Do Patents Enable Disclosure? Evidence from the Invention Secrecy Act*

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Abstract

This paper provides novel empirical evidence that patents enable knowledge disclosure. The analysis exploits the Invention Secrecy Act, which grants the U.S. Commissioner for Patents the right to prevent disclosure of new inventions that represent a threat to national security. Using a two-level matching approach, we document a negative and large relationship between the enforcement of a secrecy order and follow-on inventions, as captured with patent citations and text-based measures of invention similarity. The effect of secrecy orders is particularly salient for geographically-distant parties and for inventions in the same technological field as the secreted patent.

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1 Introduction

The patent system is supposed to "promote the progress of science" in two main ways.[1] First, it enhances the appropriability of inventions. By granting the inventor a temporary monopoly on an invention, the patent system offsets incentive problems arising from the public good character of knowledge (Nordhaus, 1967). Second, it enables knowledge diffusion. The patent document discloses the technical aspects of the invention with the aim of stimulating follow-on inventions.

Despite years of research, economists have not come to an agreement on the extent to which the patent system indeed encourages innovation. Both Williams (2017) and Sampat (2018) come to this conclusion after extensive reviews of the literature. Regarding disclosure more specifically, Sampat (2018, p.20) notes that "the quantitative effects of the disclosure function of patents on rates of innovation are not well known."

Following a stream of scholars (Rantanen, 2012; Lemley, 2012; Hall et al., 2014), one can think of the disclosure effect of patents in two ways. In a narrow way, the disclosure effect relates to the disclosure of technical information contained in the patent document. This view is the conventional view of disclosure. In a broad way, the disclosure effect captures not only the conventional effect but also acknowledges the fact that patent protection enables the disclosure of additional information about the invention (what Rantanen, 2012, calls 'peripheral' disclosure). A patent guards the inventor against the threat of expropriation. Thus, once the inventor obtains a patent, she can more freely disclose details of the invention, *e.g.*, in trade shows or in scientific publications, while still excluding others from using the invention. Both the narrow and the broad perspectives are legitimate ways of thinking about disclosure, but they come with different implications regarding how to estimate the disclosure effect empirically and what conclusions can be drawn from disclosure studies.

The present paper seeks to quantify the magnitude of the disclosure function of patents in the broad sense, *i.e.*, compared to the baseline of secrecy. We exploit the Invention Secrecy Act, which grants the U.S. Commissioner of Patents the right to withhold the publication of patent documents that represent a threat to national security. The inventor

[1] U.S. Constitution art. I, § 8, cl. 8.

of a secreted invention is further forbidden to disclose any material information relevant to the application. In short, all channels of information diffusion are muted and the invention literally falls into a black hole for the duration of the secrecy period. We have identified 2,542 patents that received a secrecy order in the period 1982–2000, which was eventually rescinded by the Commissioner of Patents.

The empirical analysis relies on a two-level matching approach, in which treated patents are patents that are cited by a patent subject to a secrecy order. Control patents are patents matched to the treated patents (level 2 matching) that are cited by patents matched to the secreted patents (level 1 matching). The main outcome variable is the number of citations received by the treated and control patents while the secrecy order lasts, which proxies for follow-on inventions.

We find a strong negative relationship between the enforcement of a secrecy order and the arrival of follow-on inventions. Estimates suggest that the imposition of a secrecy order lowers the arrival of follow-on inventions by 30 to 50 percent while the secrecy order is in force, compared to the baseline of no secrecy. One notable exception concerns follow-on inventions by U.S. government agencies, which exploit the technological paths associated with the secreted patents. We obtain a similar effect size when relying on a text-based measure of similarity to track follow-on inventions. A series of robustness tests confirm the results. Furthermore, we also find that the effect of secrecy orders is concentrated in geographically distant areas, which is consistent with the conventional disclosure argument.

Given the importance of innovation for economic growth, our empirical findings are significant for public policy. The question of whether disclosure in the patent system enables follow-on inventions has been heavily debated in the literature. The present paper offers evidence that it does. Our findings also document clearly one social cost of secrecy, namely a loss of follow-on inventions.

The rest of the paper is organized as follows. Section 2 provides background information on the disclosure function of the patent system. Section 3 explains the identification strategy and Section 4 presents the data and methods. Section 5 discusses the econometric results. Finally, Section 6 concludes.

2 Background

The patent system is often viewed as a *quid pro quo* system, in which the inventor receives the exclusive rights to use his invention in exchange for disclosure of the invention to society (Schroeder, 2010; Ouellette, 2012). Thus, the benefits that society gets out of the patent system is not just the new invention but the publication of new learning that could have been kept secret otherwise. This perspective is well embedded in patent law. The United States Code Title 35 § 112 states that a patent specification must contain a clear written description of the invention, and of the manner and process of making and using it, to enable any person skilled in the art to reproduce it. Furthermore, the Supreme Court has often reinforced the view that the disclosure of technical information in patents is beneficial to knowledge diffusion and follow-on invention (Ouellette, 2012).

Scholars have documented that patent disclosure plays *some* role in the innovation process (Graham and Hegde, 2015). Theoretical results obtained by Horstmann et al. (1985) and Anton and Yao (2004) suggest that disclosure may be used to signal costs of production or imitation. Baker and Mezzetti (2005) show that disclosure allows a second mover to buy some time in a patent race. Hegde and Luo (2018) show that early publication of patent documents speeds up licensing transactions, while Lück et al. (2020) and Hegde et al. (2020) provide evidence that patent publication reduces technology duplication.

However, there is a high degree of skepticism from legal academics and economists on whether disclosure of technical information on the patent document generates follow-on inventions—which is at the heart of the *quid pro quo*. Legal academics argue that patent documents are legal documents that are shrouded with jargon and formalism, preventing engineers to learn from them (Fromer, 2008; Seymore, 2016). Furthermore, patentees usually seek to keep patent claims as vague as possible in order to broaden the scope of the invention, and to disclose as little information as possible in order to conceal it (Risch, 2007; Devlin, 2010). Along these lines, Sun and Dulleck (2018) have estimated computational linguistics scores on a corpus of patents in the field of nanotechnology and provide evidence that patents from private firms are significantly less readable than patents from universities. These arguments have led scholars to conclude that the patent system does not effectively fulfill its disclosure function (see also Lemley, 2012; Boldrin and Levine, 2013). To illustrate this claim, consider the following sentence from U.S. patent 8,119,799 by BASF (italics our own):

> A process for preparing isocyanurate-containing polyisocyanates by *at least partly* trimerizing (cyclo)aliphatic diisocyanates, which comprises carrying out the reaction in the presence of *at least one* ammonium salt trimerization catalyst [...] wherein said reaction is carried out in a *gas or gas mixture* which is inert under the reaction conditions wherein the said gas or gas mixture [...] has a total oxygen content of *below* 2% by volume and wherein said *at least one* trimerization catalyst is at a concentration *ranging from* 0.002 to 0.05% by weight [...].

Elements in italics induce vagueness, and effectively hide the invention from would-be imitators. Another point put forward by legal scholars concerns the doctrine of willful infringement, which discourages engineers from reading the patent literature (Lemley and Tangri, 2003). Under this doctrine, evidence that engineers were aware of a competitor's patent that is claimed to be infringed upon leads to 'treble damages.' To lower the risk of willful infringement, some patent attorneys advise their clients to *not* read the patent literature altogether.

Economists show a similar level of skepticism about the conventional disclosure argument. Machlup and Penrose (1950) explain how this argument has been challenged at least since the mid-19th century. To find out whether the patent literature is a useful learning channel, scholars have directly asked the question to scientists and engineers. Jaffe et al. (2000) asked approximately 400 U.S. patent inventors to list one or two significant influences on the development of their patented invention. Only five percent of the respondents identified the patent literature as having significant influence in the invention process. In a survey administered to R&D managers of 643 firms from the United States and Japan, Cohen et al. (2000) asked to rank the relevance of different information channels for the completion of a recent major R&D project. Answers suggest that, in the United States, patents were considered less important than other information sources like scientific publications and informal exchanges. Ouellette (2012) conducted a survey of 211 researchers active in the nanotechnology field. She shows that 64 percent of the respondents have read at least one patent for a research purpose and that about 45 percent of the respondents looked at patents to search for relevant technical information. Yet, only 38 percent of the patent-reader thought that the invention was reproducible using exclusively the information included in the patent.

However, as emphasized by Hall et al. (2014, p.417), “measuring the effect of disclosure only based on how important the patent literature is for innovation may be too narrow. If there is additional (informal) disclosure, which is *enabled* by a patent [...], the disclosure effects could be substantially larger” (italics our own). When an inventor decides to keep an invention secret, knowledge diffusion may be muted not only because the new ideas are not formally codified in a patent document, but also—and perhaps primarily—because secrecy requires that those new ideas shall not be disclosed by any mean, formal or informal. Lemley (2012) similarly argues that patent protection encourages public disclosure of information through other means than the patent document. For instance, the fact that a scientist has applied for a patent allows her to disclose additional information in a scientific publication or by presenting research results in academic conferences. The technical information available in the patent document may not be as useful as that available in the scientific article or shared in a conference. But the filing of a patent application might have enabled the disclosure of technical knowledge by these other means (Gans et al., 2013; Grushcow, 2004). This point is discussed at length in Rantanen (2012), who calls ‘conventional disclosure’ the disclosure of the technical information contained in the patent document, and ‘peripheral disclosure’ the disclosure of information that is enabled by the patent document. The present paper adopts the same terms.

