GLOBAL PATENT CHOKEPOINTS

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ABSTRACT

A firm's patent strategy is commonly focused on excluding competition in the domestic market. Foreign patent rights may be sought, but the presumption is that they are valuable for a firm only if it has access to a foreign market through sales, licensing or foreign direct investment. However, in countries that are major manufacturing bases and international exporters, like China and India, a new strategy may be emerging: seeking patents solely to impact competition in external markets. This Article describes this novel use of "global patent chokepoints" and presents empirical evidence that it is actually occurring. It considers patent filings in solar photovoltaics (PV) in China between 2002 and 2007 and demonstrates that the patent filings are responsive to increases in solar PV production by Chinese rivals but not Chinese domestic installation. If this strategy is more widely adopted, pricing and access impacts for important health and sustainability technologies may result.

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I. INTRODUCTION

In the summer of 2016, the consumer electronics world reacted with surprise when Apple, Inc. was found to infringe a Chinese design patent on a cell phone shape owned by an obscure Chinese company named Baili.[1] The decision, from a tribunal at the Beijing Intellectual Property Office, has the effect of preventing the U.S. company from selling certain versions of iPhones in the municipality.[2] It could be broadened to the rest of the country in the future. The power of one company to impact iPhone sales in China with a relatively minor patent was a shock to many, and focused attention on a Chinese intellectual property system that some consider to be second tier or at least obscure. But there is even more to this story. Given the fact that so much of Apple's production is in China,[3] there is every reason to believe

1. Baili's patent is ZL201430009113.9, a design patent on cell phone outer appearance. It was filed at SIPO on January 13, 2004 and issued on July 9, 2014. Baili's parent company, Digone, apparently no longer exists, though Baili remains to pursue the litigation. Eva Dou & Alyssa Abkowitz, *Chinese Company in Patent Dispute with Apple Barely Exists*, WALL ST. J. (June 23, 2016, 12:26 AM), http://www.wsj.com/articles/chinese-company-behind-patent-suit-against-apple-barely-exists-1466597346 [https://perma.cc/3D5Z-6E6R].

2. Eva Dou & Daisuke Wakabayashi, *Apple's Challenges in China Underlined by Patent Dispute*, WALL ST. J. (June 17, 2016, 6:55 PM), http://www.wsj.com/articles/beijing-regulator-orders-apple-to-stop-sales-of-two-iphone-models-1466166711 [https://perma.cc/7WGG-EUV7].

3. Although Apple components are sourced globally, "[t]he assembly of Apple's devices is

that Baili's patent could prevent iPhones from being exported and available in countries throughout the world. In fact, Baili's patent is registered with China's customs agency, which has the power to prevent exports.[4] Due to China's importance in Apple's supply chain, this single patent can do much more to choke off sales than individual lawsuits in the target markets.

Recent discussion has focused on the inefficiencies of patent litigation in the United States. Critics have paid particular attention to the activities of nonpracticing entities (a.k.a. patent assertion entities or simply "patent trolls").[5] The implication is that savvy firms can game the system in order to extract rents or improperly preserve monopolies.[6] Such behavior purportedly has high costs with the potential to significantly deter innovation.[7] Even beyond nonpracticing entities, standard U.S. patent litigation can be a substantial expense for businesses with the power to alter the competitive environment. However, this focus may have improperly crowded out a broader discussion of litigation inefficiencies in other countries; the focus may be changing now, and countries like China are becoming the front lines of the debate.

To be sure, concern about the patent enforcement environment in other countries is not entirely new. For example, in Europe, the inconsistent country-to-country enforcement of European Patent Office-issued patents has given way to a Unified Patent Court that will consolidate at least some of the actions and reduce disarray.[8] And India's relative inexperience in high-stakes litigation may prove a liability as it now prepares for an onslaught of pharmaceutical rights disputes.[9] However, to a great extent, panic over international disparity has been contained as firms are generally only concerned with the countries that are the sites of sales. If a firm does not sell products in Latvia, who cares how its patent system operates?

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for the most part done in China." Christopher Minasians, *Where Are the iPhone, iPad and Mac Designed, Made and Assembled?*, MACWORLD (Apr. 18, 2016), http://www.macworld.co.uk/feature/apple/are-apple-products-truly-designed-in-california-made-in-china-iphonese-3633832 [https://perma.cc/AQY7-JF5N].

4. According to China's General Administration of Customs (GAC) registration database, Baili's patent was registered on December 31, 2014 and the registration expires on January 14, 2024.

5. *See generally* Christopher Anthony Cotropia et al., *Unpacking Patent Assertion Entities (PAEs)*, 99 MINN. L. REV. 649 (2014).

6. *See, e.g.*, Colleen Chien, *Patent Trolls by the Numbers,* PATENTLYO (Mar. 14, 2013), http://patentlyo.com/patent/2013/03/chien-patent-trolls.html [https://perma.cc/D7HD-4V4C] (stating that patent assertion entities brought 62% of all patent litigations in 2012).

7. *See, e.g.*, PRESIDENT'S COUNCIL OF ECON. ADVISORS, NAT'L ECON. COUNCIL & OFFICE OF SCI. & TECH. POLICY, EXEC. OFFICE OF THE PRESIDENT, PATENT ASSERTION AND U.S. INNOVATION 2 (2013) [hereinafter "WHITE HOUSE REPORT"] (discussing the impact of patent assertion entities on the U.S. economy); James Bessen & Michael J. Meurer, *The Direct Costs from NPE Disputes*, 99 CORNELL L. REV. 387, 422-23 (2014) (reporting on survey of costs of NPE litigation and concluding that NPE litigation is a significant social problem due to the net economic losses).

8. Robert D. Swanson, *Implementing the E.U. Unified Patent Court: Lessons from the Federal Circuit*, 9 B.Y.U. INT'L L. & MGMT. REV. 169, 181-86 (2013).

9. Janice M. Mueller, *The Tiger Awakens: The Tumultuous Transformation of India's Patent System and the Rise of Indian Pharmaceutical Innovation,* 68 U. PITT. L. REV. 491, 630-33 (2007) (noting the likely backlog in the Indian courts).

However, this standard model of global intellectual property management is on the cusp of change due to the overwhelming shift to global product and component manufacturing overseas, particularly focused in certain manufacturing hubs like China.[10] As a source for so much of the world's manufacturing, exports from such global hubs are more important than their imports. Both domestic and foreign companies are investing in this production capacity (either directly or through purchase).[11] Naturally, this production is subject to intellectual property rights. In the case of China, it is not a shock that patent applications and grants have increased more than any other nation—by a very wide margin.[12] This shift is important, as Chinese patent rights by their very nature can impact or even disrupt production.[13] Never before has the world's supply chain depended to such a great extent on one nation's intellectual property system, a system that has only been in existence since the 1980s.

This Article is the first to academically explore the impact of patent rights in markets that serve as global exporting focal points. It details how such markets can become "chokepoints" that affect price and supply globally. Part II describes the basic mechanism for a patent chokepoint and notes that it confers outsized importance on certain nations such as China and India but can exist in any country that is the production point for a competitor's products. Due to China's broad significance for global manufacturing, Part III details how China's patent system is susceptible to chokepoints and notes the potential for it to be gamed in favor of certain parties. Part IV provides unique empirical evidence that foreign firms are in fact using China's patent system specifically to impact exports and shape global markets. The data concerns photovoltaic solar panel technology, which has been the subject of intense scrutiny in international trade. Finally, Part V provides brief policy recommendations for a more robust review under the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) to ensure that one country's intellectual property system—whether that be China, Europe or the

10. *Made in China?: Asia's Dominance in Manufacturing Will Endure*, ECONOMIST (Mar. 14, 2015), http://www.economist.com/news/leaders/21646204-asias-dominance-manufacturing-will-endure-will-make-development-harder-others-made [https://perma.cc/XZW6-MNYV]; Lisa Mahapatra, *China Manufacturing: 10 Things the Chinese Make More of than Anyone Else in the World*, INT'L BUS. TIMES (Aug. 2, 2013), http://www.ibtimes.com/china-manufacturing-10-things-chinese-make-more-anyone-else-world-infographic-1369727 [https://perma.cc/8X5S-F5JT].

11. U.N. Conference on Trade and Dev., Global FDI Flows Declined in 2014: China Becomes the World's Top FDI Recipient (2015), http://unctad.org/en/PublicationsLibrary/webdiaeia2015d1_en.pdf [https://perma.cc/FLJ7-3J2R] (noting China's emergence as the top foreign direct investment recipient).

12. WORLD INTELLECTUAL PROP. ORG., WORLD INTELLECTUAL PROPERTY INDICATORS 25-26 (2015), http://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2015.pdf [https://perma.cc/GLQ9-7AL7] (detailing the fact that over 800,000 patent applications were filed in China in 2014 compared with only around 500,000 in the United States, the next closest country).

13. Robert Sackin, *China: Possibly the Most Important Place to File a Patent Application?*, REDDIE & GROSE LLP (Nov. 2, 2016), http://www.reddie.co.uk/news-and-resources/ip-developments/china-the-most-important-place-to-file-a-patent-application [https://perma.cc/X438-6VX7].

U.S.—does not negatively impact global innovation and technological advancement.

II. THE CHARACTERISTICS OF A GLOBAL PATENT CHOKEPOINT

How does a country or region become a global patent chokepoint? The recipe is simple enough: obtain manufacturing dominance coupled with an intellectual property environment that supports competition exclusion. But the ready ability to exclude competitors is not a given in an intellectual property environment, and to evaluate its potential, one must appreciate the characteristics of rights that give rise to the phenomenon. Those rights, coupled with an aligned enforcement system, give rise to outsized power over global markets.

A. *A Simple, but Understudied, Legal Formula*

Obviously, a relatively robust patent system with broad coverage is a necessity for a chokepoint. There are two broad types of patents in the world: utility and design.[14] Utility patents are the primary means of protecting an invention, which is an object or process that is new and useful.[15] Essentially, they cover the way a product works or is made. Design patents, on the other hand, cover the way something looks. More akin to a copyright, design patents on product shape are increasingly common in certain fields like consumer electronics. They are often easier to obtain than utility patents but commonly have a shorter term.

Some countries break utility patents down a bit more to split out improvement patents that protect incremental advances. Such patents may generally be subject to a less stringent examination and a shorter term of protection. Although this class of improvement patents is not available in the U.S., countries like Germany and Japan have had such "petty patents" available for decades.[16] In general, it is easier to obtain an improvement patent but the protection conveyed is narrower.

