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How Does Stronger Patent Laws Affect Trade in Technology? Evidence from Patent Transfers in Sweden 1871-1914

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Abstract

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State-of-the-art

According to Arora, Fosfuri and Gambardella's (2001) seminal work markets for technology (MFT) can have several positive effects on economy by diffusing useful technologies and by matching producers and users. It can also provide incentives for investment in R&D and thus enhancing the rate of technological growth. Estimates for the value of the global MFT put it at \$190 billion in 2005 and Serrano (2010) has shown that 13,5% of all US patents 1983-2000 were traded. Lamoreaux and Sokoloff (1999; 2001) and Burhop's (2010) work show that there were already well-developed MFTs in the US and Germany during the 19th century and that it should be seen as an important source for technological development.

Research gap

However, although it is assumed by literature that stronger patent protection fosters trade in technology there is little data or research showing how these MFTs actually respond to changes in legislation. Data used in previous research cover only time periods within the same legal framework and thus cannot account for exogenous changes in patent law. This paper contributes to the research field by analyzing data on technology trade both before and after an important legislative change, in this case the Swedish patent law of 1884.

Theoretical framework

Markets for technology are based on a Smithsonian division of labor, in particular the division of innovative labor, usually between inventors (suppliers) and producers (buyers). It is also assumed that stronger patent protection encourage trade in technology since it makes the patents more secure and defined for the buyer while making it more

difficult for competitors to invent around it. If this trade leads to more efficient ways of allocating new technology MFTs should then be able to shift the production-possibility frontier of an economy outward using given factor inputs and thus the economy should be able to increase its output.

Method and data

The source of my data is the official statistics of the Swedish Commerce Collegii and the original manuscript records of the Swedish Patent Office for 1871-1914. In this article I use a sample of 18,631 patents and I have collected information on all patent transfers during the period. I use time-series and descriptive statistics to show the development of the Swedish MFT, measured as proportions of patents transferred. The data comes from a new and unique database that I am constructing that will contain all Swedish patents 1746-1914.

Results

My results show that patent transfers on average doubled after the new patent law in 1884, but that the effect dissipated somewhat by the end of the period. For the sub-period of 1871-1884 about 4 percent of all patents were transferred and between 1884-1914 the same number was 8 percent. Secondly, for the period 1885-1914 transferred patents on average had a lifetime twice as long as non-traded patents and most of the traded patents were kept alive the maximum time of 15 years while patents in general expired after only one year. Furthermore, I also show that actors used to markets to find technology across borders as one fourth of all transfers were between different countries. In general, my results corroborates the theory that stronger patent protection encourages patent trade, albeit perhaps not as strongly as current research suggest.

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How Does Stronger Patent Laws Affect Trade in Technology?

Evidence from Patent Transfers in Sweden 1871-1914

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Abstract*

I describe the evolution of patent transfer in Sweden 1871-1914 before and after a major legislative change, the new patent law in 1884, by using a new patent database containing 17,000 patents. On average, patent transfers, as share of patents in force, doubled under the new law, but the affect on patent trade seems to have been short term and dissipates at the end of the period. New features such as an increasing fee structure of the 1884 law functioned to separate high quality patents from patents not used. Finally, a division of innovative labor took place as transactions went from being mainly between individuals to individuals transferring their patents to firms.

INTRODUCTION

In 2012, Swedish Telecom Company LM Ericsson had net IPR revenues of SEK 6.6 billion, passing the \$ 1 billion mark (2012 years dollars)¹ representing a 43 percent growth rate over two years compared to 2010. One year earlier in 2011 Google acquired Motorola Mobility and its 24,500 patents for \$12.5 billion to “protect the Android ecosystem”². Several economic journalists has pointed out that Google’s real goal was Motorola’s patents and not its phone operations³. These examples illustrate the increased economic importance of patents and IPR over the last years and the way they are viewed and used as economic assets in what researchers call markets for technology. For the total size or value of the global market for technology (MFT) there are not as a precise numbers, but estimates however show that during

* I would like to thank Patricio Saiz and Fransisco Cayón for valuable comments regarding data sources and the fee structure of the 1884 patent law in an earlier draft of this paper presented at a seminar in the Economic History department of Universidad Autónoma de Madrid, Spain.