A recent line of research has produced empirical evidence on the disclosure function of patents (or lack thereof) using quasi-experimental approaches. Furman et al. (2018) exploit the openings of regional USPTO patent libraries from 1975 to 1997. They document a significant increase in local patenting once a library opens, and attribute this effect to the disclosure of technical information enabled by libraries. Cox (2019) exploits the introduction of the disclosure requirement in British patent law in 1734. The reform required all patentees to submit technical specifications for their inventions which were then made publicly available (for a fee) in Chancery Lane, London. He finds evidence that the reform stimulated metropolitan inventive activity by affording London-based inventors privileged access to specifications. Baruffaldi and Simeth (2020) exploit the introduction of the American Inventors Protection Act, which reduced the publication time for patent documents. Using citation data as a measure of follow-on inventions, they conclude that the technical information contained in patent documents is not used in the production of inventions.

Gross (2019) offers a rich analysis of a mass patent secrecy program under which about 11,000 patent applications invented during World War II (WWII) were secreted until the end of the war. The author offers an analysis at the intensive margin. He finds that patents with *longer secrecy terms* were less likely to be cited (and used) by future patents. However, as Gross explains, it is not clear "why a temporary invention secrecy policy in the 1940s would affect long-run, post-war citations, and especially citations from a population of patents which were mostly led after secrecy orders were rescinded." Indeed, due to data limitations, the paper is silent on how knowledge flows, or does not flow, during the enforcement of a secrecy order, or immediately thereafter. Gross tentatively attributes the effect to a "lost generation of follow-on, in the form of inventions which might have been produced in the 1940s if information had not been suppressed." (p. 16). Furthermore, WWII is a period characterized with massive investments, and rapid improvements in military (*i.e.*, secreted) technologies, and it remains to be seen how the results would hold in peace time.

In the present paper, we study the role of patent disclosure on follow-on inventions by exploiting the U.S. Invention Secrecy Act of 1951. The Act allows us to identify inventions in the period 1982–2002 that were supposed to be disclosed through the patent system but whose disclosure was blocked by the issuance of a secrecy order. We provide direct evidence on whether, and to what extent, knowledge flows both *during* and *after* the secrecy order. Our evidence points to a 'lost generation' of follow-on inventions. Another notable difference with Gross (2019), besides observing follow-on inventions during the time of secrecy, is that we offer an analysis at the extensive margin. We measure the effect of secrecy against the baseline of disclosure—as opposed to measuring the effect of longer periods of secrecy (against the baseline of shorter periods of secrecy).

3 Identification strategy

We want to evaluate the extent to which knowledge flows are disrupted when an invention is kept secret instead of patented. As a preliminary remark, it is important to note that, although knowledge cannot flow under a secrecy regime, inventions similar to (or seemingly building on) secreted inventions might arise simply because the knowledge that has led to that invention (and to its potential improvements) is 'in the air.' As recently observed by Lemley (2012), similar inventions are often developed nearly simultaneously by different teams working independently, as new ideas are either pulled by changes in demand conditions or pushed by technological improvements. This argument, known in the literature as the 'inevitability of inventions,' exists at least since Ogburn and Thomas (1922) and Ihde (1948).

In the ideal experiment, we would observe the same invention in two mutually-exclusive regimes: a regime in which the inventor files a patent application for the invention; and another in which she decides to keep the same invention secret. We would then compare how many inventions build on the focal invention in both regimes. Inventions 'building' on the secret patent would be due to the fact that knowledge is 'in the air,' and the difference with the non-secret invention would be the broad disclosure effect. Note that this broad disclosure effect encompasses both conventional and peripheral disclosure.

Clearly, several issues prevent us from implementing this ideal experiment. But the discussion suggests that our study needs two main ingredients: a set of comparable secreted and patented inventions, and a way of tracking follow-on inventions that works in both regimes. We discuss these two issues in turn.

3.1 Identifying secret inventions: The Invention Secrecy Act

Scientific and technological progress has been gaining a more and more central role in national defense matters since the beginning of the 20th century. World War I (WWI) was the first large scale conflict that saw the use of machine guns, tanks, and aircraft. WWII dramatically transformed the relationship between science and war efforts (Stokes, 1997), with the development of technologies such as the radar, the computer, and atomic energy to name but a few major advances. Scientists cracking coded messages and breaking new grounds in theoretical physics suddenly became as important as actual soldiers on the battlefield. By the end of WWII it was clear that leadership in science and technology meant global leadership.

In this new context, being able to keep technological inventions from leaking to the enemy became a necessary condition for military supremacy. To prevent this possibility, the U.S. government approved the first Invention Secrecy Act in October 1917, six months after joining the Allies in WWI. The Act stated that, when the United States is at war, the Commissioner of Patents may order to keep a patent application secret until the termination of the war if the disclosure of the invention may be detrimental to national security.

This Act remained in force only for a few months after WWI, but it was renewed without major changes in July 1940. It authorized the imposition of secrecy orders only during war time, such that most secrecy orders were rescinded in November 1945 (for a detailed discussion, see Lee, 1997; Gross, 2019).

However, the post-war period brought forward new and growing hostilities between the United States and the Soviet Union, with the tension reaching its peak in the Berlin Blockade in 1948, the successful tests of a Soviet atomic bomb in 1949, and the outbreak of the Korean war in 1950. Once again, the risks of an imminent conflict pushed the U.S. government to issue a new version of the Invention Secrecy Act in 1951:

> Whenever the publication or disclosure of an invention by the publication of an application or by the granting of a patent [...], might [...] be detrimental to the national security, the Commissioner of Patents upon being so notified shall order that the invention be kept secret and shall withhold the publication of the application or the grant of a patent.

Unlike its predecessors, the 1951 Invention Secrecy Act, still in force today, allows the Commissioner of Patents to issue secrecy orders in peace time. It establishes specific procedures for the issuance of secrecy orders, which differ based on the kind of property right that the

U.S. government holds on the invention. If the invention was made by government employees, or by government contractors in the performance of work under a government contract, the related governmental agency can file a classified patent application at the USPTO.

The procedure is more complex if the invention is private and the government does not have any property interest in it. National defense agencies provide the USPTO with a classified list of sensitive technologies known as the *Patent Security Category Review List.* USPTO patent examiners from 'Group 220,' who possess adequate security clearance, systematically search for patent applications whose subject matter could constitute a threat to national security. They forward potential cases to the relevant defense agency for further inspection (Lee, 1997). Governmental agencies then review the applications and, when needed, request the imposition of a secrecy order to the Patent Commissioner.

Once the Commissioner imposes the secrecy order, the secreted patent application is kept only in paper form (*i.e.*, the digital version of the application is deleted from the USPTO database) and examined by patent examiners with the highest level of security clearance. If the application meets the patentability criteria, the office issues a *Notice of allowability* but does not issue the patent. The application disappears from all public documents and databases until the secrecy order is rescinded.[2]

A secrecy order lasts for a period of one year, but the government agency that initially requested it can have it renewed indefinitely.[3] It is only when the secrecy order is not renewed that the patent application is eventually granted and disclosed to the public in full.

The effect of a secrecy order extends beyond the U.S. patent system. Not only the patent application will not be granted or published in the United States, but the inventor shall not file a foreign patent.[4] Furthermore, she shall not publish or disclose the subject matter or any material information relevant to the application, including unpublished details of the

[2]In case of a rejection, the applicant can appeal the decision, but her case will not be heard until the secrecy order is rescinded.

[3]If the applicant believes that certain existing facts or circumstances would render the Secrecy Order ineffectual, he or she may informally contact the sponsoring agency to discuss these facts or formally petition the Commissioner for Patents to rescind the Order (C.F.R. 37 5.4). If such a petition is granted, a secrecy order may last for less than a year.

[4]Certain secrecy orders may allow the applicant to file a patent applications in specific countries in which the U.S. has security agreement arrangements. The list of such countries includes: Australia, Belgium, Canada, Denmark, France, Germany, Greece, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, the Republic of Korea, Spain, Sweden, Turkey, and the United Kingdom.

invention, to any person not aware of the invention prior to the date of the secrecy order.[5] In case the inventor fails to obey this rule, the patent application is considered abandoned, and the inventor could receive a pecuniary fine and face a jail sentence of up to two years.

In short, the Invention Secrecy Act grants the patent office the right to impose a secrecy order on patent applications. The secrecy order also commands the inventor to avoid disclosure through other means than the patent application. As a result, these inventions are similar to inventions willingly kept secret, at least from the information disclosure viewpoint. But with a crucial difference that we will exploit for identification: a secrecy order is limited in time. Secrecy orders last for one year but can be renewed for as many years as necessary. However, when the relevant government agency considers that the invention is no longer a threat to public safety and defense, the Patent Commissioner rescinds the secrecy order. When that happens, the patent application is granted and the invention is disclosed to the public in full, thus coming out from behind the secrecy veil.

3.2 Tracking follow-on inventions

Starting with Jaffe et al. (1993), economists interested in the study of technological change have used patent citations as "paper trails" of knowledge spillovers and knowledge flows. As explained by Hall et al. (2005, p.18), if patent B cites patent A, it implies that patent A represents a piece of previously existing knowledge upon which patent B builds, and over which B cannot have a claim.

The number of citations that a patent receives from subsequent patented inventions (so-called forward citations) serves to quantify the amount of closely-related follow-on inventions. Citation chains represent avenues along which knowledge progressively evolves and diffuses over time. Citation data remain the best available and most used measure to track cumulative innovation in the economic literature (*e.g.*, Belenzon, 2012; Galasso and Schankerman, 2014; Moser et al., 2017; Jaffe and de Rassenfosse, 2017). We follow this literature and use the count of forward citations as our main measure of follow-on inventions.