All types of patents confer power through enforcement. A broad patent system that covers many types of economically important technological advances is worthless if the government does not provide an effective way to enforce those rights. Of particular relevance is the availability of an injunction—the power to stop an infringer from making, selling, using, or exporting the infringing product.[17] If a patent owner can obtain an injunction, the rights holder can prevent infringers from selling in the relevant market or at least leverage outsized patent power to

14. The basic legal structure is represented in the Trade-Related Aspects of Intellectual Property Agreement (TRIPS), the members of which include almost all of the important markets.

15. Yieyie Yang, *Reforming the Utility Model System in China: Time to Limit Utility Model Patents' Scope of Protection and Improve the Quality of Chinese Utility Model Patents*, 42 AIPLA Q.J. 393, 398-401 (2014).

16. *Id.* at 399-401.

17. Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1665-68 (2003) (considering the power of injunctions in patent law as a "policy lever").

compel a very favorable license .[18] Even if an injunction is not on the table—in many jurisdictions including the U.S., they must be justified according to more stringent evidentiary standards[19]—damages may be available that will still impact the market performance of an infringing competitor.[20]

From a global perspective, enforcement is limited by borders. Patents are territorial rights that are enforceable only in the country in which they are issued.[21] For example, Japanese patents are completely irrelevant regarding any infringing activity in the U.S. market. Thus, a global marketing plan has always been assumed to require a global spread of patent rights.[22] There is even a well-established international filing procedure called the Patent Cooperation Treaty intended to accomplish that purpose.[23] To dominate a significant portion of the world patent market, a firm must engage in the expensive and time-consuming effort to secure a global patent portfolio.[24]

The idea of the patent chokepoint is a departure from this standard strategy. It depends on leveraging the production dominance of one or more countries to control global availability. If a product or even an essential component of a product is produced exclusively in one country, and that product or component is covered by one or more patent rights, that country's enforcement system effectively becomes the global arbiter of market availability of the product. Instead of obtaining patents in multiple countries, a manufacturer can focus on just one system with outsized influence.

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18. *See* Mark A. Lemley & Carl Shapiro*, Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 1995-99 (2007) (describing the enhanced royalty extraction power of patent injunctions).

19. *See, e.g.*, eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 394 (2006) (holding that injunctions are not automatic in patent cases but must meet the standard four-factor injunction test).

20. *See generally* Amy L. Landers, *Let the Games Begin: Incentives to Innovation in the New Economy of Intellectual Property Law*, 46 SANTA CLARA L. REV. 307 (2006) (reviewing the current damages regime in U.S. patent law and making proposals to better align it with the actual innovation impact of an invention).

21. Curtis A. Bradley, *Territorial Intellectual Property Rights in an Age of Globalism*, 37 VA. J. INT'L L. 505, 520-23 (1997).

22. This is referred to as the market covering patent strategy. Jonathan Eaton & Samuel Kortum, *International Technology Diffusion: Theory and Measurement*, 40 INT'L ECON. REV. 537 (1999); Edith Penrose, *International Patenting and the Less-Developed Countries*, 83 ECON. J. 768 (1973); Chih-Hai Yang & Nai-Fong Kuo, *Trade-Related Influences, Foreign Intellectual Property Rights and Outbound International Patenting*, 37 RES. POL'Y 446 (2008).

23. Patent Cooperation Treaty, June 19, 1970, 28 U.S.T. 7645, 1160 U.N.T.S. 231 .

24. Note that the inclination to file rights in multiple countries has even been viewed as a proxy for patent value, because only the most important rights are worthy of such an investment. Catalina Martinez, *Insight into Different Types of Patent Families* 9 (Org. for Econ. Cooperation & Dev., Directorate for Sci., Tech., and Innovation, Working Paper 2010/2), http://www.oecd.org/science/inno/44604939.pdf [https://perma.cc/J3MC-KS9H] (detailing studies that establish the connection between patent family size and patent value).

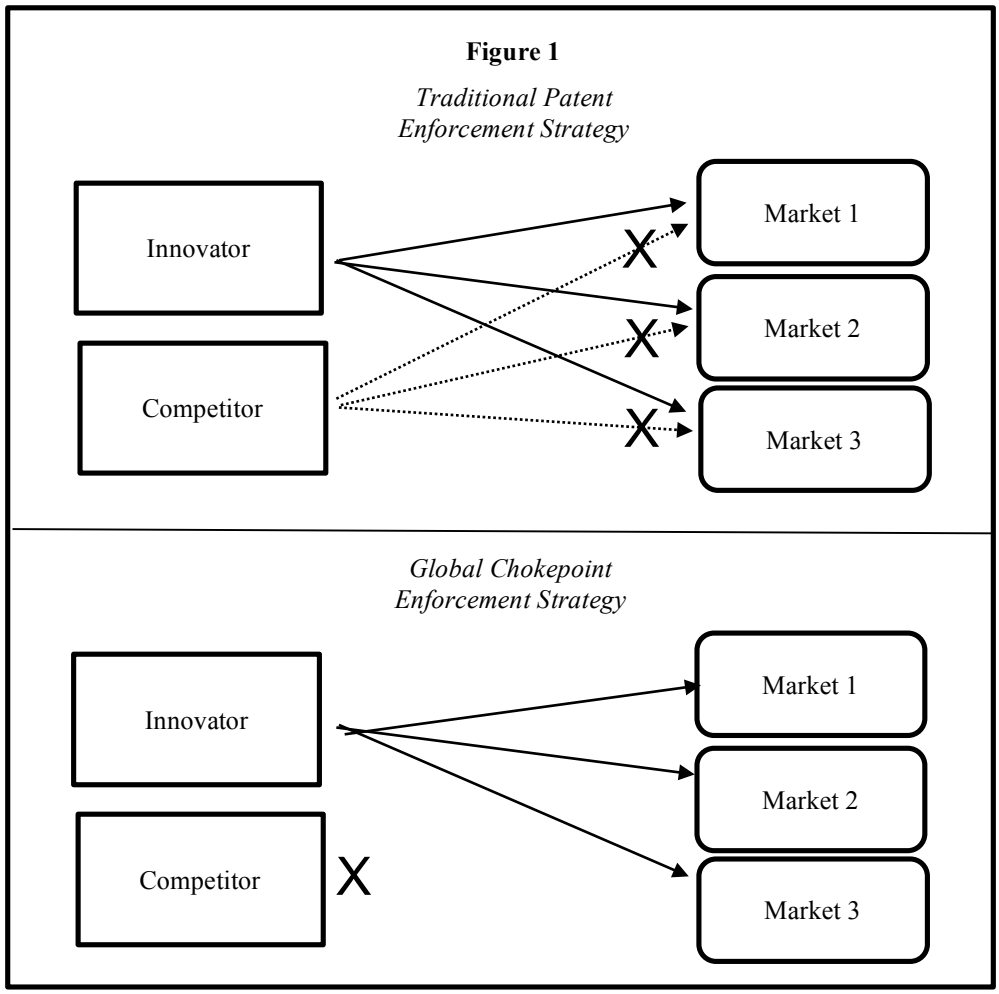

Figure 1. Traditional Patent and Global Chokepoint Enforcement Strategies

Although this strategy is not well-described in the academic literature, it does have a precedent in cases in which critical raw materials have limited availability. Take, for example, rare earth minerals. These elements are essential components of modern consumer electronics.[25] When China took control of rare earth mineral production in the last decade and threatened to withhold materials from Japan during a conflict, the power of global interdependency was evident.[26] China gained

25. U.S. DEP'T OF ENERGY, CRITICAL MATERIALS STRATEGY 10-11 (2010), http://energy.gov/sites/prod/files/edg/news/documents/criticalmaterialsstrategy.pdf [https://perma.cc/MZ9M-CV59] (defining important rare earth minerals for industry).

26. Keith Bradsher, *Amid Tension, China Blocks Vital Exports to Japan*, N.Y. TIMES (Sept. 22, 2010), http://www.nytimes.com/2010/09/23/business/global/23rare.html [https://perma.cc/Q73L-4EXM].

such power not through acquisition but rather abdication; other rare earth mineral-producing countries (including the U.S.) gradually decreased production until one country had nearly total control.[27] With this control, China had outsized negotiating power in a number of countries in a variety of important product areas.

Intellectual property rights give rise to the same concern evident in the rare earth mineral crisis, albeit indirectly. In essence, when manufacturing in a particular industrial segment is shifted so completely to one nation, the power to control that manufacture also gains an outsized influence. Note that in the case of patent chokepoints, the control can come from within the country or from a foreign firm outside the market. Moreover, the basic elements of such a strategy are fairly straightforward and not limited to one form of intellectual property. The key is to first acquire rights that can block export and (depending on the country's rights enforcement structure) may include everything from utility/invention patents to design patents, trademarks, and even copyrights. Then, one may threaten infringement proceedings that include injunctive relief.

As a proven example of a country in which patent chokepoints may exist, one may look to India in the context of patented pharmaceuticals. India has traditionally served as a global supplier of generics, building on both a scientific competency advantage as well as a specific government push to pay in this field.[28] Even when drugs were patented in other countries, India did not offer patent protection over pharmaceutical compounds, permitting domestic companies to produce unauthorized but legal generic versions.[29] When the country accepted more constraining patent right obligations in 2005[30]—namely, to provide patent protection to pharmaceutical compounds in addition to methods of manufacture—India gave power to foreign drug companies to curtail unauthorized production of generics.[31] As a result, such firms theoretically had more power to control the world market in generic versions of their drugs, maintaining high prices or at least maintaining a price discrimination model that sustains profits and/or limits supply.[32] Recent analysis suggests that the impact is more modest than previously presumed, but there is a statistically significant impact on price.[33]

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27. Brian J. Fifarek et al., *Offshoring Technology Innovation: A Case Study of Rare-Earth Technology*, 26 J. OPERATIONS MGMT. 222, 226 (2008).

28. Samira Guennif & Julien Chaisse, *Present Stakes Around Patent Political Economy: Legal and Economic Lessons from the Pharmaceutical Patent Rights in India*, 2 ASIAN J. WTO & INT'L HEALTH L. & POL'Y 65, 69 (2007).

29. Daniel R. Cahoy, *Breaking Patents,* 32 MICH. J. INT'L L. 461, 487-88 (2011) (describing India's generic company interactions with branded drug companies).

30. The Patents (Amendment) Act, 2005, No. 15, Acts of Parliament, 2005 (India).

31. Cahoy, *supra* note 29, at 487-88.

32. *See* Pooja Van Dyck, Comment, *Importing Western Style, Exporting Tragedy: Changes in Indian Patent Law and Their Impact on AIDS Treatment in Africa,* 6 NW. J. TECH. & INTELL. PROP. 138, 147-49 (2007) (describing the impact of increased pharmaceutical patent protection in India on generic AIDS medicines in Africa).