¹ Telefonaktiebolaget LM Ericsson, “Annual Report 2012” (2013), Stockholm, pp. 27

² The Wall Street Journal, “Google-Motorola: It’s All About the Patents”, 2011-08-15 (accessed: 2013-10-20)

³ The Economist, “Valuing patent. Doing the maths”, 2011-08-17 (accessed: 2013-10-20). Although unscientifically, in the article the journalist refers to analysts Frost & Sullivans calculation that the price per patent could be \$510,204.08 when using total aquisition sum and total patents and comparing it to earlier patent auctions.

the mid 1990s it was about \$35-60 billion⁴, around 2000 about \$90-100 billion and some put it at \$190 billion in 2005⁵. Furthermore, Carlos Serrano has showed that 13,5 percent of all US patents were transferred at least ones during their lifetime between 1983-2000⁶ demonstrating that it is a considerable phenomenon. According to Arora, Fosfuri and Gambardella's seminal work MFTs and trade in technology can have several positive effects on economic development and innovation by promoting ".../.../...*the diffusion and efficient use of existing technology and can enhance the rate of technological advance by providing additional incentives to invest in research and development*"⁷ and by improving ".../.../...*efficiency by reducing duplicative R&D and by matching technology producers and users*"⁸. However, it is not clear that ex post transactions are purely beneficial. A recent report from the Federal Trade Commission (FTC) asserts that although the possibility to enter into ex post transactions is a vital and necessary feature of the patent system's incentives to innovate there can also be detrimental effects of such transactions. There could for example be incentives for firms to hold back important patents until they are embedded in another firm's product and than assert the rights to it. If the firm using the technology is then forced to pay licensing royalties this could raise the costs for final consumers and the firm itself obtains nothing but the freedom from litigation.⁹ Since the patents licensed, transferred or sold are defined by IPR laws scholars have started to look at the effects of IPR legislation on the trade and transfer of technology and innovation. After the implementation of the TRIPS agreement at the end of the Uruguay round in 1994¹⁰ and its later amendments the issue of strong versus weak¹¹ IPR legislation has been under scrutiny by researches, but without reaching any consensus as pointed out by renowned patent and entrepreneurship scholar Josh Lerner "*[t]he impact of intellectual property rights on innovation is one of the most persistent empirical questions in the economics of technological change*"¹²

⁴ Ashish Arora and Alfonso Gambardella, "Ideas for Rent: an Overview of Markets for Technology," *Industrial and Corporate Change* 19, no. 3 (May 24, 2010): 775–803, doi:10.1093/icc/dtq022.

⁵ Carsten Burhop, "The Transfer of Patents in Imperial Germany," *Journal of Economic History* 70, no. 4 (2010): 921.

⁶ Carlos J Serrano, "The Dynamics of the Transfer and Renewal of Patents," *The RAND Journal of Economics* 41, no. 4 (2010): 686–708.

⁷ Ashish Arora, Andrea Fosfuri, and Alfonso Gambardella, *Markets for Technology*, (MIT Press, 2001).

⁸ *ibid.*

⁹ Federal Trade Commission, "*The Evolving IP Market*", 2011.

¹⁰ TRIPS: Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, THE LEGAL TEXTS: THE RESULTS OF THE URUGUAY ROUND OF MULTILATERAL TRADE NEGOTIATIONS 320 (1999), 1869 U.N.T.S. 299, 33 I.L.M. 1197 (1994)

¹¹ A strong patent system is commonly referred to as being one with more patentable domains, longer patent durations or where the patentholder has more power in lawsuits. Saint-Georgers and van Pottelsberghe de la Potterie instead argues that "applicant friendly" is a better term. See for example: de Saint-Georges, M., & Van Pottelsberghe de la Potterie, B. (2012). A quality index for patent systems. *Research Policy*; la Potterie, de, B. V. P. (2011). The quality factor in patent systems. *Industrial and Corporate Change*, 20(6), 1755–1793.