Yet, citation data have limitations (Alcácer et al., 2009; Sampat, 2010) and their use

[5] See Manual of Patent Examining Procedure, 120, III.

to track follow-on inventions has been criticized (Alcacer and Gittelman, 2006; Roach and Cohen, 2013; Kuhn et al., 2019). An alternative approach involves using content-based measures, such as the diffusion of novel words in patent documents or text similarity scores between patent documents (Iaria et al., 2018; Arts et al., 2018). Therefore, we will exploit data provided by the Google Patents team on patent similarity. The Google similarity measure comes from a model that has learned a set-of-words embedding of the patent full text to the technology classes (CPCs) of that patent using the WSABIE embedding algorithm (Weston et al., 2011).[6]

The next section discusses the evaluation problem that we face and presents our solution. We explain this using the count of forward citations as an indicator for tracking follow-on inventions. But the problem (and the solution) also applies to the content-based measure.

3.3 The evaluation problem

Although the two ingredients are in place—a way of identifying secret inventions and of tracking follow-on inventions—we still face a major challenge. If an invention is kept secret there are no forward citations to count, at least not until the secrecy order is rescinded.

The economic literature has long suggested that knowledge production is a cumulative process (*e.g.*, Scotchmer, 1991; Jones, 2009; Dosi and Nelson, 2010), in which the production function for new knowledge depends on new recombination of existing knowledge (Weitzman, 1998; Fleming, 2001). Thus, if we were able to prevent a specific body of new knowledge to come into existence, we would not only deprive the world of that piece of knowledge but also of the possible improvements and modifications that would build on that knowledge. If we extend the analogy to new inventions, a given invention provides the foundations for the development of follow-on inventions and a missing link, *i.e.*, removing an invention in a hypothetical invention sequence, would affect the direction and volume of follow-on inventive activity.

This observation has two key implications for our identification strategy. First, although we cannot observe the inventions that could potentially build upon the secreted patents, we

[6] See, *e.g.*, https://patents.google.com/?q= patent%2fUS7945525B2. More details on the similarity algorithm are available at https://media.epo.org/play/gsgoogle2017.

can go back one step in the invention sequence and identify the technological antecedents of the secreted inventions. This is easily done with patent data. As discussed in Section 3.1, secreted inventions are fully examined before Notices of Allowability are issued. This implies that the patent examiners produced a search report with the citations to the relevant prior art, as of the time of examination. Clearly, this set of information is not affected by the imposition of the secrecy order nor does it change over time—and it becomes available in full once the secrecy order is rescinded and the USPTO issues the patent. Therefore, we can use backward citations to track the technological antecedents of secret patents in the inventive sequence.

Second, we can consider technological antecedents as the starting point of an invention sequence that could evolve in two alternative regimes: the *secret* regime or the *patent* regime. In the *secret* regime, the technological antecedents are cited (*i.e.*, used as input) by an invention that receives a secrecy order, for which no patent is issued and no disclosure happens. In the *patent* regime, the follow-on invention is patented and disclosed. In both regimes, the innovation sequence that started with the antecedent keeps evolving as time goes by. Even in the *secret* state, we can still observe new follow-on inventions citing the antecedents in the period between the imposition of the secrecy order on the follow-on patent and the moment in which the secrecy order is rescinded.

Our empirical strategy lies precisely in the differences in the rate of arrival of follow-on inventions in this time window between the two regimes, as summarized in Figure 1. If the imposition of a secrecy order does not affect follow-on inventions, we should not find any difference in the evolution of the invention sequence between the *patent* and the *secret* regimes. Conversely, if the imposition of a secrecy order hampers the arrival of follow-on inventions, the innovation sequence in the two regimes would look substantially different. We can measure this difference by counting the number of citations to the antecedents from follow-on patented inventions during the period through which the secrecy order was in force.

[INSERT FIGURE 1 ABOUT HERE]

The validity of the identification strategy rests on the selection of suitable patent-antecedent control pairs. The next section describes the two-stage matching approach that we have adopted as well as the econometric model.

4 Data and methods

4.1 A sample of matched patents

We exploit the USPTO Patent Examination Research Dataset (PatEx) to identify granted patents subject to a secrecy order (which was then rescinded). The PatEx dataset, assembled by Graham et al. (2018), provides full access to the bulk data collected by the Public Patent Application Information Retrieval system (Public PAIR).[7] The PAIR system includes data about the history of the administrative transactions that occurred between the patent examiners and the applicants during the patent prosecution process, including information on secrecy orders.

The sample covers 2,542 patents filed between 1982 and 2000 subject to a secrecy order. Starting with patents filed in 1982, it is possible to identify the communications through which the examiner notified the imposition of a secrecy order to the applicant, including the renewal(s) and the rescinding of the secrecy order.[8] Figure A.1–A.3 in Appendix A provides an example of such communications. We limit our sample to patents applied up to the year 2000 in order to avoid any potential bias due to the implementation of the American Inventors Protection Act (AIPA).[9] A total of 421 patents with a secrecy order filed in 1982–2000 had assignees located outside the United States. We discard these foreign-owned patents to strengthen our identification strategy, thus reducing the sample to 2,121 patents.

Figure 2 depicts the distribution of the length of the secrecy orders (solid line). The distribution is right skewed, with a modal value of one year and a mean of 4.1 years.

From the sample of patents with a secrecy order, we then construct our final sample by

[7]The PatEx dataset is available at https://www.uspto.gov/learning-and-resources/electronic-data-products/patent-examination-research-dataset-public-pair

[8]Before 1981, the information on the rescission of the secrecy order is not available, thus patents might have been secreted and then unsecreted without leaving a trail in the data.

[9]After the AIPA, the patent application is disclosed in full after 18 months from filing. See Graham and Hegde (2015) for a detailed description of this policy change.

matching patents at two levels, see Figure 1. *Level 1* matching involves the identification of a suitable group of control patents for the sample of 2,121 patents for which a secrecy order has been imposed. We draw the control patents from 123,618 U.S. patents filed between 1982 and 2000 that were examined by examiners who have inspected at least one patent subject to a secrecy order—thereby ensuring some consistency regarding the subject matter of the inventions.[10] We then implement an exact matching procedure based on the main technological class (USPC) and the application year. This procedure results in a sample of 46,291 control patents matched with 1,941 patents with a secrecy order.[11]

[INSERT FIGURE 2 ABOUT HERE]

As described in Section 3.3, the empirical analysis focuses on the antecedents of the secreted patents (and their controls), which we obtain from the *Level 2* matching. To perform that matching, we start by retrieving all patent antecedents associated with the two selected groups (secreted patents and their matches). We identify 16,146 and 410,377 patent antecedents linked to the group of secreted and matched patents, respectively. We then perform an exact matching with the aim of maximizing homogeneity between these two groups of patents. We exact match on the main USPC patent class, the patent application year, and the geographical location of the assignees (U.S. *vs* foreign). We also impose that treated and control patent antecedents must have received the same number of forward citations during the period of time that goes from their application year until the year in which the secrecy order on their citing patent has been imposed.[12] This restriction ensures that we consider treated and control patents that are similarly 'promising' until the secrecy order is imposed.

This stringent double matching procedure leads to a final sample of 1,313 treated and 3,176 control patent antecedents, which represent our focal patents. The treatment is clearly exogenous to the focal patent's characteristics. These patents are linked to 725 citing patents

[10] According to the USPTO Manual of Patent Examining Procedure (MPEP, 130), all applications in which a secrecy order has been imposed are examined in a secure location by examiners possessing national security clearances under the control of a specific working unit.

[11] We do not find any exact match for 180 treated patents.

[12] Note that, by construction, all the patent antecedents must have at least one forward citation. For the calculation of the forward citations of the control patent antecedents, we consider the year of imposition of the secrecy order of the associated treated patent.

with a secrecy order and 2,824 citing patents without a secrecy order, respectively. We further enrich the dataset by retrieving relevant characteristics of our focal and citing patents, such as the number of claims, the family size, the number of backward citations and the number of inventors listed in the patent document (EPO-PATSTAT, release 2015).

Figure 3 plots the frequency distribution of the year in which the 725 patents subject to a secrecy order were filed. Patents in the sample are primarily from the late 1980s to early 1990s.

[INSERT FIGURE 3 ABOUT HERE]

To provide evidence on the technological domains of these patents, Table 1 lists the different USPC main classes sorted by number of patents. Unsurprisingly, many of the most frequent classes relate to technologies that have clear military applications, including class 342 (Communications: directive radio wave systems and devices), class 102 (Ammunition and explosives), class 149 (Explosive and thermic compositions or charges), and class 343 (Communication: radio wave antennas). However, this is not the case for all technologies. An initially classified document from 1971 reveals that technologies such as "solar photovoltaic generators," "computer aided design," and the "rapid production of photographic prints" were possibly worth restricting.[13]

Table 2 shows summary statistics related to the citing patents with a secrecy order both for the matched sample (725 observations), as well as, for comparison purposes, for the total sample (2,121 observations). Focusing on the matched sample, the average patent contains about 15 claims, has received more than 16 citations, and has a family size of two, meaning that it was extended in another jurisdiction (after the rescission of the secrecy order). It makes about twelve citations to prior patent literature and one to non-patent literature (including scientific references), and was invented by two inventors. Secrecy orders lasted on average 3.7 years. However, as in the case of the total sample, the distribution of this variable is rather skewed (see Figure 2, dashed line), ranging from a few months to 20 years, with more than one third of the secrecy orders that lasted for less than two years. In these cases, it is clear that the secrecy order did *not* extend the non-disclosure period

[13] Source: https://fas.org/sgp/othergov/invention/pscrl.pdf, last accessed Jan 24, 2020.

because patent documents were not published before grant until the AIPA came into force on November 2000. In fact, the median lag between the filing date of a patent application at the USPTO and the grant date is about 23 months in the period we consider. Therefore, for the baseline empirical analysis, we decided to consider exclusively patents with a secrecy order that lasted more than three years. This restriction ensures that the disclosure of any information about the secreted patent was substantially delayed compared to the control patent. It led to a final working sample of 505 treated and 1,313 control patent antecedents (our focal patents), linked to 297 citing patents with a secrecy order and 1,152 citing patents without a secrecy order, respectively.