33. Mark Duggan, Craig Garthwaite & Aparajita Goyal, *The Market Impacts of Pharmaceutical Product Patents in Developing Countries: Evidence from India*, 106 AM. ECON. REV. 99 (2016).

Of course, the Indian example is one of an imperfect intellectual property barrier because primary, branded manufacturers usually have global production based in another country. That means a competitor could not use the system in India to fully control the global market, but only to constrain low-cost competition. Thus the chokepoint is incomplete. A broader and more robust model would be a country such as that serves as the near total production point for goods sold internationally.

B. *Leveraging Rights for Competitive Advantage*

Chokepoint strategies can be available under a variety of circumstances. An effective chokepoint merely needs to restrict competition such that the monopoly benefits outweigh the intellectual property prosecution and enforcement costs.[34] Even a temporary restriction may be useful in securing market share that is difficult for competitors to erode. The specific focus depends on the relationship of the competitors to the forum.

When most or all competitors that may be covered by a particular intellectual property right exist in one country, a premium or branded competitor strategy may be possible. If successful, it would yield significant price or supply advantages until competitors can work around the rights or ramp up production elsewhere. Few markets are so concentrated, but the potential exists if a technology-dependent duopoly or very small oligopoly exists. An example is the agribusiness segment. If a proposed merger between Bayer AG and Monsanto Co. is consummated,[35] three firms would control 60% of genetically-modified seeds and 65% of agrichemicals.[36] With such concentration it is easy to deploy a near-chokepoint strategy. One company need only obtain and enforce patents in the two locations of its competitors, and nearly two thirds of the competition can be impacted (assuming their production takes place in their home countries). Compared to a country-by-country global enforcement strategy, this is much more direct.

More commonly, a firm may be able to use a chokepoint strategy against generic or "copycat" competitors that are concentrated in one country. Such action would at least help contain global low price competition in the good or service. Chinese firms have become particularly well-known for focusing on imitations of

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34. *See* Rebecca S. Eisenberg, *Patent Costs and Unlicensed Use of Patented Inventions*, 78 U. CHI. L. REV. 53, 59-62 (2011) (describing owner costs as a weeding out process for less valuable patents).

35. Jeffrey McCracken, *Bayer, Monsanto Said to Move Closer to Merger Deal*, BLOOMBERG NEWS (Aug. 23, 2016), https://www.bostonglobe.com/business/2016/08/23/bayer-monsanto-said-move-closer-merger-deal/VJGwss3TiSYuNZ6ZL1jGYP/story.html [https://perma.cc/3HFU-5BS7]. The agribusiness sector has moved around quite a bit with two major recent mergers or acquisitions and several failed bids. Thus, it is far from certain that the Monsanto-Bayer merger will go through at this writing.

36. Emiko Terazono & Arash Massoudi, *Bayer-Monsanto Would be Latest Deal to Shake Up Agribusiness*, FIN. TIMES (May 12, 2016), https://www.ft.com/content/e5095826-1856-11e6-bb7d-ee563a5a1cc1 [https://perma.cc/P6TP-FW55] (displaying figure with companies' market share by sales in 2015).

popular global brands,[37] and thus the country is an obvious focal point for both branded and copycat competitor restriction.

The economic benefits of chokepoint strategy certainly flow from the greater profits a patent owner may reap from relative market exclusivity. However, alternate benefits could be obtained that require less intensive enforcement. The most important of such alternatives is the non-exclusive license.[38] In this case, the patent owner simply threatens enforcement and offers a relatively low-cost license (below the cost of litigating) to the intellectual property as an alternative.

Another non-exclusion strategy is the option to be purchased by a better-funded competitor, particularly if it clears a production obstacle.[39] This may result in the patent owner exiting the market, and the essential transfer of monopolies to another party. Again, the ability to undertake such a transaction is not new to chokepoint locales, but the incentive to do so is greatly enhanced by the power of such a strategy.

C. *Caveats Limit Chokepoint Availability*

Of course, not all products or industrial segments are as equally susceptible to a patent-specific chokepoint. Newer technologies or products that are dependent on modern production techniques are more likely to be covered by patents than commoditized goods, and industries that have rapid turnover are likely to be covered by broader patents.[40] And in general, as demonstrated by the patent trolling phenomenon in the United States, the more complex the product, the more likely ownership of intellectual property covering a minor aspect will be sufficiently strong to prevent export.[41] But if the restraining potential exists, it can potentially be exercised by both domestic and foreign companies.

In addition to dependence on a protectable, modern technology, designing around the chokepoint must be difficult. If a competitor can simply substitute some other unprotected component or method—even if such substitution is imperfect—the patent power will be relatively weak.[42] Of course, even if it is possible to design

37. *See* Wendy Dobson & A.E. Safarian, *The Transition from Imitation to Innovation: An Enquiry into China's Evolving Institutions and Firm Capabilities*, 19 J. ASIAN ECON. 301, 306 (2008) (noting characteristics that drive Chinese firms toward imitation rather than innovation).

38. 1 DAVID M. EPSTEIN, ECKSTROM'S LICENSING IN FOREIGN & DOMESTIC OPERATIONS § 1:8 (June 2016).

39. Rosemarie Ham Ziedonis, *Don't Fence Me in: Fragmented Markets for Technology and the Patent Acquisition Strategies of Firms*, 50 MGMT. SCI. 804, 817-18 (2004); *see also* Michael Kremer, *Patent Buyouts: A Mechanism for Encouraging Innovation*, 113 Q. J. ECON. 1137 (1998).

40. Benjamin N. Roin, *The Case for Tailoring Patent Awards Based on Time-to-Market*, 61 UCLA L. REV. 672, 737-41 (2014).

41. Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 1992-93 (2007) (explaining that, with certain products like cell phones, thousands of patents can read on a single device, which creates a greater likelihood of injunctions).

42. *See* Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421, 1434 (2009) (describing design around theory as a means of copying aspects of the invention while avoiding liability).

around the chokepoint, the delay a competitor faces in instituting a change may still be valuable to the patent owner.

Finally, the chokepoint right must cover some production aspect that cannot be easily shifted to another country. This could be an inherent limitation, such as a material that is economically produced (or in some other way physically captured) in only one locale. But more commonly, it will be the result of historic market choices that lead to certain manufacturing expertise or sunk investment costs that makes it practically impossible for competitors to pull up stakes and leave. On the other hand, if the intellectual property right covers a shiftable technology, the only alternate option is to use the standard global patent strategy of covering several countries,[43] which may be economically inefficient. The truth is, for most firms, the question of moving facilities in response to chokepoint strategy is not a binary issue. The decision to relocate facilities—now a popular point of discussion in the context of backshoring or reshoring[44]—comes down to cost.[45] It may be in the chokepoint practitioner's interest to relieve enough pressure to permit the alleged infringer to maintain operations while still making a substantial payment to the chokepoint practitioner under a license.

III. HOW INVENTION RIGHTS AND ENFORCEMENT MAKE CHINA A FREQUENT CHOKEPOINT

To investigate in more depth how patent chokepoint strategy works, it is helpful to consider the world's most likely focus for such a strategy: China. China's intellectual property system is relatively new compared to most other industrialized nations. As a result, China has a system with the advantages of being able to adopt the most modern attributes without the drag of legacy systems but also the disadvantages of youth and inexperience. Some might argue that such a system constitutes a significant risk for intellectual property owners. Risky or not, the manufacturing significance of countries like China propel those countries' systems to the forefront of relevance for chokepoint strategy.

In order to fully describe rights and enforcement, the following section will concentrate primarily on patents. However, it is important to keep in mind that other rights such as copyrights or trademarks may have a similar ability to restrict exports.

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43. *See supra* note 22 and accompanying text.

44. See, e.g., Jeffrey Rothfeder, *Why Donald Trump is Wrong about Manufacturing Jobs and China*, NEW YORKER (Mar. 14, 2016), http://www.newyorker.com/business/currency/why-donald-trump-is-wrong-about-manufacturing-jobs-and-china [https://perma.cc/K6PA-KFZT].

45. *Id.* (noting that rising costs in countries like China compel firms to consider reshoring); Jan Stetoft, et al., *Manufacturing Backshoring: A Systematic Literature Review*, 9 OPERATIONS MGMT. RES. 53, 58 tbls.3-4 (2016) (listing the studies that point to cost in addition to quality, time, and flexibility as drivers for moving manufacturing back to an outsourcing country).

A. *Development and Basic Invention Rights*

The nature of China's patent regime is a consequence of its communist political system, which did not emphasize private property protection—let alone intellectual property rights—until the country began to more fully engage the rest of the world in trade.[46] The fully modern architecture arguably dates from the first major revision of Chinese patent law in 1992.[47] Although many authors trace its genesis to 1984, which was the first official creation of invention rights following the Cultural Revolution, there were many important pieces missing and it was a somewhat weak system.[48] For example, the Chinese government owned many of the patents because state-controlled firms could not independently own patents, nor could individuals.[49] Additionally, the 1984 law excluded important categories of inventions such as food, beverages, and pharmaceuticals.[50] A 1993 revision (based on the 1992 U.S.-China memorandum of understanding, or MOU[51]) broadened the categories of protection and conferred rights on private owners, making it a more proper intellectual property regime by global standards.[52] Further refinements came as China desired to enter the World Trade Organization (WTO) in 2000.[53] And in 2008, yet another revision of China's law was enacted, this time slightly weakening the rights to prevent false or abusive claims of infringement.[54]

In a departure from the U.S system, China offers two types of rights for new technologies: the invention patent and the utility model patent.[55] The invention patent is analogous to the "utility patent" in the United States in that it covers a

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46. John R. Allison & Lianlian Lin, *The Evolution of Chinese Attitudes Toward Property Rights in Invention and Discovery*, 20 U. PA. J. INT'L ECON. L. 735, 744-51 (1999) (describing the failure of the 1950 patent regulation to generate substantial innovation incentives).

47. Patent Law of the People's Republic of China (promulgated by the Standing Comm. Nat'l People's Cong., Mar. 12, 1984, rev'd Sept. 4, 1992, effective Jan. 1, 1993), *translated in* 2 CHINA L. FOREIGN BUS. (CCH) P 11-600 (1993) (China).

48. *See* Peter K. Yu, *From Pirates to Partner: Protecting Intellectual Property in China in the Twenty-First Century*, 50 AM. U. L. REV. 137, 137-42 (2000) (describing the legal and political history of the 1984 law as it transitioned into the 1992 law). Of course, one can find roots of the Chinese patent system before 1984, particularly pre-dating the founding of the People's Republic. *See* Kong Quingjiang, *The Political Economy of the Intellectual Property Regime-Building in China: Evidence from the Evolution of the Chinese Patent Regime*, 21 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 111, 115 (2008) (noting that evidence of Chinese patent law can be found back to the Qing Dynasty in the early part of the last century).