¹² Lerner, "Patent Protection and Innovation Over 150 Years." pp. 3

Although the academic interest in the topic can be seen to be fairly recent, research in economic history has showed that trade in technology can be traced back to the beginning of the industrial revolution. Lamoreaux and Sokoloff and Khan and Sokoloff have demonstrated in several articles that a market for technology existed in the US at least as early as 1836 and as much as one third of all patents are said to have been transferred¹³. Carsten Burhop in his research on Imperial Germany¹⁴ shows that the relative share of patent transfers in Germany between 1884-1913 were similar to Serrano's US numbers and Tom Nicholas has investigated Japan during the period 1885-1930¹⁵ and reaches similar conclusions about the size of the MFT in terms of patent transfers. Regarding the issue of weak versus strong IPR systems Patricio Saíz investigates patents of introduction (a policy related to weak systems) in Spain in a recent article and finds that it could have a positive effect on technology transfer.¹⁶

In this article I try to add perspectives to this debate by using patent transfer data from a new and unique database covering the Swedish patent system 1871-1914. As pointed out recently by Petra Moser history "*offers a laboratory in which researchers can explore the effectiveness of alternative remedies to problems with the current patent system*"¹⁷. I use the data to demonstrate that a market for technology existed in Sweden during both weak and strong patent systems, an indication that trade in technology was a global phenomena and not only something reserved for the larger patent markets of the US and Germany and not dependent on current IPR legislation. Unlike previous studies on German and Japanese data I show how the market for technology developed before and after a major legislative change, the Swedish patent law of 1884, which transformed Swedish patent law from a registration system with varying patent length (3-15 years) and a one-time fee, to a rigorous examination system with uniform patent length of fifteen years and an increasing annual fee structure. I demonstrate that trade in patents already existed well before the new law and that the new law seems to have had a short term positive effect but a negligible effect over the whole period in

¹³ Naomi R Lamoreaux and Kenneth L Sokoloff, "Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries," in *Learning by Doing in Markets, Firms, and Countries*, ed. Naomi R Lamoreaux, Daniel M G Raff, and Peter Temin, (University of Chicago Press, 1999), 19–60. *of Economic History*, 53(02), 289–307.

¹⁴ Burhop, "The Transfer of Patents in Imperial Germany;" Carsten Burhop and Nikolaus Wolf, "The German Market for Patents During the 'Second Industrialization,' 1884–1913: a Gravity Approach," *Business History Review* 87, no. 1 (May 16, 2013): 69–93, doi:10.1017/S0007680513000147.

¹⁵ Tom Nicholas, "Independent Invention During the Rise of the Corporate Economy in Britain and Japan," *The Economic History Review* 64, no. 3 (January 29, 2011): 995–1023; Tom Nicholas and Hiroshi Shimizu, "Intermediary Functions and the Market for Innovation in Meiji and Taishō Japan," *Business History Review* 87, no. 1 (May 16, 2013): 121–149, doi:10.1017/S0007680513000160.

¹⁶ Patricio Saíz, "Did Patents of Introduction Encourage Technology Transfer? Long-Term Evidence From the Spanish Innovation System," *Cliometrica* (March 6, 2013): 1–30, doi:10.1007/s11698-013-0094-2.

¹⁷ Petra Moser, "Patents and Innovation: Evidence From Economic History," *The Journal of Economic Perspectives* 27, no. 1 (February 2013): 23–44, doi:10.1257/jep.27.1.23.

contrast with the US and German markets. Furthermore, transactions went from an interpersonal trade to an individual-firm trade during the same period. I also show that the market was highly successful in selecting and evaluating the quality of patents (at least in economic terms) with help of the new fee structure of the 1884 law. A significant proportion of the traded patents 1885-1914 were kept alive for the maximum of fifteen years. For the whole period transferred patents in general had a longer lifetime.

IS STRONGER BETTER?