[INSERT TABLE 1 ABOUT HERE]

[INSERT TABLE 2 ABOUT HERE]

4.2 Empirical model

The econometric model follows logically from our identification strategy. We estimate:

$$y_i = c + \phi \mathrm{Secret_i} + \gamma \mathrm{X_i} + \delta_s + \delta_t + \epsilon_i, \quad (1)$$

where, the dependent variable y_i records the number of forward citations that the focal patent i has received starting from the year in which the secrecy order of its citing patent has been imposed. We let citations accrue up to three points in time: until the publication year of the patent (which roughly corresponds to the year of the rescission of the secrecy order), until three years after the publication of the patent and until five years after the publication of the patent.[14]

The variable of interest is the dummy $Secret_i$. It takes value 1 if the focal patent has been cited by at least one patent that has been imposed a secrecy order, and 0 otherwise. The sign and significance of the coefficient ϕ will therefore provide indications on whether and to what extent the enforcement of a secrecy order acts as a barrier to the diffusion of knowledge.

[14]For the calculation of the forward citations of a control patent, we consider the year in which the secrecy is rescinded for the associated treated patent.

The vector δ_s is a complete set USPC (main) classes fixed effects, and the vector δ_t includes filing year fixed effects (both for the citing and the cited patents). The vector X_i captures features of the focal patent, including: the size of the patent family (at international level), the number of inventors that are listed on the patent document, the number of claims, and the number of citations made to the patent literature and to the non-patent literature. Moreover, we follow Moser et al. (2014) to control for variation in the pace of inventive activity across the technology life cycle. We construct a variable measuring the number of years that have elapsed since the first patent was issued in the specific technological class.

Table 3 shows summary statistics of the variables for the working samples of control and treated patents. Treated patents seem to receive a lower number of citations during the secrecy order ('Secrecy,' which runs from the imposition of the secrecy order to the publication of the patent document), providing preliminary evidence about the disclosure effect. Note that, by design, treated and control patents have accrued the same number of citations until the secret patent arrives ('Pre-Secrecy,' which runs from the filing date of the focal patent to the arrival of the secreted patent). Treated patents appear to have a lower number of claims and a lower number of backward citations than control patents.

[INSERT TABLE 3 ABOUT HERE]

5 Econometric results

5.1 Baseline results

Table 4 presents the results of the baseline OLS estimates for the three dependent variables. As mentioned in Section 4.1, the sample contains treated (and control) focal patents that have been cited by at least one patent with a secrecy order (or its control) that lasted at least three years. The results, reported in columns (1) to (3), show a negative and statistically significant relationship between the enforcement of a secrecy order and follow-on inventions. A patent cited by one or more patents that have been kept secret for at least three years receives on average about 1.3 less citations than its control (column 1). Compared with the average of 3.31 forward citations received by focal patents, this coefficient implies a 41-percent reduction in forward citations during the secrecy period (1.354/3.313). The negative effect of secrecy slightly increases to 43 percent and 45 percent when the citation window is extended to three and five years after the publication of the citing patent, respectively (columns 2 and 3).

[INSERT TABLE 4 ABOUT HERE]

To shed some light on the effect at the intensive margin, we re-estimate the regression model by considering a secrecy length threshold of at least six years, instead of three, in Table 5. OLS estimates range between -1.77 and -2.99, corresponding to a reduction between 43 percent and 48 percent of the number of forward citations received by the focal patent compared to the control patent.

Next, to account for the fact that citations are count data, we re-estimate the baseline model using the Poisson and negative binomial estimators. Table 6 reports the estimates, together with the previously-estimated OLS coefficients as a benchmark. Non-linear estimators yield slightly smaller marginal effects than OLS. If we consider citations during the secrecy period, the Poisson estimate implies a 32-percent reduction in the number of forward citations of the focal patent (column 1 of panel B) compared with 41 percent for the OLS estimator.

[INSERT TABLE 5 ABOUT HERE]

This first set of estimates points to a rather strong effect of secrecy orders on follow-on inventions. Being cited by one or more patents that are temporarily kept secret significantly reduces the arrival of follow-on inventions. Furthermore, the length of the secrecy order seems to amplify this negative effect.

[INSERT TABLE 6 ABOUT HERE]

5.2 Robustness tests

There are several potential threats to the validity of our estimates, which this section discusses. One threat relates to the specific nature of the patents subject to a secrecy order.

Although the empirical analysis focuses on patents cited by secret patents (and their control patents), one may be concerned that our two-level matching approach does not address this threat perfectly. A second threat relates to potential alternative explanations that would account for the pattern we observe. In particular, technology areas subject to secrecy orders could be known to insiders and the drop in citations could reflect a drop in the number of patents filed (as opposed to a drop in the number of inventions created). Finally, patent citations are an imperfect measure of follow-on inventions, despite their wide use.

5.2.1 Validity test and alternative matching

The two-level matching approach should be sufficient to account for the specific nature of the secreted patents. The fact that patent A is cited by a secreted patent is clearly exogenous to patent A. Nevertheless, there may be something specific about patent A, which makes it more likely to be cited by a secreted patent.

We can use a feature of the data to assess the validity of our identification strategy. As Figure 2 (dashed line) illustrates, some secrecy orders do not last very long: about 100 patents in the matched sample have been subjected to the enforcement of a secrecy order that has lasted less than one year. For such short secrecy orders, the effect of secrecy should be null since patents were not published before grant during the time period of our study.

The validity test involves performing the same analysis as before but on the set of patents (and their controls) subject to a secrecy order that lasted less than one year. As shown in Table 7, the treatment effect becomes indistinguishable from zero, providing further evidence on the validity of our approach.

[INSERT TABLE 7 ABOUT HERE]

Next, we show that the results are robust to an alternative matching, which is more stringent than the baseline matching. In the baseline analysis, the *Level 1* matching coupled secreted patents with similar non-secreted patents based on their main technology class and year of filing. But it did not consider the similarity of the knowledge upon which they build. For this new matching, we impose in *Level 1* that a non-secreted patent should have at least one backward citation in common with a secreted patent. From this new, more restrictive sample, we identify the treated and control focal patents (*Level 2*) by performing an exact matching using the same set of covariates as the baseline case (namely, application year, main USPC class and number of forward citations accumulated from the filing year of the patent until the year in which the associated citing patent application has been filed). We obtain a final sample of 534 treated and control cited patents. The additional restriction in *Level 1* matching increases the similarity of the secreted and the non-secreted matched patents, minimizing the technological distance between the focal technological trajectories identified in the *Level 2* matching.

Table 8 reports the results of OLS and Poisson regression models. The coefficients of the variable of interest are negative and statistically significant in all the models. The effect is larger compared to the baseline model. The OLS estimate in column (1) implies a 50-percent reduction in forward citations during the secrecy period.

[INSERT TABLE 8 ABOUT HERE]

5.2.2 Inventions or patents?

As alluded to earlier, the drop in citations that we observe may reflect a drop in patenting rather than a drop in inventions. Follow-on inventive activity may remain strong, but assignees building on a sensitive technology may prefer secrecy over patenting, which would lead to a drop in citations. Although we cannot address this issue upfront (because we do not observe inventions that remain secret) we can identify assignees who were more likely to be aware of the existence of secrecy orders, or assignees who may better understand the sensitive nature of the technology.

In a first robustness test, we recompute the dependent variables by excluding forward citations coming from assignees that have received at least one secrecy order—indeed, these assignees are the most likely to work on sensitive technologies. Results, reported in Table 9, are in line with the baseline estimates. The OLS coefficient in column (1) implies a 41-percent reduction in forward citations during the secrecy period.

[INSERT TABLE 9 ABOUT HERE]

Next, we identify a larger population of assignees working on sensitive technologies, namely contractors for the Department of Defense. We decompose the dependent variable in two variables. The variable 'Cites by DoD contractors' records forward citations coming from patents belonging to contractors that performed R&D works with the U.S. government between 1982 and 2000.[15] The variable 'Cites by non-DoD contractors' is the complementary set. Table 10 shows the results of these additional estimates. Interestingly, the magnitude of the effect is stronger when the focus is on citations coming from organization that are not DoD contractors compared to organizations that are DoD contractors. This finding confirms that there seems to be a genuine drop in follow-on inventions.

[INSERT TABLE 10 ABOUT HERE]

In a final test, we broaden the focus to relevant technologies instead of relevant organizations. We break down citations between those arriving from USPC classes at risk of receiving a secrecy order and those that are not at risk. The variable 'Cites from secret classes' records forward citations from patents belonging to USPC classes that were assigned, at least once, as primary class to patents that received a secrecy order in our reference period. The variable 'Cites from non-secret classes' records only forward citations from patents belonging to USPC classes that were never assigned as primary class to patents that received a secrecy order in our reference period. As Table 11 shows, the treatment effect remains negative and statistically significant also in the 'non-secret' patent classes.