49. Yu, *supra* note 48, at 137.

50. *Id.* at 142.

51. *Id.*

52. *See* Allison & Lin, *supra* note 46, at 760-66 (noting the 1993 revisions actually end up reflecting European patent law more than U.S. patent law).

53. Edward J. Walneck, Note, *The Patent Troll or Dragon? How Quantity Issues and Chinese Nationalism Explain Recent Trends in Chinese Patent Law*, 31 ARIZ. J. INT'L & COMP. L. 435, 439 (2014).

54. Jennifer Wai-Shing Maguire, *Progressive IP Reform in the Middle Kingdom: An Overview of the Past, Present and Future of Chinese Intellectual Property Law*, 46 INT'L LAW. 893, 900-01 (2012).

55. Patricia E. Campbell & Michael Pecht, *The Emperor's New Clothes: Intellectual Property Protections in China*, 7 J. BUS. & TECH. L. 69, 86 (2012).

new technical solution for a product or process and lasts for twenty years.[56] On the other hand, a Chinese utility model patent is a much simpler right given to an improvement on existing technology.[57] The examination of utility models is much briefer—arguably a mere formality—and the right lasts for only ten years.[58] Generally speaking, foreign firms tend to favor invention patents and Chinese firms favor utility model patents (at least to date).[59]

For the non-utilitarian shape of products, China offers design patents.[60] Like utility model patents, these rights last ten years.[61] They are enforced much like copyrights (as in the U.S.) and are actually the most popular type of patent in China.[62]

B. *Special Enforcement Concerns*

Unlike most other modern patent systems, China's system heavily relies on the administrative state for enforcement (see Figure 2 for a comparison of enforcement options through the Chinese legal system). Although private civil litigation is possible, the great majority of patent owners first seek relief from an administrative agency.[63] The primary enforcing agency, in terms of number of investigations,[64] is China's State Intellectual Property Office (SIPO). In comparison to private litigation in the U.S., SIPO handles over twice the number of complaints.[65] However, Chinese administrative patent actions are generally much shorter than U.S. patent litigation,[66] suggesting the burden on the system is not so extreme.

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56. *Id.*

57. Mark Shiqian Zhai, Note, *The Chinese Utility Model Patent is Destroying Innovation in China*, 39 AIPLA Q.J. 413, 422-23 (2011).

58. *Id.*

59. Yang, *supra* note 15, at 398.

60. Campbell & Pecht, *supra* note 55, at 86.

61. *Id.*

62. Grace Pan, *Obtaining and Enforcing Patent Rights in the People's Republic of China*, *in* DEFENDING INTELLECTUAL PROPERTY RIGHTS CASES IN CHINA: LEADING LAWYERS ON PROTECTING CLIENTS' RIGHTS IN CHINA'S EVOLVING IP ENVIRONMENT *4, 2013 WL 4192385.

63. Christopher J. Hayes et al., *Patent Litigation in China and the United States: What Every Patent Holder Should Know*, ACC DOCKET, Nov. 2008, at 78, 80-81; Shengping Yang, *Patent Enforcement in China*, LANDSLIDE, Nov./Dec. 2011, at 48, 49, http://www.americanbar.org/content/dam/aba/publications/landslide/landslide_november_2011/yang_landslide_novedec_2011.authcheckdam.pdf [https://perma.cc/9JVD-LT33].

64. Brian J. Love, Christian Helmers & Markus Eberhardt, *Patent Litigation in China: Protecting Rights or the Local Economy?*, 18 VAND. J. ENT. & TECH. L. 713, 721-23 (2016).

65. Consider that in 2015, there were 14,607 patent dispute cases filed with SIPO. State Intellectual Prop. Office of China, 2015 Intellectual Propperty Rights Protection in China 15 (July 21, 2016), http://english.sipo.gov.cn/laws/whitepapers/201607/P020160721403876149335.pdf [https://perma.cc/FTL6-675L]. In the same period in the U.S., there were approximately 5,819 cases filed. Terry Ludlow, *2016 Patent Litigation Trends in the United States,* IPFRONTLINE (May 10, 2016), http://blog.ip.com/2016/05/2016-patent-litigation-trends-in-the-united-states [https://perma.cc/Z6W8-EWZE]; *see also* Love et al., *supra* note 64, at 714.

66. *See* Yang, *supra* note 63, at 2 (noting that administrative enforcement is "cheap, quick, and simple," and that local authorities often take action on the same day as the complaint).

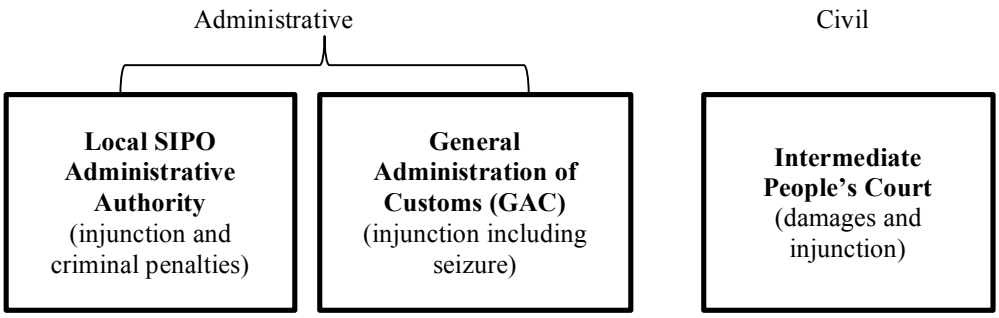

Figure 2. Chinese Patent Enforcement Options

To begin an enforcement action with SIPO, a patent owner files a complaint with a regional office of SIPO. Regional offices are located in each of China's thirty-one provinces.[67] If the regional office decides to pursue the case, the agency has the power to collect evidence and determine whether infringement has occurred.[68] Generally, the rules anticipate that the process will be concluded within four months.[69] When the local agency renders its decision, a notice is posted but no written opinion is provided.[70] This fact, in combination with the speed of the inquiry, suggests that the investigation is somewhat cursory.

Decisions of SIPO local administrative units can be appealed to the Chinese court system, beginning at the Intermediate People's Court.[71] Because private litigants do not have discovery powers in the Chinese court system,[72] the evidence collected by the local SIPO office can be extremely useful.

A second, and in some ways more intriguing, route for administrative action is to file an action with the General Administration of Customs (GAC).[73] In many respects, the GAC is analogous to the U.S. International Trade Commission, which has the power to block imports that infringe the patent rights of domestic firms. But, notably, the GAC has the power to issue injunctions both to prevent imports *and exports*.[74] This power gives the agency authority over an expanded range of

67. *Administration of Local Patent Affairs*, STATE INTELLECTUAL PROP. OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA (July 19, 2007), http://english.sipo.gov.cn/about/Administration/200804/t20080416_380178.html [https://perma.cc/6AK8-PAGF].

68. Patricia E. Campbell & Michael Pecht, *The Emperor's New Clothes: Intellectual Property Protections in China*, 7 J. BUS. & TECH. L. 69, 97 (2012)

69. *Id.*

70. Pan, *supra* note 62, at *9; *Intellectual Property Rights*, EMBASSY OF THE U.S., BEIJING (Nov. 7, 2016), http://beijing.usembassy-china.org.cn/iprpatent.html [https://perma.cc/XLW5-BFZ3] [hereinafter *U.S. Embassy IPR*].

71. Love et al., *supra* note 64, at 722-23.

72. Pan, *supra* note 62, at *8; J. Benjamin Bai, Peter J. Wang & Helen Cheng, *What Multinational Companies Need to Know About Patent Invalidation and Patent Litigation in China*, 5 NW. J. TECH. & INTELL. PROP. 449, 459 (2007).

73. Yang, *supra* note 63, at 3; *U.S. Embassy IPR*, *supra* note 70.

74. *U.S. Embassy IPR*, *supra* note 70.

cases, such as those involving companies that only produce for export. A patent owner must register the relevant patent with the GAC before filing a complaint, representing a slight hurdle to obtaining recovery in court.[75] As with SIPO actions, the GAC decision is issued relatively quickly.[76]

At this point, most administrative patent actions in China are initiated by Chinese patent owners against Chinese citizens.[77] A smaller percentage are directed against foreign interests.[78] But the smallest share concerns foreign patent owner actions against infringers in China.[79]

Owners of Chinese patents can also pursue an initial action in the court system, starting at the Intermediate People's Court.[80] Compared to the U.S., that system is still relatively fast, with a total litigation period lasting about eighteen months.[81] Since 2014, patent owners in Beijing, Shanghai and Guangzhou provinces have had the ability to file cases at a special, dedicated intellectual property tribunal that substitutes for the Intermediate People's Court.[82] Invention patent owners are more likely to use the court system than the administrative system due to the court system's enhanced abilities to make complex technological determinations.[83]In contrast, according to a 2012 Report on Patent Enforcement in China prepared by the US Patent and Trademark Office, stakeholders believe that the administrative system lacks resources and technical expertise, as well as the ability to enforce orders for evidence production.[84]

Significantly, neither the enforcing agencies nor the courts can invalidate issued patents in the first instance.[85] For that to happen, a defendant must file a request with the SIPO Patent Reexamination Board.[86] However, courts are quite willing to suspend a litigation to permit SIPO to render a decision on patentability if a request for review is filed.[87] And the SIPO decision can be appealed to a court for review.[88]

What can we conclude about the nature of Chinese patent enforcement? It is a

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75. *Id.*; Yang, *supra* note 63, at 3.

76. Yang, *supra* note 63, at 3.

77. *Id.* at 2.

78. *Id.*

79. *Id.*

80. Bai et al., *supra* note 72, at 457-58.

81. Yang, *supra* note 63, at 3.

82. Luo Xia, *China Judicial Reforms Are Creating Opportunities for Technology Transfer and Licensing*, 52 LES NOUVELLES 1, 2 (2017).

83. Pan, *supra* note 62, at *9.

84. U.S. PATENT & TRADEMARK OFFICE, REPORT ON PATENT ENFORCEMENT IN CHINA 10 (2012), https://www.uspto.gov/ip/global/China_Report_on_Patent_Enforcement_%28FullRprt%29FINAL.pdf [https://perma.cc/22DH-AXMM].

85. Wayne C. Jaeschke, Zhun Lu & Paul Crawford, *Comparison of Chinese and U.S. Patent Reform Legislation: Which, if Either, Got it Right?*, 11 J. MARSHALL REV. INTELL. PROP. L. 567, 582-83 (2012).

86. *Id.* at 581; Bai et al., supra note 72, at 450.