In regards to MFTs Gambardella et al claim that stronger patent protection should encourage technology licensing since it makes it more difficult to invent around the patent and reduces transactions costs¹⁸. Lee Branstetter has shown that technology transfers increase between US corporations and their affiliates with stronger IPR legislation, however this transfer regards intra firm and are not market transactions¹⁹. Ryuhei Wakasugi and Banri Ito reach the same conclusion using Japanese firm-level data²⁰. On the other side of the argument however we find researchers who suggest that stronger IPR rights have a negative impact on innovation and transfer of technology. Sadao Nagaoka investigates licensing contracts of Japanese firms and find that strong IPR could reduce technology transfers and raise costs²¹. In more general terms of innovation, Kausik Gangopadhyay and Debasis Mondal build on Grossman and Helpman's theories to show how stronger IPR protection not always stimulate innovation. They reach the conclusion that strong IPR protection may have a negative impact on the diffusion of knowledge and researchers' possibilities to use prior discoveries.²² Finally there is also the far end of the negative spectrum where economic scholars such as Michelle Boldrin and David Levine advocates strongly in several publications for the reform of intellectual property law or even its abolishment. As a first step they propose to phase in

¹⁸ Alfonso Gambardella, Paola Giuri, and Alessandra Luzzi, "The Market for Patents in Europe," *Research Policy* 36, no. 8 (January 1, 2007): 1163–1183, doi:10.1016/j.respol.2007.07.006.

¹⁹ Lee G Branstetter, Raymond Fisman, and C Fritz Foley, "Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence From U. S. Firm-Level Panel Data," *The Quarterly Journal of Economics* 121, no. 1 (February 1, 2006): 321–349.

²⁰ Ryuhei Wakasugi and Banri Ito, "The Effects of Stronger Intellectual Property Rights on Technology Transfer: Evidence From Japanese Firm-Level Data," *The Journal of Technology Transfer* 34, no. 2 (November 25, 2007): 145–158, doi:10.1007/s10961-007-9073-8.

²¹ Sadao Nagaoka, "Does Strong Patent Protection Facilitate International Technology Transfer? Some Evidence From Licensing Contracts of Japanese Firms," *The Journal of Technology Transfer* 34, no. 2 (December 11, 2009): 128–144, doi:10.1007/s10961-007-9071-x.

²² Kausik Gangopadhyay and Debasis Mondal, "Does Stronger Protection of Intellectual Property Stimulate Innovation?," *Economics Letters* 116, no. 1 (July 2012): 80–82, doi:10.1016/j.econlet.2012.01.006.

shorter patent durations²³. Even renowned patent scholars as Adam Jaffe and Josh Lerner has reach the conclusion that the modern US patent system needs a reform to not be a hindrance to innovation.²⁴

As can be seen by this short overview of the research field there exists some common understanding that MFTs and trade in technology are important. However, the opinions regarding if strong versus weak (or no) IPR protection is the best way to promote it does not show any tendency to agreement. Even though the TRIPS agreement introduced considerable changes to IPR legislation in the WTO it is hard to compare to changes taking place during the end of 19th century. As an example of how diverse patent legislation was Table 1 shows a contemporary comparison between Sweden and other industrialized countries.

TABLE 1
Comparison between different national patent systems in 1884

Country	Examination type	Application cost (SEK)	Max cost (SEK)	Working clause	Max Patent Time
USA	Strong	133	133	None	17
France	None	72	1080	Within 2 years	15
Great Britain and Ireland	None	73	2772	None	14
Belgium	None	7	1512	Within 1 year	20
Sweden	None	100*	144	Within 2-4 years	15
Germany	Strong	45	4770	Within 3 years	15
Austria-Hungary	None	58	1761	Within 1 year	15
Denmark	None	34	34	Within 1 year	10
Norway	Weak	40	40	Within 2 years	10
Italy	None	36	1080	Within 1-2 years	15

Source: Andrée (1888)
*This is an average based on the average patent length of 6.3 years. Administrative costs were SEK 69 plus SEK 5 per year granted

To my knowledge the only available historical analysis of MFTs covering different IPR legislations is Zorina Khan's article *Selling Ideas* from 2013²⁵ where she concludes that there are a positive correlation between stronger IPR and patent assignments. Apart from that the only indication of an effect of stronger patent legislation on trade in technology, measured as

²³ Michele Boldrin and David Levine, "The Case Against Intellectual Property," *The American Economic Review* 92, no. 2 (2002): 209–212; Michele Boldrin and David K Levine, "The Case Against Patents," *The Journal of Economic Perspectives* 27, no. 1 (January 1, 2013): 3–22.