In brief, these tests provide evidence that the drop in citations reflects a genuine drop in the rate of invention. The result is not driven by inventors filing less (but producing as much) inventions that are at risk of being secreted.

[INSERT TABLE 11 ABOUT HERE]

[15] To identify contractors that performed R&D work for the Department of Defense in the period 1982-2000 we used the *Records of Prime Contracts Awarded by the Military Services and Agencies* made available in electronic format by the National Archives and Records Administration (NARA). The records include information from the Defense Contract Action Data System (DCADS) about contracts for goods and services between the private sector and agencies of the Department of Defense between the year 1976 and 2000. Data are available at https://www.archives.gov/research/electronic-records/reference-report/federal-contracts

5.2.3 Alternative way of tracking follow-on inventions

As discussed in Section 3.3, the use of patent citations to track follow-on inventions has received some criticism. In this section, we show that the results are robust to the identification of follow-on inventions using the textual similarity of patent documents.

We start from the set of treated and control patents as identified by the *Level 2* matching described in Section 4.1. However, instead of counting citations, we track inventions that are most similar to the treated and control focal patents based on the text of the patent document. We rely on data provided by the Google Patents team to identify textually-similar inventions. The search for similar patents returned an average of 1,905 patents per document, ranked by relevance. This number includes U.S. patents filed at any point in time, in any technology field, as well as patents pertaining to the same family of the focal patents. To ensure meaningful levels of similarity, we focus on the 50 most similar patents. In addition to that, for each focal patent i, we rule out those similar patents that are part of the same patent family, or that pertain to the focal patent i's family. Finally, we further restrict our sample by excluding similar patents with a USPC primary class different from the USPC class of the matched (secreted or control) patents citing the focal patent i. In this way, we can better isolate the potential hindering effect of the secrecy order on follow-on inventions. We then build three different dependent variables by following the same approach used in the main analysis. We count patents similar to the focal patent i arriving between the year in which the secrecy order of its citing patent has been imposed and the publication year of the secret patent (Secrecy), three years after publication (Secrecy+3), and five years after publication of the patent (Secrecy+5).

The results, reported in Table 12, confirm the negative effect of the imposition of a secrecy order on follow-on inventions. In all the specifications, patents cited by patents subject to a secrecy order are associated with significantly smaller numbers of textually similar patents compared to the control group. The results are robust to a specification that focuses on the 30 most similar patents, as shown in Table 13.

[INSERT TABLE 12 ABOUT HERE]

[INSERT TABLE 13 ABOUT HERE]

5.3 Knowledge is in the air, but also in the patent document

We have shown so far that the enforcement of a secrecy order substantially hinders the arrival of follow-on inventions. We interpret this finding as the effect of lack of disclosure of secreted inventions. In the previous section, we ruled out confounding factors and several potential alternative explanations to the effect that we observe. In this section, we explore whether the disclosure function of patents plays a role in driving this effect.

We first test the potential mediating effect of geographical distance. If, as we believe, the effect we observe is indeed driven by a limitation of the access to technical information contained in the patent documents, then we would expect that geographical distance between pairs of patents would amplify this effect.

A second test focuses on the technological proximity of citations to the secret and control patents. If disclosure is the key mechanism driving our results, then we should expect to find a stronger effect of secrecy for follow-on inventions characterized by the same technological field as the secret patent.

In a final test, we track citations coming exclusively from U.S. government agencies, which are the only parties entitled to access and use the information contained in the secreted inventions. In such a context, where the role of patent disclosure loses relevance, we would expect to find no impact of secrecy on follow-on inventions.

5.3.1 Disclosure and geographical proximity

The spillover literature tells us that knowledge is in the air, and that it is localized (see, among others Agrawal et al. (2008) and Murata et al. (2013)). The knowledge that has led to the secret invention is available for everyone to build on, such that it is very likely that closely-related follow-on inventions would pop up in geographically close entities irrespective of the secrecy order. Thus, to the extent that the patent document itself carries useful information, we expect the effect of secrecy to be stronger for geographically distant pairs of patents.

In order to test this hypothesis, we first rebuild the sample by focusing exclusively on focal patents owned by U.S.-based institutions. For comparative purposes, we start by re-estimating equation (1) with the new sample in Table 14. The coefficients of the variable of interest are always negative and highly significant in all models and they are similar in magnitude to the coefficients of the baseline model.

[INSERT TABLE 14 ABOUT HERE]

We then construct five dependent variables, each counting the number of forward citations coming from assignees located within different geographical radius: within 100 km, within 300 km, within 500 km, from 500 km to 1000 km and more than 1000 km. Table 15 reports the results of this new set of estimates. For geographically closer pairs of citing and cited patents, the enforcement of a secrecy order is associated with a weaker drop in follow-on inventions (coefficients are not significantly different from zero below 500 km). Beyond a 500-km radius, OLS estimates imply a reduction in the number of forward citations of 68 percent (500–1000 km, column 4) and 33 percent (more than 1000 km, column 5).

The fact that the effect becomes substantially smaller in magnitude (and loses statistical significance) for close pairs of patents is consistent with the 'knowledge is in the air' hypothesis. Knowledge is highly localized, and it seems that assignees in a relatively close proximity to the secret inventions do not critically rely on patents to learn; they will keep exploiting the technological antecedents. The fact that the effect of secrecy is primarily observed for geographically distant pairs of patents, where the patent literature is more likely to be an important learning channel, suggests that the information contained in the patent document is conducive to knowledge diffusion—thereby providing evidence of the conventional disclosure effect.

[INSERT TABLE 15 ABOUT HERE]

5.3.2 Disclosure and technological proximity

Not only the geographical distance but also the technological distance can help establish the presence of a disclosure effect. If the conventional disclosure argument were true, we would expect that a disruption in knowledge flow caused by a secrecy order should disproportionately affect fields that are more likely to use the secreted knowledge as an input, *i.e.*, fields that are closer in terms of technological distance to the secreted patent.

To test this hypothesis, we construct two new outcome variables by breaking down citations to our focal patents based on whether they arrive from the same technological class of the secreted patent (or the matched control patent) or from a different patent class. If disclosure is actually driving our main result, we should observe that the missing citations disproportionately arrive from the patent class of the secreted patent.

Table 16 reports the results of this empirical test. The level of significance and magnitude of the coefficients in columns (1) to (4) seem to support this interpretation. When we consider citations coming exclusively from the same technological class as the secret (and control) patents, the hindering effect of secrecy is remarkably high, implying a 62 percent reduction in the rate of follow-on innovation, see column (1). By contrast, the secrecy regime does not seem to play any notable role in reducing the rate of follow-on inventions generated in technological fields different from the secret (and control) patents, see columns (3) and (4). These results are consistent with the view that patent disclosure fosters follow-on inventions that build on the technical knowledge published in the patent document.

[INSERT TABLE 16 ABOUT HERE]

5.3.3 Knowledge flows within governmental agencies

An additional argument in favor of the disclosure interpretation comes from speculating about what should happen in case the secrecy orders did not actually block knowledge flows. If there is indeed a disclosure effect, and in case where secrecy orders did not prevent disclosure, then we should not observe a negative effect of the imposition of a secrecy order on follow-on inventions.

We have explained previously that secreted inventions fall into a black hole until the order is rescinded. This is not entirely true, at least not for everybody. Government agencies still have access to them. They have recommended the imposition of the secrecy order and thus scientists and engineers working for these agencies might be well aware of the existence of the secreted technology. It is, therefore, reasonable to assume that the secrecy regime would not disrupt the flow of follow-on inventions originating from these entities. In order to verify this assumption, we recompute our dependent variable by counting exclusively citations coming from patents owned by government agencies.

Table 17 reports the results of the OLS and Poisson regression model. The coefficient associated with the secrecy order turns out to be *positive*, although very small in magnitude. This result is in sharp contrast with the previous set of estimates. It suggests that, wherever secrecy orders do not interfere with knowledge disclosure, there is no reduction in the arrival of follow-on inventions. Once again, this empirical test points to the lack of patent disclosure as the key mechanism behind the reduction in follow-on inventions observed within the secrecy regime.

[INSERT TABLE 17 ABOUT HERE]

6 Conclusion

The standard economic argument in favor of the patent system is that a patent offsets incentive problems arising from the public good character of knowledge, by granting the patentee a temporary monopoly on the patented technology. At the same time, the patent system is specifically designed to stimulate the diffusion of the technical knowledge of the invention. In exchange for the dead-weight loss caused by the exclusion right of patents, society gets more inventions (incentive effect) and gets to know the details of these inventions (disclosure effect)—which also generates more inventions. The magnitude of this latter benefit largely depends on the degree to which the new knowledge associated with the patent is actually used by others. Our paper seeks to quantify this effect.

The identification strategy exploits a feature of U.S. patent law, namely 35 U.S.C. § 181–188, also known as the 1951 Invention Secrecy Act. Under this act, the USPTO has the right to prevent disclosure of inventions that threaten the national defense and economic stability of the country. Imposing a secrecy order on a patent makes the invention literally fall into a black hole.

Our results suggest that secrecy orders inhibit the growth of knowledge around the secreted inventions. We analyze the citation pattern of 505 prior patents that are cited by a secret patent compared to a control group of 1,244 other prior patents (that are cited by a non-secret patent). We find a negative and statistically significant relationship between the enforcement of a secrecy order and follow-on inventions. OLS estimates indicate that patents cited by a patent with a secrecy order, receive on average 30–50 percent less forward citations than the group of control patents during the period in which the secrecy order was in force. The main results are robust to a broad range of alternative specifications, notably the use of a text-based measure of follow-on inventions. We also find evidence supporting the conventional disclosure argument, namely that the information contained in the patent document facilitates knowledge dissemination.