87. Bai et al., supra note 72, at 458.

88. Bai et al., supra note 72, at 456-57.

large system that could provide strength to even weak rights by virtue of the fact that decisions are issued quickly in the face of a cursory review that may not uncover flaws in the examination process. Might it be subject to manipulation or biased toward domestic individuals and firms? This is a highly relevant question, as the impact would be exacerbated by chokepoint strategy.

C. *Allegations of Bias, Inefficiency, or Manipulation*

Perhaps it is not surprising that a relatively new intellectual property system with such broad reach is criticized on the basis that it may be unfair in some way. Whether it is a design failure or institutionalized favoritism, the result could be disincentives for true innovation or other business investment. And because China is emerging as a global intellectual property focal point, these issues are unavoidable for any modern business. The foregoing chokepoint discussion suggests that firms have no choice but to protect intellectual property rights in key countries like China, and thus are compelled to confront any systemic problems.

The greatest concern appears to be bias against certain groups, particularly foreign firms. For example, some studies have suggested that Chinese individuals or firms are favored by the Chinese domestic intellectual property system, in part because of government-industry connections.[89] A related issue that has been raised for years is the notion that certain countries are culturally biased against intellectual property enforcement. China in particular has faced scrutiny for its Confucian roots that allegedly conflict with the notion of information ownership.[90] Similar issues have been raised about India and its communal traditions.[91] These assertions are not necessarily borne out by the weight of empirical evidence. A recent analysis of 471 Chinese patent infringement lawsuits found that "foreign companies perform as well, if not better, than Chinese firms in patent suits."[92] This criticism of bias may be overblown or misguided, but more investigation is necessary.

A second concern is the rapid buildup in rights stressing an enforcement system struggling to catch up. China has accounted for the largest number of patent applications received by a single office since 2011,[93] and its year-to-year growth is

89. See, e.g., Love et al., supra note 64, at 718 n.18 (detailing several studies that suggest favoritism to Chinese firms and/or government owned companies); Pan, supra note 62.

90. Edward J. Walneck, *The Patent Troll or Dragon? How Quantity Issues and Chinese Nationalism Explain Recent Trends in Chinese Patent Law*, 31 ARIZ. J. INT'L & COMP. L. 435, 450-52 (2014) (describing in particular the arguments in WILLIAM ALFORD, TO STEAL A BOOK IS AN ELEGANT OFFENSE: INTELLECTUAL PROPERTY LAW IN CHINESE CIVILIZATION 19-29 (1995)); Yu, supra note 48, at 165.

91. See Mueller, supra note 9, at 544-45 (discussing India's tradition of communal ownership).

92. Love et al., *supra* note 64, at 738; *see also* Xuan-Thao Nguyen, *The China We Hardly Know: Revealing the New China's Intellectual Property Regime*, 55 ST. LOUIS U. L.J. 773, 789-98 (2011) (stating that China's intellectual property system in general is more rigorous than previously believed).

93. WORLD INTELLECTUAL PROP. ORG. (WIPO), WIPO IP FACTS AND FIGURES 17-18 (2015).

even more striking. In 2014, SIPO recorded a 12.5% increase over 2013.[94] Other developing nations like India and Brazil are also in the top ten for applications.[95] It is reasonable to question whether existing enforcement systems are adapting rapidly enough to accurately and fairly assess infringement and related penalties.

It is important to keep in mind that all patent systems are imperfect in some way and the point of highlighting problems in countries like China is not to cast blame on that system (which has come an amazingly long way in a short amount of time). Rather, chokepoint strategy dictates that firms must care simply because of the nature of the global marketplace. Avoiding a chokepoint market will not necessarily avoid the chokepoint patent system. And as detailed below, this is not simply a theoretical problem, but one that can be observed now.

IV. EVIDENCE THAT FIRMS USE PATENT CHOKEPOINTS: SOLAR PHOTOVOLTAIC PATENTING IN CHINA

To determine whether empirical evidence of firms actually employing chokepoint strategy exists, we studied foreign patenting in photovoltaic (PV) solar cells in China in the last decade. This context is particularly useful because the product category is so specific and production by almost all of the low-cost competitors is in China, creating a strong enforcement incentive for both domestic and foreign innovator firms.

The Chinese solar PV manufacturing industry, virtually nonexistent before 2000, has been growing rapidly since the early 2000s, benefitting from both supportive government policies and various cost advantages in a rapidly growing world market for solar energy.[96] The *New Energy and Renewable Energy Industry Development Planning (2000-2015)* (released in 2000) and the *Chinese Renewable Energy Law* (enacted in 2005) both stress the development of Chinese renewable technology industries including the solar PV industry.

In a short period of time, the Chinese solar PV manufacturing industry has grown into one of the major players in the world market. The Chinese share of the world solar PV production has risen to 45% in 2010 (ranked as the top producer of the year), from only 7% in 2005. As demonstrated in Table 1, of the top ten solar PV panel and module producers in the world in 2011, five are based in mainland China.

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94. *Id.*

95. *Id.*

96. Li-qun Liu, Zhi-xin Wang, Hua-qiang Zhang & Ying-cheng Xue, *Solar Energy Development in China—A Review*, 14 RENEWABLE & SUSTAINABLE ENERGY REVS. 301, 302-04 (2010); Nicoletta Marigo, *The Chinese Silicon Photovoltaic Industry and Market: A Critical Review of Trends and Outlook*, 15 PROGRESS IN PHOTOVOLTAICS: RES. & APPLICATIONS 143, 145, 148-49 (2007).

TABLE 1: TOP 10 SOLAR MODULE MANUFACTURERS IN THE WORLD (2011)

Manufacturers	**Country**	**Share of global module production (%)**	**Module production in 2011 (MW)**
First Solar	United States	7	2001
Suntech Power	China	6.5	1866
Yingli Green Energy	China	5.5	1554
Trina Solar	China	4.9	1395
Canadian Solar	China	4.8	1363
Sharp	Japan	4.1	1155
Hanwha Solar One	Korea	2.9	825
Jinko Solar	Taiwan(China)	2.8	782
LDK Solar	China	2.7	774
SolarWorld	Germany	2.7	767
Total		**43.9**	**12482**

Note: data is based on the news released on the website of Cleantechnica: top ten solar panel companies in 2011.[97] http://cleantechnica.com/2012/03/15/top-10-solar-panel-companies-in-2011

In sharp contrast to Chinese solar PV manufacturing industry, the solar PV installation in China had until recently remained small. The annual solar PV installation in China totaled 520 MWs in 2010, much smaller than the top markets such as Germany and Italy (7408 MWs and 2321 MWs, respectively).[98,99] Electricity generated from solar PV is more expensive than electricity generated from wind power, which at least partly explains why China did not focus on solar PV installation during the first decade of the twenty-first century.[100]

Given the small domestic market, 98% of solar cells and panels produced by

97. Zachary Shahan, *Top 10 Solar Panel Companies in 2011*, CLEAN TECHNICA (Mar. 15, 2012), http://cleantechnica.com/2012/03/15/top-10-solar-panel-companies-in-2011 [https://perma.cc/K5RV-89HE].

98. A Megawatt is a standard measure of electrical generation capacity. One Megawatt represents enough capacity to power about 800 homes in the United States.

99. The major solar PV markets in the world are Germany, Spain, Italy, the U.S., and Japan. By 2010, Germany had become the largest solar PV market; in Germany, the cumulative PV installation counted for 43% of the world installation in solar PV. *Climate, Energy, and Transportation*, EARTY POLICY INSTITUTE (May 11, 2017), http://www.earth-policy.org/?/data_center/C23 [https://perma.cc/8V9Q-AMXY] (follow "Cumulative and Newly-Installed Solar Photovoltaics Capacity in Ten Leading Countries and the World, 2013" hyperlink).

100. The Chinese government has recently started to stimulate the installation of solar PV in China. The 12TH Five-year Plan for Solar Photovoltaic Industry, issued in April 2012, sets a target of 20 GW of installed capacity in solar PV generation (including both centralized and distributed) by 2015. For the policy document in English, see 12TH Five-year Plan for Solar Photovoltaic Industry, http://www.americansolarmanufacturing.org/news-releases/chinas-five-year-plan-for-solar-translation.pdf [https://perma.cc/8556-6P35].

Chinese solar PV companies are exported. There has been fierce competition in the global market between Chinese solar PV firms and non-Chinese firms, with the former often outperforming the latter. This is vividly evidenced in the recent anti-dumping and anti-subsidy cases in the United States and Europe, which were brought by non-Chinese solar PV firms against their Chinese rivals. In October 2011, a coalition of solar PV manufacturers filed an anti-dumping case in the U.S. Department of Commerce against Chinese solar PV firms, accusing that the Chinese firms were benefiting from unfair government subsidies and were selling their products in the U.S. below the cost of production.[101] In Europe, an investigation of anti-dumping by Chinese solar PV producers was initiated in September 2012.[102]

A. *Foreign Patenting in China's Solar PV Sector*

This Article focuses specifically on foreign patenting in solar PV in China, which experienced substantial growth in the early and mid-2000s. During this time period, domestic demand for solar PV systems in China (in other words, installed solar PV capacity in China) was small and grew slowly, but the solar PV manufacturing sector grew rapidly.

As shown in Figure 3, the annual number of invention patent applications related to solar PV technology filed by non-Chinese firms at SIPO had been growing significantly between 2002 and 2007.[103] Given that China had a small domestic solar PV market during the period, the data does not suggest that foreign patenting in solar PV in China has been motivated by "market covering" including export demand to China, technology licensing to Chinese firms, or FDI in China. First, given the small size of the Chinese domestic solar PV market, it is unlikely that increased foreign patenting was driven by exports to the Chinese domestic market. Exports of solar PV to China by foreign firms were roughly two orders of magnitude smaller than exports of Chinese-made solar PV to the rest of the world.[104] Second, competition between Chinese and major non-Chinese firms in

101. In May 2012, a preliminary anti-dumping duty was imposed by the U.S. on Chinese solar cells and panels. In October 2012, The U.S. Department of Commerce issued the final ruling, imposing tariffs ranging from 24% to nearly 36% on most Chinese solar PV products. *See* Diane Cardwell & Keith Bradsher, *U.S. Will Place Tariffs on Chinese Solar Panels*, N.Y. TIMES (Oct. 10, 2012), http://www.nytimes.com/2012/10/11/business/global/us-sets-tariffs-on-chinese-solar-panels.html [https://perma.cc/9RE9-542L].

102. The trade dispute in Europe was settled in July 2013. *EU, China Settle Solar Panel Dispute*, SOLAR DAILY (July 27, 2013), http://www.solardaily.com/reports/EU_China_settle_solar_panel_dispute_999.html [https://perma.cc/BL23-L2DG].