²⁴ Adam B Jaffe and Josh Lerner, *Innovation and Its Discontents*, (Princeton University Press, 2004).

²⁵ B Zorina Khan, "Selling Ideas: an International Perspective on Patenting and Markets for Technological Innovations, 1790–1930," *Business History Review* 87, no. 1 (May 16, 2013): 39–68, doi:10.1017/S0007680513000135.

trade in patents, is Lamoreaux and Sokoloff's assertion that patent assignments "boomed"²⁶ after the 1836 US patent law and that secure property rights are essential if markets for technology are to emerge and Burhop's note that the German patent law of 1877 "likely fostered the development of a market for technology"²⁷.

INSTITUTIONAL AND HISTORICAL BACKGROUND

Similar to other countries in North Western Europe, Sweden experienced a wave of industrialization during the second half of the 19th century. The period is often referred to as the second industrial revolution, the first taking place in England in the end of the 18th century. This development is often credited to the many large industrial companies that were founded during this period. These industrial companies that still today make out a large base of Sweden's economy were to a large degree based on inventions made by single inventors that used the patent system in one way or another. The before mentioned LM Ericsson were one of them, but others include multinational firms such as ASEA (Today ABB), Alfa Laval, Nobel and AGA (for more examples and their US patenting see Ivo Zander's extensive work²⁸). If patents can be seen an indicator for economic activity²⁹ then by looking at the increase in patenting following the new patent law in 1885, it is indeed clear that economic activity in Sweden increased significantly compared to earlier periods (see Figure 2). Figure 2 also shows that Sweden has had a long history of openness and internationalization. Foreign patenting in Sweden during 1870-1914 was consistently around 50 percent. This shows that Sweden was an important enough consumer market for contemporary technology leaders such as Germany and the US to want to take out a patent.

²⁶ B. Zorina Khan and Kenneth L. Sokoloff, "Patent Institutions, Industrial Organization, and Early Technological Change: Britain and the United States, 1790-1850," in *Technological Revolutions in Europe: Historical Perspectives*, ed. Maxine Berg and Kristine Bruland (Cheltenham, UK: Edward Elgar,

²⁷ Burhop, "The Transfer of Patents in Imperial Germany."

²⁸ Ivo Zander, "The Tortoise Evolution of the Multinational Corporation : Foreign Technological Activity in Swedish Multinational Firms 1890-1990," (Institute of International Business (IIB), Stockholm School of Economics, 1994).

²⁹ Zvi Griliches, "Patent Statistics as Economic Indicators: a Survey," in *R&D and Productivity: the Econometric Evidence*, ed. Zvi Griliches, (University of Chicago Press, 1998), 287-343.