These findings come with several policy implications. A first, immediate implication is that the Invention Secrecy Act produces the intended effects, in the sense that the technological paths associated with secreted patents receive significantly less visibility than they would otherwise. Furthermore, the results suggest that the U.S. government actively exploits these inventions. Government agencies are more involved in the technological paths associated with the secreted patents than in the technological paths associated with the control patents.

Second, the paper contributes to the debate on secrecy, by documenting one of its social costs, namely a loss of follow-on inventions. Recent legislative changes in the United States, such as the expansion of prior user rights defense to patent infringement with the AIA (Khamin, 2014) and the adoption of the Uniform Trade Secrets Act by an increasing number of U.S. states (Seaman, 2015), have strengthened the incentives to keep inventions secret. Although the present paper is silent on whether the incentives are too (or not enough) skewed towards secrecy, it does highlight one social cost of secrecy (see also Ganglmair and Reimers, 2019). Other costs have been discussed elsewhere, such as the duplication of R&D investments (Lück et al., 2020; Hegde et al., 2020). Conversely, scholars have identified benefits of secrecy, such as an increase in private R&D investments (Png, 2017). Overall, we still do not know what level of secrecy is desirable to maximize growth. The question is far from settled and further research on the topic is warranted.

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Tables and Figures

Figure 1: Illustration of empirical strategy

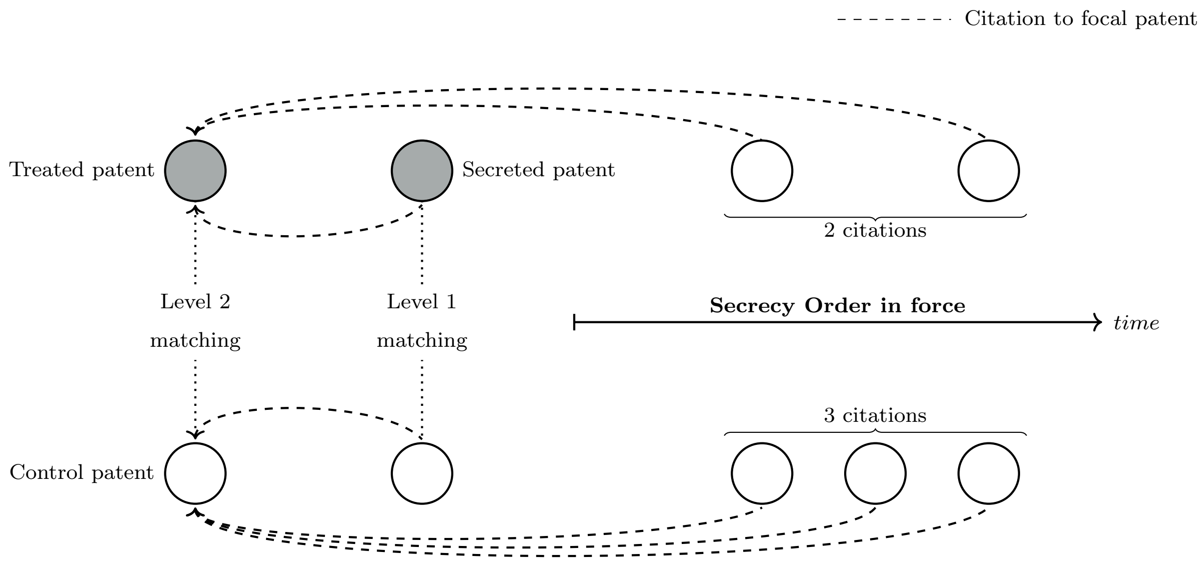

Figure 2: Frequency distribution of secrecy order length

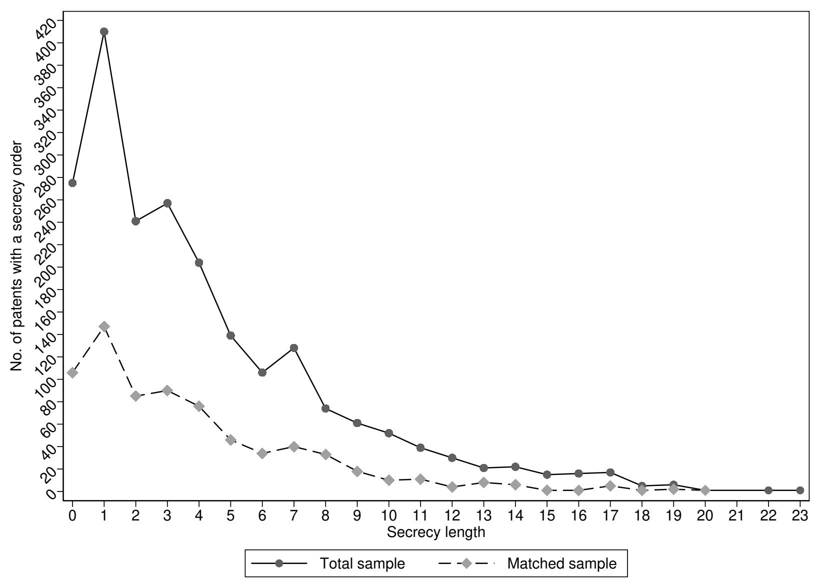

Figure 3: Frequency distribution of secrecy order's application year

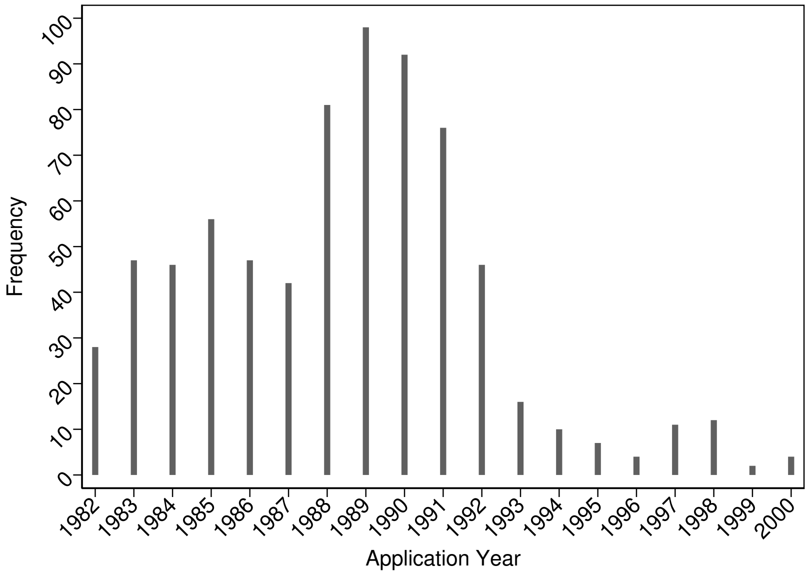

Table 1: Distribution of patents with a secrecy order by technological class (top 25 USPC main classes)

USPC code	*USPC definition*	*Freq.*	*Perc.*
428	Stock material or miscellaneous articles	52	7.17
342	Communications: directive radio wave systems and devices (e.g., radar)	50	6.90
102	Ammunition and explosives	33	4.55
367	Communications, electrical: acoustic wave systems and devices	31	4.28
356	Optics: measuring and testing	26	3.59
250	Radiant energy	26	3.59
244	Aeronautics and astronautics	26	3.59
89	Ordnance	23	3.17
60	Power plants	22	3.03
427	Coating processes	21	2.9
372	Coherent light generators	21	2.9
264	Plastic and nonmetallic article shaping or treating: processes	18	2.48
364	Electrical Computers and Data Processing Systems	18	2.48
149	Explosive and thermic compositions or charges	17	2.34
333	Wave transmission lines and networks	17	2.34
359	Optical: systems and elements	16	2.21
343	Communications: radio wave antennas	16	2.21
501	Compositions: ceramic	13	1.79
156	Adhesive bonding and miscellaneous chemical manufacture	12	1.66
324	Electricity: measuring and testing	11	1.52
416	Fluid reaction surfaces (i.e., impellers)	9	1.24
423	Chemistry of inorganic compounds	9	1.24
429	Chemistry: electrical current producing apparatus, product, and process	8	1.10
228	Metal fusion bonding	8	1.10
340	Communications: electrical	7	0.97
–	Residuals USPC Classes (87 classes)	215	29.7
Total		725	100

Table 2: Summary Statistics; citing patents with a secrecy order

	Total sample				Matched sample			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Secrecy length	4.1	4.0	0	23	3.7	3.6	0	20
No. of claims	14.8	12.4	1	126	15.4	11.9	1	106
Family size	2.1	2.5	1	29	2.0	2.3	1	29
No. of backward citations	9.6	8.0	1	100	12.1	9.4	1	100
No. of non-patent literature	1.4	3.4	0	37	1.3	3.1	0	37
No. of inventors	2.0	1.2	1	12	2.0	1.3	1	11
No. of forward cit (tot)	16.5	20.9	0	234	16.6	19.4	0	179

Notes: Figures computed over the total sample of patents with a secrecy order imposed - total sample: 2,121 obs.; matched (*level 2*) sample: 725 obs.