103. Here we focus on invention patent filings at SIPO by foreign firms. SIPO allows three types of patents: invention patents, utility models, and design patents. Invention patents in China correspond to utility patents in the U.S., and they are substantially examined and of highest inventiveness among the three types of patents in China. Our data shows that the foreign solar PV firms in our study filed very few other types of patents.

104. In 2011, for example, China exported $151 million worth of solar cells and $2.65 billion of PV modules to the U.S, whereas U.S. firms exported only $12 million worth of PV modules to China. Felicity Carus, *US Solar Exports to China Delivered US $913 Million Surplus in 2011*,

the global solar PV market has been intense, as evidenced by the recent anti-dumping cases against Chinese solar PV companies in the United States and Europe. Technology licensing from major foreign firms to Chinese firms is virtually non-existent in the PV industry.[105] It is thus unlikely that foreign patenting is attributable to major non-Chinese companies' intent to license technologies to their Chinese rivals. Finally, foreign direct investment (FDI) in China by foreign solar PV firms has been small and FDI-based firms were late entrants to the Chinese solar PV manufacturing sector.[106] In particular, as demonstrated in Table 2, among the fifteen major non-Chinese solar PV firms whose patenting activity in China is investigated in the Article, only two have FDI in China.[107]

However, it is evident from Figure 3 that foreign patenting in China largely parallels the solar PV production of Chinese firms. This suggests that the observed growth in foreign solar PV patenting in China during this period might be mainly driven by the "global chokepoint" strategy by foreign firms. This strategy makes a lot of sense here. First, solar PV manufacturing is very capital intensive, and mobility carries high costs. Second, solar PV markets in many countries are still evolving or have yet to emerge, and are driven by national and local policies towards renewable energy in general or solar PV in particular.

PVTECH (Mar. 6, 2013), https://www.pv-tech.org/news/exports_of_us_solar_products_to_china_reach_913m_surplus_in_2011 [https://perma.cc/D7ND-LHMT].

105. de la Tour et al. finds only one case of technology licensing: Germany's Johanna Solar Technology granted a license to a Chinese company Shandong Solar Technology in 2008 to build a production line. Arnaud de la Tour et al., *Innovation and International Technology Transfer: The Case of the Chinese Photovoltaic Industry*, 39 ENERGY POL'Y 761, 765 (2011).

106. *Id.*

107. *See infra* Table 2 for the list of major non-Chinese solar PV firms and information about their FDI in China.

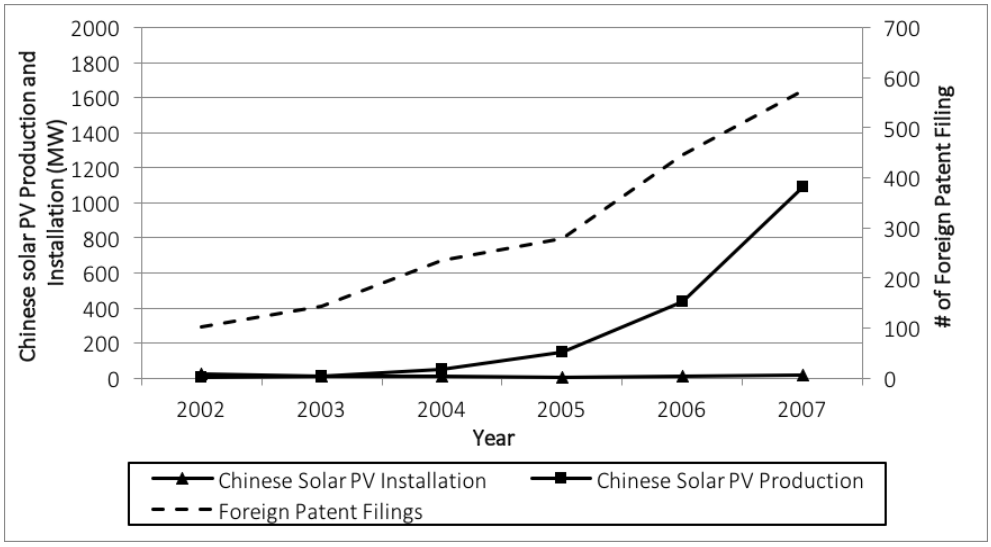

Figure 3: Foreign patenting in Solar PV, production and installation of solar PV in China

Note: Data on invention patent applications are retrieved from the Chinese Patent Database (year 2011). The information on solar PV production and installation in China is from Earth Policy Institute.[108]

Companies may fail to foresee some market development when deciding where to patent new technology, making the "market covering" strategy difficult to implement.[109] Moreover, patenting in China (the manufacturing base) is also likely to be a less costly way of preventing Chinese firms from copying, relative to patenting in each of the markets (the demand bases, some of which may be quite small) in which the foreign solar PV firm competes with Chinese firms.

B. *Data and Empirical Strategy*

To examine whether foreign patenting in solar PV in China is mostly related to the use of "global chokepoint" strategy, a deeper empirical investigation is helpful. More specifically, we test whether foreign solar PV patenting in China is more responsive to the solar PV production of Chinese firms (aiming at protecting inventions in rivals' manufacturing base), or to the solar PV installation in China (aiming at covering the Chinese market).[110]

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108. *See generally* EARTH POL'Y INST. (Nov. 7, 2016), http://www.earth-policy.org [https://perma.cc/N5T6-VWA9].

109. The strategy of patenting in demand bases, rather than the manufacturing base, may not even be feasible. An inventor would need to file patent applications in other countries within one year after the first patent filing to claim they are the same invention (with the same priority date).

110. Technology licensing and FDI are unlikely to be the motivation for foreign patenting in solar PV in China, as discussed earlier.

As Table 2 indicates, the investigation focuses on fifteen major non-Chinese solar PV firms that were top producers in the world market during the study period.[111]

TABLE 2: TOP 15 NON-CHINESE SOLAR PV PRODUCERS IN THE STUDY AND THEIR FDI IN CHINA[112]

List	Firm	Country/Region	FDIs (Y/N)
1	Sharp	Japan	N
2	Kyocera	Japan	Y (2003, Tianjin)
3	BP Solar	United Kingdom	N
4	Mitsubishi	Japan	N
5	Shell Solar	Netherlands	N
6	Sanyo	Japan	N
7	Isofoton	Spain	N
8	Evergreen	United States	N
9	First Solar	United States	N
10	Motech	Taiwan	Y (2006, Suzhou)
11	Q-cells	Germany	N
12	Schott	Germany	N
13	SolarWorld	Germany	N
14	Sunpower	United States	N
15	United Solar Ovonic	United States	N

The study considers patenting in solar PV in China by these firms between 2002 and 2007,[113] during which period the Chinese solar PV manufacturing

111. According to Renewable Energy World, the nine top global solar PV manufacturers in 2004 were Sharp, BP solar, Kyocera, Mitsubishi, Sanyo, Shell Solar, Schott, Q-cells, and Isofoton. Paula Mints, *Top Ten PV Manufacturers from 2000 to Present: A Pictorial Retrospective*, RENEWABLE ENERGY WORLD (Jan. 21, 2014), http://www.renewableenergyworld.com/articles/2014/01/top-ten-pv-manufacturers-from-2000-to-present-a-pictorial-retrospective.html. The other six major non-Chinese solar PV producers were identified by reviewing trade reports and industry news.

112. The top seven firms are listed in accordance with their ranks in production in 2004 (according to the Prometheus Institute Report published in 2005) (on file with author). The remaining firms are in alphabetical order. The information about their FDIs is collected from the official websites of these fifteen firms.

113. We chose 2002 as the start year of the study period since China joined the WTO in 2001 and amended its patent law to be in greater harmony with other WTO members, both of which could impact foreign patenting behavior in China. We chose 2007 as the end of the study period for the following reasons: (1) the worldwide economic crisis that began in 2008 likely impacted foreign patenting; and (2) there is significant truncation in the data for patent applications filed in 2008 and onward. The Chinese Patent Database covers published patent applications up to 2011. Although in theory a patent application is published 18 months after the

industry experienced rapid growth. It is noteworthy that although the data involves only a small number (90) of observations, the results from regressions with firm fixed effects are significant.

1. *Data*

We collected invention patent applications filed at SIPO by the above fifteen companies from the Chinese Patent Database (2011 version).[114] This study focuses on patent applications rather than granted patents, as patent filings better reflect firms' intentions to protect their inventions without importing the quirks of the patent examination system that may serve as a barrier to obtaining patent protection.[115] For robustness, we also conducted analyses on granted patents (based on their filing years) by these non-Chinese solar PV firms. The results are similar, which we might expect since more than 95% of foreign patent applications in our data set were ultimately granted by SIPO.

We retrieved patent applications filed at SIPO specific to solar PV technologies, components, and systems, based on the International Patent Classification (IPC) codes for solar PV that are identified in the IPC Green Inventory (compiled by WIPO, the World Intellectual Property Office) and covering seven categories of technologies in solar PV.[116] Then patent applications filed by the fifteen focal non-Chinese solar PV firms in our study are identified based on patent assignee names.

Seven categories of technologies in solar PV distinguished by WIPO were aggregated into three groups, based on their positions within the value chain of solar PV: silicon production, solar cells/modules and systems, and end applications.[117] Our study focuses primarily on patent filings related to solar cells, modules, and systems, as these are the products over which competition is most intense between Chinese and non-Chinese solar PV firms.[118]

Patent filings in the U.S. at the U.S. Patent and Trademark Office (USPTO) by these fifteen non-Chinese solar PV companies were collected from the Thomson

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date of its priority, in practice the lag between filing and being recorded in the Database is longer and many patent applications filed in 2008 and after are not included in the Database.

114. The Chinese Patent Database we use contains all published patent applications or granted patents between 1985 through 2011.

115. Another reason for focusing on patent applications is that information on granted patents could be truncated. The Chinese Patent Database (2011 version) covers published patent applications and granted patents up to 2011. It takes three to four years from patent filing to patent grant at SIPO, and there is also some lag between patent grant and being recorded in the Chinese Patent Database.

116. The IPC codes for solar PV technology include H01L 27/142, 31/00-31/078, H01G 9/20, H02N 6/00, H01L 25/00, 25/03, 25/16, 25/18, H01L 31/042, and G05F 1/67. *See IPC Green Inventory*, WORLD INTELL. PROP. ORG. (Nov. 7, 2016), http://www.wipo.int/classifications/ipc/en/est/index.html [https://perma.cc/2SY5-LYAH].

117. This categorization was done through consultation with Dr. Jeffrey Brownson and other experts in solar PV technologies at Penn State.

118. More than 85% of the solar PV patent applications—1628 out of 1882—in our data are related to solar PV cells, modules, and systems, according to WIPO technology categories.

