ☑ **Nonpublication Request** under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.

113211 U.S. PTO 11/30/2005 121605

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