Table 3: Summary Statistics; treated and control focal patents (working sample)

	Control		Treated		Mean-Diff	
Pre-Secrecy	2.82	(5.04)	2.82	(2.84)	0.00	[1.000]
Secrecy	2.35	(6.22)	1.56	(2.71)	0.79***	[0.000]
Secrecy+3	3.97	(9.51)	2.70	(4.91)	1.27***	[0.000]
Secrecy+5	5.02	(11.61)	3.58	(6.52)	1.44***	[0.000]
Priority	0.58	(0.49)	0.51	(0.50)	0.07***	[0.000]
Family size	3.73	(3.76)	3.39	(3.35)	0.34**	[0.003]
No. of backward citations	7.92	(7.56)	6.95	(6.29)	0.97***	[0.000]
No. of non-patent literature	1.05	(2.79)	0.89	(2.38)	0.15	[0.061]
No. of inventors	1.94	(1.18)	1.91	(1.18)	0.03	[0.503]
No. of claims	12.60	(10.70)	10.04	(9.93)	2.57***	[0.000]
Age classes (USPC)	134.98	(22.89)	131.97	(22.96)	3.01***	[0.000]
Number of observations	1,244		505		1,749	

Notes: Standard deviation in parentheses, p-value in square brackets. ***, ** and * indicate significance at 1%, 5% and 10% level, respectively.

Table 4: Effect of secrecy orders on forward citations – OLS

No. of fwd citations:	(1) Secrecy	(2) Secrecy+3	(3) Secrecy+5
Secret	-1.354***	-2.004***	-2.480***
	(0.238)	(0.326)	(0.376)
Pre-Secrecy	0.369***	0.517***	0.551***
	(0.122)	(0.145)	(0.158)
Priority	0.240	0.610	0.932
	(0.384)	(0.528)	(0.603)
Family size	0.017	0.056	0.079
	(0.043)	(0.057)	(0.064)
No. of backward citations	0.080*	0.096	0.124*
	(0.044)	(0.059)	(0.072)
No. of non-patent literature	0.055	0.175	0.143
	(0.083)	(0.116)	(0.141)
No. of inventors	-0.158	-0.176	-0.156
	(0.107)	(0.155)	(0.174)
No. of claims	0.021	0.043**	0.044*
	(0.013)	(0.018)	(0.024)
Class fixed effects	Yes	Yes	Yes
Filing year fixed effects	Yes	Yes	Yes
Filing year (secr.) fixed effects	Yes	Yes	Yes
Number of observations	1,749	1,749	1,749
R^2	0.32	0.35	0.33
Mean of dep. var.	3.313	4.683	5.479

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by at least one patent with a secrecy order.

Table 5: Effect of secrecy orders on forward citations: secrecy length greater than 6 years – OLS estimations

	(1)	(2)	(3)
No. of fwd citations:	Secrecy	Secrecy+3	Secrecy+5
Secret	-1.769***	-2.491***	-2.989***
	(0.348)	(0.471)	(0.534)
Pre-Secrecy	0.431**	0.500**	0.511**
	(0.168)	(0.195)	(0.211)
Priority	0.208	0.638	0.917
	(0.456)	(0.638)	(0.819)
Family size	-0.016	0.048	0.063
	(0.071)	(0.094)	(0.113)
No. of backward citations	0.127*	0.157	0.197
	(0.075)	(0.099)	(0.121)
No. of non-patent literature	0.100	0.161	0.156
	(0.131)	(0.182)	(0.218)
No. of inventors	-0.193	-0.155	-0.042
	(0.157)	(0.211)	(0.255)
No. of claims	0.015	0.024	0.022
	(0.018)	(0.028)	(0.035)
Class fixed effects	Yes	Yes	Yes
Filing year fixed effects	Yes	Yes	Yes
Filing year (secr.) fixed effects	Yes	Yes	Yes
Number of observations	848	848	848
R^2	0.53	0.56	0.51
Mean of dep. var.	4.140	5.546	6.288

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by at least one patent with a secrecy order that lasted at least three years.

Table 6: Effect of secrecy orders on forward citations – OLS, Poisson, Negative binomial estimations

	(1)	(2)	(3)
No. of fwd citations:	Secrecy	Secrecy+3	Secrecy+5
Panel A: OLS Estimations			
Secret	-1.354***	-2.004***	-2.480***
	(0.238)	(0.326)	(0.376)
Panel B: Poisson Estimations			
Secret	-1.051***	-1.578***	-1.943***
	(0.161)	(0.223)	(0.265)
Panel C: Negative Binomial Estimations			
Secret	-0.953***	-1.447***	-1.829***
	(0.143)	(0.194)	(0.226)
Number of observations	1,749	1,749	1,749
Mean of dep. var.	3.313	4.683	5.479

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Panel A reports the coefficients of Table 4 for comparative purposes. Coefficients in panel B and C are expressed as marginal effects.

Table 7: Effect of secrecy orders on forward citations: falsification test – OLS, Poisson, Negative binomial estimations; secrecy length lower than 1 year

No. of fwd citations:	(1) Secrecy	(2) Secrecy+3	(3) Secrecy+5
Panel A: OLS Estimations			
Secret	-0.168	-0.193	0.236
	(0.146)	(0.399)	(0.570)
Panel B: Poisson Estimations			
Secret	-0.028	-0.066	0.179
	(0.021)	(0.137)	(0.232)
Number of observations	689	689	689
Mean of dep. var.	0.929	2.816	4.254

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted less than one year. Coefficients in panel B are expressed as marginal effects.

Table 8: Effect of secrecy orders on forward citations: alternative matching – OLS, Poisson estimations

No. of fwd citations:	(1) Secrecy	(2) Secrecy+3	(3) Secrecy+5
Panel A: OLS Estimations			
Secret	-1.588***	-2.341***	-2.797***
	(0.391)	(0.539)	(0.618)
Panel B: Poisson Estimations			
Secret	-0.902***	-1.363***	-1.675***
	(0.173)	(0.243)	(0.284)
Number of observations	534	534	534
Mean of dep. var.	3.160	4.410	5.105

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 9: Effect of secrecy orders on forward citations: excluding forward citations coming from any of the patents' assignees with a secrecy order – OLS, Poisson estimations

No. of fwd citations:	(1) Secrecy	(2) Secrecy+3	(3) Secrecy+5
Panel A: OLS Estimations			
Secret	-1.271***	-1.854***	-2.303***
	(0.238)	(0.326)	(0.376)
Panel B: Poisson Estimations			
Secret	-0.956***	-1.428***	-1.759***
	(0.155)	(0.216)	(0.257)
Number of observations	1,749	1,749	1,749
Mean of dep. var.	3.130	4.393	5.127

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Self-citations, foreign (not-U.S.) citations, and citations coming from any of the patents' assignees with a secrecy order are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 10: Effect of secrecy orders on forward citations: distinguishing citations coming from contractors that performed R&D works with the U.S. government or not – OLS, Poisson estimations

	Cites by DoD contractors		Cites by non-DoD contractors	
	(1)	(2)	(3)	(4)
No. of fwd citations	Secrecy	Secrecy+5	Secrecy	Secrecy+5
Panel A: OLS Estimations				
Secret	-0.604***	-1.152***	-0.900***	-1.509***
	(0.186)	(0.272)	(0.150)	(0.227)
Panel B: Poisson Estimations				
Secret	-0.419***	-0.895***	-0.390***	-0.654***
	(0.110)	(0.183)	(0.049)	(0.086)
Number of observations	1,749	1,749	1,749	1,749
Mean of dep. var.	2.197	3.402	1.257	2.309

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variables 'Cites by DoD contractors' record only forward citations from patents belonging to contractors that performed R&D works with the U.S. government between 1982 and 2000. The dependent variables 'Cites by non-DoD contractors' record forward citations from patents not belonging to contractors that performed R&D works with the U.S. government between 1982 and 2000. Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. Forward citations are calculated over the period spanning from the year in which the secrecy order of its citing patent has been imposed until the publication year of the patent (col. 1-3) and 5 years after the publication of the patent (col. 2-4). The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 11: Effect of secrecy orders on forward citations: counting citations by 'secreted' and not 'secreted' classes – OLS, Poisson

	Cites from secret classes		Cites from non-secret classes	
	(1)	(2)	(3)	(4)
No. of fwd citations	Secrecy	Secrecy+5	Secrecy	Secrecy+5
Panel A: OLS Estimations				
Secret	-1.124***	-1.936***	-0.238**	-0.554***
	(0.207)	(0.303)	(0.112)	(0.200)
Panel B: Poisson Estimations				
Secret	-0.874***	-1.548***	-0.030**	-0.109***
	(0.135)	(0.209)	(0.013)	(0.035)
Number of observations	1,749	1,749	1,749	1,749
Mean of dep. var.	2.666	4.250	0.632	1.177

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variables 'Cites from secret classes' record only forward citations from patents belonging to USPC classes that were assigned, at least once, as primary class to patents that received a secrecy order in our reference period. The dependent variables 'Cites from non-secret classes' instead record only forward citations from patents belonging to USPC classes that were never assigned as primary class to patents that received a secrecy order in our reference period. Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. Forward citations are calculated over the period spanning from the year in which the secrecy order of their citing patent has been imposed until the publication year of the patent (col. 1-3) and 5 years after the publication of the patent (col. 2-4). The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 12: Effect of secrecy orders on follow-on innovation: text-based similarity measure; first 50 most similar patents – OLS, Poisson estimations

	(1)	(2)	(3)
No. of similar patents:	Secrecy	Secrecy+3	Secrecy+5
Panel A: OLS Estimations			
Secret	-0.693***	-0.699***	-0.839***
	(0.206)	(0.257)	(0.286)
Panel B: Poisson Estimations			
Secret	-0.426***	-0.441***	-0.536***
	(0.125)	(0.159)	(0.179)
Number of observations	1,744	1,744	1,744
Mean of dep. var.	3.008	3.938	4.431

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative similar patents to the focal patent i filed between the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Foreign similar patents (not-U.S.) as well as similar patents from the same assignees and/or inventors of the focal patent are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 13: Effect of secrecy orders on follow-on innovation: text-based similarity measure; first 30 most similar patents – OLS, Poisson estimations

No. of similar patents:	(1) Secrecy	(2) Secrecy+3	(3) Secrecy+5
Panel A: OLS Estimations			
Secret	-0.345***	-0.331**	-0.422**
	(0.128)	(0.157)	(0.173)
Panel B: Poisson Estimations			
Secret	-0.204***	-0.204**	-0.261**
	(0.074)	(0.095)	(0.105)
Number of observations	1,744	1,744	1,744
Mean of dep. var.	1.783	2.300	2.587

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative similar patent to the focal patent i filed between the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Foreign similar patents (not-U.S.) as well as similar patents from the same assignees and/or inventors of the focal patent are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 14: Effect of secrecy orders on forward citations: only U.S. patents – OLS, Poisson, Negative binomial estimations.