Innovation Patent Database by searching the WIPO IPC codes for solar PV technologies and assignee names.[119] The information on solar PV production and installation in China was gathered from the data released by the Earth Policy Institute and contained in the China Solar PV Industry Development Report (2002-2007).[120]

2. *Empirical Strategy*

The econometric strategy involves balanced panel data linear regressions,[121] as specified below:

$$CN\_Filing_{it} = \alpha + \beta \times US\_Filing_{it} \times CN\_Production_t + \gamma \times US\_Filing_{it} \times CN\_Installation_t + \theta \times US\_Filing_{it} + Controls + u_i + v_t + \varepsilon_{it} \quad (1)$$

where the dependent variable, CN_Filing_{it}, is the number of patent applications in solar PV filed in China by a non-Chinese solar PV firm i in year t. $CN\_Production_t$ is the production of solar PV cells/modules (in hundreds of Megawatts of capacity) by Chinese firms in year t, as a proxy for the development of the Chinese solar manufacturing industry. $CN\_Installation_t$ is the annual solar PV installation (in Megawatts of capacity) in China, as a measurement of the development of the Chinese domestic solar PV market. $US\_Filing_{i,t}$ is the number of patent applications in solar PV filed by the same firm i in the United States in year t.[122] u_i and v_t are firm-level fixed effects and year indicators, respectively; and $\varepsilon_{i,t}$ is the error term.

119. More information about the Thomson data is available online. *See generally* THOMSON INNOVATION (Nov. 7, 2016), http://info.thomsoninnovation.com [https://perma.cc/6XB5-Z6BT].

120. The Earth Policy Institute data is available online. *See Climate, Energy, and Transportation*, EARTH POL'Y INST. (Nov. 7, 2016), http://www.earth-policy.org/data_center/C23 [https://perma.cc/Y7VL-EF9W].

121. The dependent variable in our regressions (patent counts) has a wide range (from 0 to 32) with a mean of 2.7. Thus we employ panel data OLS with fixed effects in our estimation.

122. Since firms tend to protect their inventions in the U.S. market, patent filings in the U.S. are used here to proxy for the pool of patentable inventions that a firm i has in year t.

The two variables of key interest in our regression are $US\_Filing_{it} \times CN\_Production_t$ and $US\_Filing_{it} \times CN\_Installation_t$. The coefficients on these two variables (β and γ) can be written as follows:

$$\beta = \frac{\partial\left(\frac{\partial CN\_Filing_{it}}{\partial US\_Filing_{it}}\right)}{\partial CN\_Production_t} \quad \gamma = \frac{\partial\left(\frac{\partial CN\_Filing_{it}}{\partial US\_Filing_{it}}\right)}{\partial CN\_Installation_t}$$

(2) $$\frac{\partial CN\_Filing_{i,t}}{\partial US\_Filing_{i,t}}$$

indicates the propensity of non-Chinese solar PV firms to engage in foreign patenting in China. Thus the two coefficients, β and γ, can be interpreted as measuring the responsiveness of the foreign-patenting propensity to Chinese solar PV production and to Chinese solar installation (market demand), respectively. Our hypothesis is that the foreign-patenting propensity is more sensitive to the former than to the latter, if the firms engage the "global patent chokepoint" strategy in China.

We also include two additional control variables that could impact foreign solar PV firms' propensity to patent in China. The first variable, $US\_Filing_{it} \times CN\_Expectation_t$, controls for expected growth in the Chinese domestic solar PV market, where $CN\_Expectation_t$ is a binary indicator that is equal to one for year 2005 and after, and zero otherwise. $CN\_Expectation_t$ captures the potential effect of the Chinese Renewable Energy Law, which was enacted in 2005 to promote renewable energy development in China. Firms might expect the policy increase the domestic demand for solar PV panels in China, which would increase the propensity of foreign firms to patent solar PV technologies in China. The second additional variable, $US\_Filing_{i,t} \times CN\_Innovation_t$, measures whether non-Chinese firms' propensity to patent in China is responsive to the innovative capacity of the Chinese solar PV firms, as measured by the total number of patent applications by large Chinese solar PV manufacturers.[123] $CN\_Innovation_t$ provides another indicator of the development of the solar PV technology industry in China.

C. *Results*

The baseline results are presented in Table 3. In Columns 1 to 4, $CN\_Production_t$, $CN\_Installation_t$ and $CN\_Innovation_t$ are measured using the *levels* of solar PV production by Chinese firms, solar PV installation in China, and

123. $CN\_Innovation_t$ is the number of patent applications filed at SIPO in year t, by the top five Chinese solar PV firms (based on production and capacity): Suntech, Yingli, China Electric Equipment Group, Canadian Solar, and Linyang. Here we do not use the total number of patent filings in solar PV by all Chinese applicants, as many applicants are small firms, academic institutions and individuals that do not directly compete with non-Chinese firms in the world market.

patent filings at SIPO by major Chinese firms, respectively, in year *t*. In Columns 5 to 8 of Table 3, these three variables are measured by their *growth rates*.

TABLE 3: ECONOMETRIC ANALYSES OF FOREIGN PATENTING IN CHINA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Independent variables: based on annual amount of production, installation, and innovation in solar PV in China				Independent variables: based on annual growth rate in production, installation, and innovation in solar PV in China			
US_Filing*CN_Production	0.0931***	0.0924***	0.0818***	0.0915***	0.150***	0.145***	0.149***	0.158***
	(0.0179)	(0.0223)	(0.0175)	(0.0217)	(0.0308)	(0.0269)	(0.0286)	(0.0274)
US_Filing*CN_Installation	-0.00374	-0.00352	0.000968	-0.00109	-0.000412	-6.80e-05	0.00166	0.00132
	(0.00559)	(0.00988)	(0.00750)	(0.0100)	(0.00352)	(0.00450)	(0.00355)	(0.00423)
US_Filing*CN_Expectation		0.00554		-0.171		0.0274		-0.0412
		(0.189)		(0.290)		(0.141)		(0.168)
US_Filing*CN_Innovation			0.00831	0.0167			0.00830***	0.00901*
			(0.00592)	(0.0111)			(0.00207)	(0.00427)
US_Filing	0.0256	0.0212	-0.0695	-0.0292	-0.0385	-0.0445	-0.0686	-0.0621
	(0.138)	(0.217)	(0.177)	(0.225)	(0.0815)	(0.0919)	(0.0861)	(0.0973)
Firm fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Observations	90	90	90	90	90	90	90	90
R-squared	0.678	0.678	0.685	0.693	0.670	0.670	0.694	0.696
Number of firms	15	15	15	15	15	15	15	15

Note: Standard errors clustered at the firm level. *, **, *** significant at 10%, 5%, and 1%, respectively. The regressions are specified in Equation (1), and investigate patent filings in China by top 15 non-Chinese solar PV firms between 2002 and 2007. US_Filing indicates the annual number of patent filings in the U.S., by non-Chinese firms. CN_Production and CN_Installation are the annual Chinese solar PV production and installation (in 100MWs and MW, respectively). CN_Expectation equals to 0 in 2002 to 2004, and 1 afterwards, to control for the expectation about the Chinese market after the enactment of the Chinese Renewable Energy Law in 2005. CN_Innovation is the number of patent filings at SIPO by top five Chinese solar PV firms. In columns (1) to (4), we use in the regressions the actual amount of annual solar PV production, installation, and innovation in China; and in columns (5) to (8), we use their growth rates. We focus on patent filings on inventions related to solar PV cells, modules, and systems.

Across all these regressions, the coefficients of the interaction term *US_Filing×CN_Production* are consistently significant and positive, whereas the coefficients of *US_Filing×CN_Installation* are insignificant. Thus, the propensity to patenting in China by non-Chinese solar PV firms is significantly and positively responsive to the annual solar PV production by Chinese rivals, but not to the annual solar PV installation in China. The coefficients of

US_Filing×CN_innovation are also significant in the growth-rates version of the model (Columns 5 to 8 of Table 3)[124], further supporting that foreign patenting in China is responsive to the development of the Chinese solar PV manufacturing, both in terms of its production and innovative capacity, rather than responding to market demand in China.[125]

Thus, our analysis takes into account the propensity of non-Chinese solar PV firms to patent in China as compared to the U.S. as a control on their overall innovative activity. And it specifically considers patenting in response to Chinese market demand as opposed to production for export. The results indicate that the firms are patenting in China to influence the export market specifically. This provides evidence that that the non-Chinese firms actually engaged in the patent chokepoint strategy.[126]

D. *Foreign Patenting in China Versus that in Australia*

We also compared foreign patenting in China versus that in Australia. For the purpose of our study, Australia makes an interesting comparison to China. The domestic solar PV installation has been small in both countries despite their abundant solar energy resources. However, the solar PV manufacturing sector in Australia drastically differs from that in China. None of the world's leading PV manufacturing firms are Australian, and PV components and systems manufacturing in Australia is much smaller than in China. Figure 4 compares China and Australia in terms of solar PV production and installation.

124. Note that the magnitude of the coefficients for *US_Filing*CN_Innovation* are similar in both the level and growth models, even though the coefficients are less significant in the level model. Therefore, it is reasonable to conclude that the positive coefficient for *US_Filing*CN_Innovation* in the level model still supports the conclusion that patenting is responsive to manufacturing.

125. The coefficients of $US\_Filing_{it} \times CN\_Expectation_t$ are consistently insignificant, suggesting that foreign companies did not expect the enactment of the Chinese Renewable Energy Law to promote the Chinese domestic market of solar PV (which is more expensive than wind power) in the near future.

126. This basic finding is robust to a number of specifications, as shown in Columns 1-8 in Table 3. We also studied the number of foreign patent filings at SIPO in all solar PV related technologies (silicon production, solar cells/modules/systems, and end applications) between 2002 and 2007. We ran regressions assuming that foreign patenting at SIPO is responsive to the solar PV production or installation in the previous year in China. We also studied the periods 2002-2008 and 2002-2009. The results hold in all these robustness checks. Data and additional figures are available from the authors upon request.