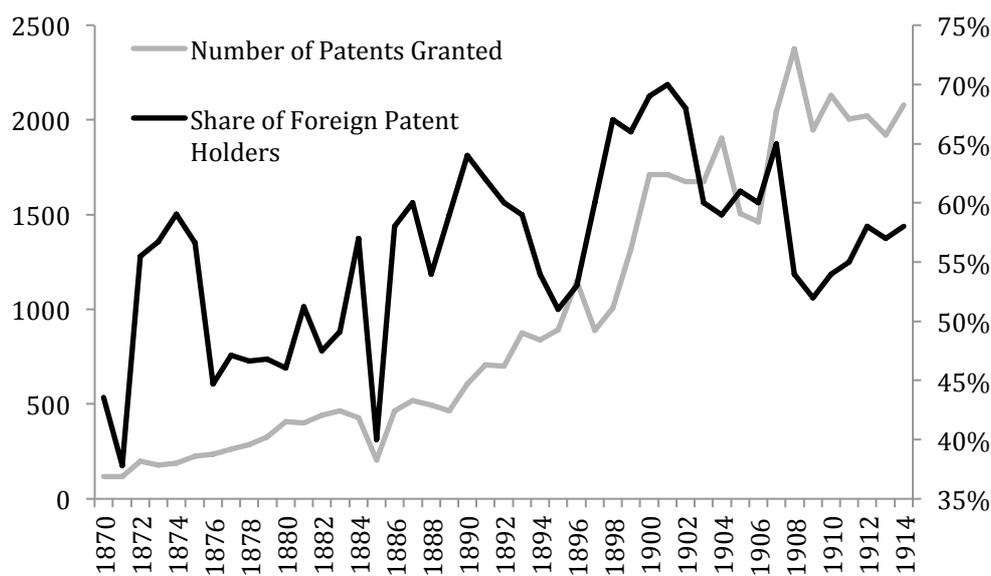


FIGURE 1
Patents Granted and Share of Foreign Patent Holders,
Source: PRV, Patent register & Kommerskollegium

In relative terms this was also a period of catching up for Sweden. Figure 2 shows patenting per capita for a number of countries and as can be seen from very low numbers Sweden early on passed Germany and reached the same levels as the US and Britain after the turn of the 20th century. Only Japan could match Sweden in patenting growth rate, as both experienced an 800 percent increase in patenting between 1885 and 1904³⁰. This number is consistent with Nicholas and Shimizu's findings concerning Japan's development³¹. All together, the period around 1880-1910 was a breakthrough for Swedish growth that in many ways laid the foundation for contemporary Swedish welfare. For example GDP growth 1890-1910 in Sweden were higher (2,4 %) than both the US (2,0 %) and Japan (1,4 %) during the same time³².

³⁰ Tisell, H. G. (1907). Internationell patentstatistik för åren 1885-1904.

³¹ Nicholas, T., & Shimizu, H. (2013). Intermediary Functions and the Market for Innovation in Meiji and Taishō Japan. *Business History Review*, 87(01), 121–149. 130.

³² Sweden 2,4%; Other Nordic countries 1,7%; UK 0,9%; Rest of Europe 1,4%; North America 2,0%; Japan 1,4 % (annual GDP growth rates) Data from Maddison (1995) in Schön, L. 1. (2000). *En modern svensk ekonomisk historia : tillväxt och omvandling under två sekel*. Stockholm : SNS förlag, pp. 223.

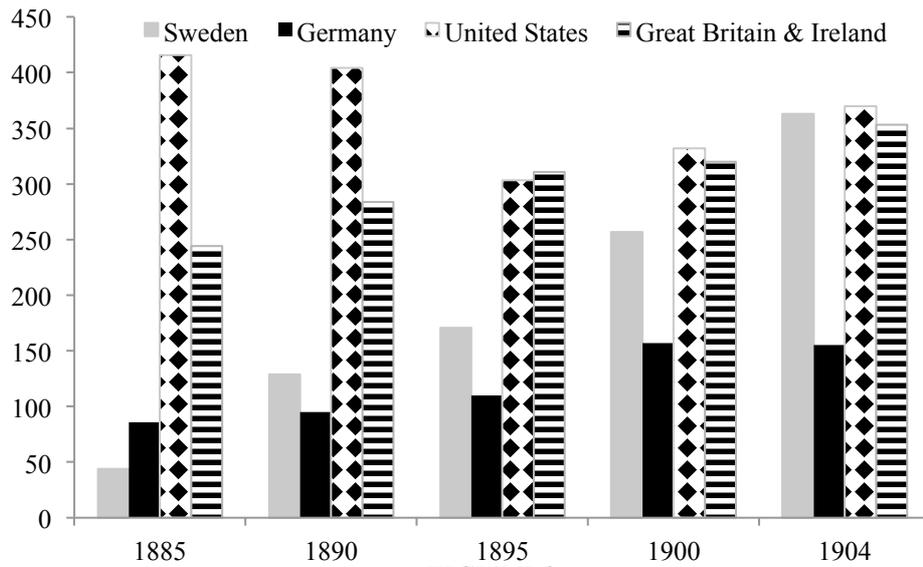


FIGURE 2
Patents per million inhabitant, 1885-1904
Source: Tisell (1907)