No. of fwd citations:	(1) Secrecy	(2) Secrecy+3	(3) Secrecy+5
Panel A: OLS Estimations			
Secret	-1.441***	-2.262***	-2.966***
	(0.326)	(0.446)	(0.544)
Panel B: Poisson Estimations			
Secret	-1.290***	-2.055***	-2.685***
	(0.282)	(0.385)	(0.469)
Number of observations	1,033	1,033	1,033
Mean of dep. var.	4.208	5.975	7.163

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), 3 years after the publication of the patent (col. 2), 5 years after the publication of the patent (col. 3). Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 15: Effect of secrecy orders on forward citations: counting citations by geographical distance – OLS, Poisson, Negative binomial estimations

	(1) <100 km	(2) <300 km	(3) <500 km	(4) 500-1000 km	(5) >1000 km
Panel A: OLS Estimations					
Secret	-0.115	-0.090	-0.210	-0.466***	-0.774***
	(0.131)	(0.192)	(0.215)	(0.125)	(0.244)
Panel B: Poisson Estimations					
Secret	-0.023	-0.043	-0.111	-0.154***	-0.600***
	(0.024)	(0.073)	(0.108)	(0.032)	(0.153)
Number of observations	1,033	1,033	1,033	1,033	1,033
Mean of dep. var.	0.546	0.909	1.201	0.684	2.323

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative forward citations that the focal patent i has received from the year in which the secrecy order of its citing patent has been imposed until the publication year of the patent. We construct four dependent variables by counting citations within different geographical distance from the residence of the citing and cited assignees: within 100 km (col. 1); within 300 km (col. 2); within 500 km (col. 3); between 500 and 1000 km (col. 4); from 1000 km onward (col. 5). Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 16: Effect of secrecy orders on forward citations: counting citations with and without the same USPC classes of the citing patents (secreted-not secreted) – OLS, Poisson

	Cites citing classes		Cites non-citing classes	
No. of fwd citations:	(1) Secrecy	(2) Secrecy+5	(3) Secrecy	(4) Secrecy+5
Panel A: OLS Estimations				
Secret	-1.114***	-1.792***	-0.240	-0.688**
	(0.194)	(0.297)	(0.174)	(0.294)
Panel B: Poisson Estimations				
Secret	-0.166***	-0.470***	-0.072	-0.195**
	(0.024)	(0.061)	(0.048)	(0.098)
Number of observations	1,749	1,749	1,749	1,749
Mean of dep. var.	1.772	2.788	1.542	2.691

Notes: Significant at ***1%, **5% and 10%*. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variables "Cites citing classes" record only forward citations from patents belonging to USPC classes that were assigned as primary class to the citing (secreted and not secreted) patents. The dependent variables "Cites non-citing classes" instead record only forward citations from patents belonging to USPC classes that were never assigned as primary class to the citing (secreted and not secreted) patents. Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. Self-citations and foreign (not-U.S.) citations are excluded from the count of the dependent variables. The variable Secret is a binary indicator that identifies those focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

Table 17: Effect of secrecy orders on forward citations: counting forward citations coming exclusively from U.S. governmental agencies

	(1)	(2)	(3)
No. of fwd citations:	Secrecy	Secrecy+3	Secrecy+5
Panel A: OLS Estimations			
Secret	0.076***	0.101***	0.100***
	(0.025)	(0.034)	(0.035)
Panel B: Poisson Estimations			
Secret	0.003***	0.007***	0.008***
	(0.001)	(0.002)	(0.002)
Number of observations	1,740	1,740	1,740
Mean of dep. var.	0.129	0.158	0.165

Notes: Significant at ***1%, **5% and *10%. Robust Standard errors in parentheses. This table shows only the regressor of interest. Regressors not listed are those of Table 4 (see the text for details). The dependent variable records the cumulative forward citations that the focal patent has received from the year in which the secrecy order of its citing patent has been imposed until: the publication year of the patent (col. 1), three years after the publication of the patent (col. 2), five years after the publication of the patent (col. 3). Self-citations are excluded from the count of the dependent variables. The variable *Secret* is a binary indicator that identifies focal patents that have been cited by a patent with a secrecy order that lasted at least three years. Coefficients in panel B are expressed as marginal effects.

A Example of secrecy order documents

Figure A.1: Secrecy order imposition document

#8

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

MAILED
JUN 24 1986
GROUP 220

Serial No. 631,044 Filed 07/16/84

Applicant DONALD L. SCOFIELD

Title VARIABLE MISSILE CONFIGURATION-STANDARD TELEMETRY SYSTEM

SECRECY ORDER

(Title 35, United States Code (1952), sections 181-188)

NOTICE: To the applicant above named, his heirs, and any and all his assignees, attorneys and agents, hereinafter designated principals.

You are hereby notified that your application as above identified has been found to contain subject matter, the unauthorized disclosure of which might be detrimental to the national security, and you are ordered in nowise to publish or disclose the invention or any material information with respect thereto, including hitherto unpublished details of the subject matter of said application, in any way to any person not cognizant of the invention prior to the date of the order, including any employee of the principals, but to keep the same secret except by written consent first obtained of the Commissioner of Patents and Trademarks, under the penalties of 35 U.S.C. (1952) 182, 186.

Any other application already filed or hereafter filed which contains any significant part of the subject matter of the above identified application falls within the scope of this order. If such other application does not stand under a secrecy order, it and the common subject matter should be brought to the attention of the Security Group, Licensing and Review, Patent and Trademark Office.

If, prior to the issuance of the secrecy order, any significant part of the subject matter has been revealed to any person, the principals shall promptly inform such person of the secrecy order and the penalties for improper disclosure. However, if such part of the subject matter was disclosed to any person in a foreign country or foreign national in the U.S., the principals shall not inform such person of the secrecy order, but instead shall promptly furnish to the Commissioner of Patents and Trademarks the following information to the extent not already furnished: date of disclosure; name and address of the disclosee; identification of such part; and any authorization by a U.S. Government agency to export such part. If the subject matter is included in any foreign patent application, or patent this should be identified. The principals shall comply with any related instructions of the Commissioner.

This order should not be construed in any way to mean that the Government has adopted or contemplates adoption of the alleged invention disclosed in this application; nor is it any indication of the value of such invention.

Kenneth L. Cage
Director,
Special Laws
Administration Group

PTOL-96 (REV. 2-75) USCOMM-DC 70596-P75

Figure A.2: Secrecy order renewal document

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address : COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
06/631,044	07/16/84	SCOFIELD	D 67592

ROBERT F. BEERS
OFFICE OF PATENT COUNSEL, CODE 012
NAVAL WEAPONS CENTER
CHINA LAKE, CA. 93555-6001

EXAMINER	
TARCZA, T	
ART UNIT	PAPER NUMBER
2202	

DATE MAILED: 07/23/92

RENEWAL OF SECRECY ORDER
[Title 35, United States Code (1952), Sections 181-188]

NOTICE: To the applicant(s), heirs of applicant(s), and any and all assignees, attorneys and agents, the designated principals.

The Armed Services Patent Advisory Board, Department of Defense (DOD), has notified the Commissioner of Patents and Trademarks that an affirmative determination has been made by a DOD agency, identified below, that the national interest requires renewal of the secrecy order. The secrecy order is therefore, renewed, effective for a period of ONE YEAR from the date of this renewal notice.

The secrecy order may be renewed for additional periods of not more than one year upon notice by a government agency that the national interest so requires.

DOD AGENCY: ☐ DARCOM ☒ NAVY ☐ AIR FORCE ☐ ASPAB

for J. Bradshaw
Director,
Special Laws Administration

PTOL-416 (Rev. 7-83)

Figure A.3: Secrecy order rescinding document

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
06/631,044	07/16/1984	DONALD L. SCOFIELD	67592	7443

7590 07/14/2010

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EXAMINER	
TARCZA, THOMAS H	

ART UNIT	PAPER NUMBER
3662	7-14-10

RESCINDING OF SECRECY ORDER
(35 U.S.C. 181-188)

The Secrecy Order, dated , prohibiting disclosure of publication of the subject matter of the above-identified application under 35 U.S.C. 181-188 is herby rescinded. Normal prosecution is continued and any suspension thereof because of the secrecy order has been removed. This rescinding order does not affect the provisions of any classified government contract or existing laws relating to espionage and national security.

Note that this decision does not affect the removal of any national security markings. Applicant is required to obtain authorization to remove any such markings or pursue a new security order.

for
Director, Technology Center 3600
(571) 272-5150

PTOL-216 (Rev. 11/06)