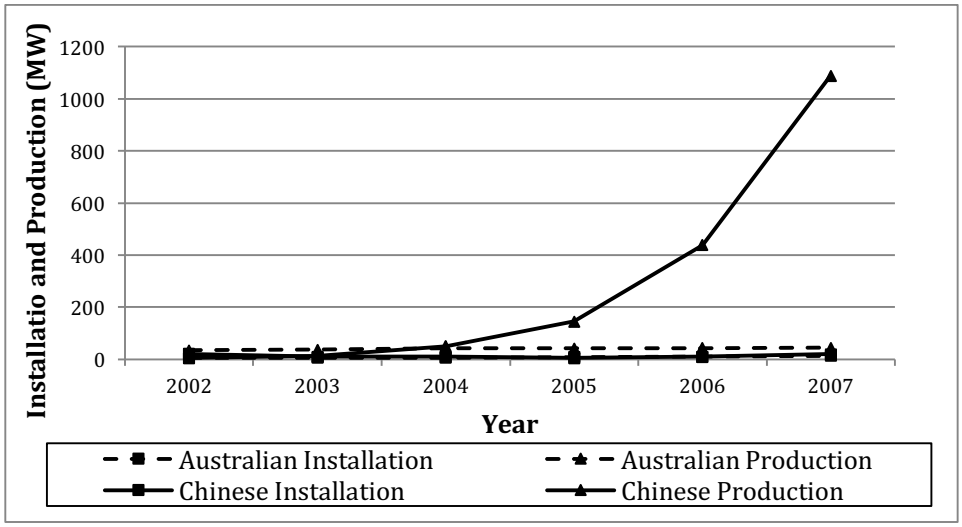

Figure 4: Solar PV production and installation in China (CN) and Australia (AU)[127]

Thus we expect that Australia is unlikely to become a "global chokepoint" in solar PV patenting and thus foreign patenting in Australia would not be motivated by firms seeking to protect their technology from Australian competitors in that country. Meanwhile, we would not expect foreign patenting in Australia to be responsive to the Australian solar PV market, because of that market's small size.

Table 4 presents the results on foreign patenting (on inventions related to solar PV cells, modules, and systems) in Australia by the fifteen solar PV companies whose foreign patenting activities in China have been examined in the present Article. As shown in Columns 1 and 3 of Table 4, the propensity to file patents in Australia is uncorrelated with either the production of solar PV by Australian firms ($AU\_Production_t$) or domestic Australian solar PV demand ($AU\_Installation_t$). By comparison, foreign patenting in China by the same companies is correlated with the solar PV production by Chinese firms, as shown in Columns 2 and 4.[128]

127. Data on Chinese solar PV production and installation is from Earth Policy Institute. *See generally* EARTH POL'Y INST. (Nov. 7, 2016), http://www.earth-policy.org [https://perma.cc/N5T6-VWA9]. Data on Australian solar PV production and installation is collected from National Survey Reports of PV Power Applications in Australia by International Energy Agency for years 2004-2010. *National Survey Reports*, INT'L ENERGY AGENCY PHOTOVOLTAIC POWER SYS. PROGRAMME (May 11, 2017), http://www.iea-pvps.org/index.php?id=93 [https://perma.cc/RC6Z-6877].

128. The variable *AU_Expectation* controls for the expectation of the market development in Australia. The variable equals 0 for years 2002 and 2003, and 1 for year 2004 and after. The Australian Business Council for Renewable Energy, with support from the Australian government, published in 2004 THE AUSTRALIAN PHOTOVOLTAIC INDUSTRY ROADMAP, stressing

TABLE 4: ECONOMETRIC ANALYSES OF FOREIGN PATENTING IN AUSTRALIA VS. IN CHINA

	(1)	(2)	(3)	(4)
	Independent variables: based on annual amount of production, installation, and innovation in solar PV		Independent variables: based on annual growth rate in production, installation, and innovation in solar PV	
Dependent Variables	Foreign patenting in Australia	Foreign patenting in China	Foreign patenting in Australia	Foreign patenting in China
US_Filing *AU_Production	0.01165		-1.418	
	(0.05069)		(1.534)	
US_Filing *AU_Installation	-0.00436		-0.0244	
	(0.0130)		(0.0228)	
US_Filing *AU_Expectation	-0.134		-0.0481	
	(0.437)		(0.101)	
US_Filing	-0.408		0.0221	
	(1.693)		(0.0265)	
US_Filing*CN_Production		0.0924***		0.145***
		(0.0223)		(0.0269)
US_Filing*CN_Installation		-0.00352		-6.80e-05
		(0.00988)		(0.00450)
US_Filing*CN_Expectation		0.00554		0.0274
		(0.189)		(0.141)
US_Filing		0.0212		-0.0445
		(0.217)		(0.0919)
Year fixed effects	Y	Y	Y	Y
Firm fixed effects	Y	Y	Y	Y
Observations	90	90	90	90
R-squared	0.146	0.678	0.176	0.670
Number of firms	15	15	15	15

Note: Standard errors clustered by foreign firms. *, **, *** significant at 10%, 5%, and 1%, respectively. The regressions are similar to Equation (1) and investigate patent filings in Australia and China, respectively, by the top 15 non-Chinese solar PV firms between 2002 and 2007. US_Filing indicates the annual number of patent filings in the U.S. by non-Chinese firms. AU_Production and AU_Installation are the annual Australian solar PV production and installation (both in MW), and AU_Expectation equals to 0 in 2002 to 2003, and 1

the development of solar PV in Australia in the next 25 years. AUSTL. BUS. COUNCIL FOR SUSTAINABLE ENERGY, THE AUSTRALIAN PHOTOVOLTAIC INDUSTRY ROADMAP (2004) http://www.efa.com.au/Library/David/Published%20Reports/2004/PVRoadmap.pdf. [https://perma.cc/H6Y7-TY8U] "The Roadmap" is the most important policy document related to solar PV development in Australia since the amendment to the federal Renewable Energy (Electricity) Act in 2000. Also, given that there are very few patent filings in Australia by Australian solar PV firms, we do not include another control variable, *AU_Innovation*, in our analyses here.

afterwards, to control for the expectation about the Australian market after the release of the "Australian Photovoltaic Industry Roadmap" in 2004. CN_Production and CN_Installation are the annual Chinese solar PV production and installation (in 100MW and MW, respectively), and CN_Expectation equals to 0 in 2002 to 2004, and 1 afterwards, to control for the expectation about the Chinese market after the enactment of the Chinese Renewable Energy Law in 2005. In columns (1) and (2), we use in the regressions the actual amount of annual solar PV production and installation in the two countries respectively; and in columns (3) and (4), we use their growth rates. We focus on patent filings on inventions related to solar PV cells, modules, and systems.

V. POLICY IMPLICATIONS OF PATENT CHOKEPOINTS AND POTENTIAL RESPONSES

It is clear that patent chokepoints are theoretically possible given the appropriate conditions. In particular, patent rights must coincide with manufacturing focal points. Not all manufacturing for the impacted products must be conducted in the chokepoint locale, but so long as one critical piece is there, control is possible. As a result of our study, there is now evidence to support the use of patent chokepoints by some firms. The strategy is known to firms with global reach and will likely be utilized even more extensively in the future. However, the fact that a powerful market-shaping strategy exists does not necessarily suggest a normative issue. Are there any negative consequences to global patent chokepoints?

At least two reasons for concern exist. First, patent chokepoint strategy could have supply consequences in countries with vulnerable populations. By essentially turning off the faucet with injunctive relief, patent chokepoints preclude competitor exports across the world, even in markets in which the patent owner does not compete. Some such markets may have no other source of the patented good, and any replacement may take a considerable amount of time to appear. If the waylaid good is important for health or ameliorating a harm like global warming, the temporary restriction may have a dire impact. There is a diversity of impacts that likely distinguishes an Apple iPhone from a pharmaceutical critical to public health.

Another way to look at this issue may be to put it in the context of sustainability. In other words, does the technology in question have an impact on human rights, labor rights, anti-corruption, or the environment (to note the most prominent categories[129])? If so, a heightened responsibility to manage or even eliminate the chokepoint exists. Such a categorization will not always be clear, of course, and it may be easier to take it out of the realm of legislative politics to case-by-case judicial determinations. For example, common law courts can consider equitable principles in enforcing rights even if the law calls for a remedy.

Even if one can define inappropriate global chokepoint subject matter, the legal fix is surprisingly elusive, primarily because the impact is on markets outside of the patent enforcement zone. Consider the lack of treaty protection. From an

129. *See, e.g.*, *The Ten Principles of the UN Global Compact*, U.N. GLOBAL COMPACT (Nov. 7, 2016), https://www.unglobalcompact.org/what-is-gc/mission/principles [https://perma.cc/688G-GEND].

international perspective, one naturally looks to the TRIPS agreement for relief valves for intellectual property rights.[130] With respect to patents, Article 31 of TRIPS permits compulsory licensees—essentially the elimination of injunctive relief—for a variety of reasons including national emergency or public non-commercial use.[131] However, an important limitation of TRIPS is that it does not permit compulsory licenses for exported goods. In the context of essential medicines, a work-around amendment to TRIPS was created,[132] but it is narrow and limited. If a relaxation broad enough to cover other areas of "sustainability" is to be created, TRIPS must again be revised.

As an alternative to international treaty reinterpretation or revision, one might look to altering the laws of particular individual countries that are likely to serve as chokepoints like China and India. For example, the rather light procedure that permits injunctive relief from the Customs Administration in China could be eliminated and in favor of an import-only focus like the International Trade Commission in the U.S. Such a change would not impact the existence rights and would leave enough domestic enforceability in place to satisfy international agreements. Of course, it is not clear why a country like China would accede to international pressure to change its customs law simply because it has the good fortune of serving as such an important global exporter.

A second concern is that global patent chokepoints amplify the power of the chokepoint country's patent law, along with all of its deficiencies. For example, if patents are granted too easily or too broadly, legitimate competitors may suffer. Moreover, if a chokepoint's enforcement system is inconsistent or inexperienced, the certainty that is supposed to accompany patent rights may be reduced.

VI. CONCLUSION

A global chokepoint strategy shifts the focus of obtaining and enforcing patent rights. Instead of working to exclude competition in the markets with firm access, foreign patent rights are sought specifically in countries that are major international producers and exporters, like China and India. The idea of this emerging strategy is to broadly impact competition in external markets. The empirical evidence presented in this paper demonstrates that chokepoint strategy is actually occurring. The existence of patent chokepoints is significant because if this strategy is more widely adopted, there may eventually be pricing and access impacts for important

130. *See generally* Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, 1869 U.N.T.S. 299, 33 I.L.M. 1197 (1994) [hereinafter TRIPS].

131. *Id.* art. 31.

132. *See* The General Council, *Amendment of the TRIPS Agreement*, WTO Doc. WT/L/641 (adopted Dec. 8, 2005) (containing Annex to Protocol amending TRIPS agreement). Technically, the amendment takes force only when two thirds of the WTO members approve it. The deadline for such approval has been extended to Dec. 31, 2017. *Members Accepting Amendment of the TRIPS Agreement*, WORLD TRADE ORG., (June 22, 2016), http://www.wto.org/English/tratop_e/trips_e/amendment_e.htm [https://perma.cc/FJD6-QZJZ].

health and sustainability technologies.