Patent protection in Sweden has its origins in a 1668 law concerning *privilegia exclusiva*, however between 1781-1819 there is no existing evidence that any such privileges were granted. A new law regarding *privilegia exclusiva* was enacted in 1819 and was later replaced by the first Swedish patent law in 1834. The law of 1834 was then replaced by the patent law of 1856, which was the law in force for the first third of my data, 1871-1884. According to the law of 1856 patents were to be granted by *Commerce Collegii*, the Swedish government for foreign trade and trade policy. When discontents with the 1856 law started to materialize the Swedish government appointed a committee in 1877 to investigate whether or not patent protection were needed and in the best interest of the country, and if so draw up the outlines for a new law. The committee presented its report to government in 1878 and on basis of that a proposition was presented to the parliament in 1884 and the law was issued on the 16th of May the same year and came into effect January 1, 1885.

TABLE 2
Comparison between the 1856 and the 1884 patent laws

	Type of System	Patents of Introduction	Patent time	Cost (SEK)	Working clause	Fee structure
Law of 1856	Registration	No	3-15 years	69-144	Yes: 2-4 years	Application fee only
Law of 1884	Examination	No	15 years	75*-800	Yes - until 1902, from 1902 compulsory licensing	Year 1-5: 25 SEK Year 6-10: 50 SEK Year 11-15: 75 SEK

Source: Andrée (1888) and Stockholms Patentbyrå (1928)

The most important differences between the 1856 and 1884 laws are shown in table 2 and were the introduction of a rigorous examination system and an increasing fee structure. In connection with the new law a special bureau, The Royal Patent Bureau, was created to process the patent applications. In 1895 it was restructured into the agency that is now the Swedish Patent Office. Besides the examination of patents the patent office now also had the possibility to reject applications without any examination if it was obvious that the invention was not new. From new patent law included, just as the old one, a working clause that could stipulate the patent holder to show proof of the patent's use within three years or it could render the patent invalid. This working clause was changed in 1902 and turned into a compulsory licensing clause, which meant that failure to use a granted patent could not render it invalid, but instead force a licensing agreement if other actors wished to use the patent³³. The next major difference from earlier patent laws was a new cost structure. Earlier laws had only had a application cost and an additional fee for every year of patent time granted. As can be seen in table 2 in 1856 the cost of the application was SEK 69 and with the maximum patent time of 15 years the maximum cost could be SEK 144. This sum was to be paid in whole when the patent was granted.

The law of 1884 stipulated that the application fee was set to SEK 75, but that the patent holder then had to pay a annual fee to keep patent in force. The fee structure was divided in three levels: SEK 25 for year 1-5, SEK 50 for every year 6-10 and SEK 75 for every year until the fifteenth, which still was the maximum patent time. As such, to keep a patent in force for the maximum of fifteen years in 1914 cost SEK 800. According to official Swedish statistics this equals about SEK 35,000 in today's nominal terms³⁴. In comparison, to keep a patent in force for the same time period today cost approximately SEK 37,000³⁵.

DATA SOURCES

I have collected data on patent transfers from two different sources for the years 1871-1884 and 1885-1914³⁶ in total 17,000 patents. However, the data indicates that transfers of patents have been a feature of the patent system even from the very first patent law of 1834³⁷. For the

³³ Stockholms patentbyrå, "Grunddragen av det industriella rättsskyddets utveckling i Sverige under de senaste 50 åren", 1928.

³⁴ SCB, Historical prices, <http://www.scb.se/Prisomraknaren> (accessed 2013-10-20)

³⁵ PRV, Fees and Payment, <http://prv.se/en/Patents/Fees-and-payment/> (accessed 2013-10-20)

³⁶ The data used for this article comes from a larger empirical project involving the digitalization and construction of a complete historical patent database for Sweden for the period 1746-1914, which will include all 45,000 patents granted during the period along with all available micro data. Data on intermediaries in the patent market from the same dataset has been presented in Andersson and Tell (2013).

³⁷ Share of patent transfers for 1843-1845 are 10 percent although the actual number of patents are negligible

first period the source is *Bidrag till Sveriges officiella statistik d) Fabriker och Manufaktur* published by *Commerce Collegii*. This register, published annually, includes all patents granted during a specific year and includes the name of the patent holder, their occupation, patent time, short description of the invention and also if the patent were transferred. However, there is reason to believe that the transfer data from this publication is not complete due to the nature of its publication. As is still the case with national accounts today, the statistics were published with a lag of about a year (data for 1870 was published 1871 and so forth). This means that only transfers registered with the *Commerce Collegii* within a time period of more or less a year, depending on the grant date of the patent, were registered as transfers in the official publication. As such, information on patent transfers after more than a year should not be considered complete. Data from Germany shows that about 70 percent of all transfers occurred after the first year after issue³⁸. As such this data most likely underestimates the amount of patent transfers from the first sub-period.

Patent transfer data for the period 1885-1914 comes from the original manuscript records of the Royal Swedish Patent Office's patent register. With the new patent law of 1884 PRV took over the responsibilities of producing and keeping statistics over registered firms and patents and did so by keeping an updated register of all patents in force. This patent register consists of large liber volumes where information about all granted patents was registered and updated as long as the current patent holder paid the annual patent fees. It contains information on all owners of the patent, their name, profession, residence, legal status, patent fees paid and more. For this period, due to data collection I use a full sample for 1885-1892 and a 1/3 sample for the remaining years³⁹.

There are some issues regarding patent transfer data that need to be taken into consideration. These also apply to the Swedish data. First, all transfers were not the result of an economic arm's length transaction, but some were of more administrative or legal nature such as a change of a firm's legal form. However, in this case patents could also have played an important role as a sign of the value and innovativeness of the firm. I have followed their lead and coded these as transfers. There is also the risk that some patents were transferred as result of inheritance.

There is also the question of the economic value of patents. In this article I measure patent quality simply as the amount of years that the patent holder chose to pay the annual fee.

³⁸ Burhop, "The Transfer of Patents in Imperial Germany."

³⁹ Nicholas uses a similar sampling in: Nicholas, "Independent Invention During the Rise of the Corporate Economy in Britain and Japan." pp. 1002.

However, this is only possible for the period 1885-1914. For the earlier period no good proxy is available except the fact that transferred patents obviously were of high enough value to the acquiring party in the transaction.

Another shortcoming of the data is that, since the Swedish patent law did not, in contrast to the American, demand that only the true and first inventor could register a patent, ownership changes made between the time of the invention and the patent application cannot be traced in the patent register. However, as Burhop points out regarding the German data⁴⁰, this also means that inventions made and patented by firm employees are probably not registered as transfers in the same degree as in the US, which makes the transfers in the Swedish data a more accurate measure on actual business transfers.

PRELIMINARY ANALYSIS

During the investigated period 7 percent of all granted patents in my sample of 18,631 patents were transferred at least once. For the sub-periods representing one weak IPR legislation and one stronger the same transfer rate was 3.6 and 8.1 from 1871-1884 and 1885-1914 respectively. First of all, it is difficult to do country comparisons during this period. As can be seen in Table 1 patent legislations were highly heterogeneous. Even after the law of 1884, fee structure, costs and working clauses differed in comparison with the US and Germany. However, my data shows that trade in technology was indeed a global phenomenon already during the 19th century and was well developed even in smaller markets such as the Swedish one. The Swedish transfer rates are close to the current US market (13.5 percent) and that of the German (8.3 percent) and Japanese (14 percent) markets during the end of the 19th century. Regarding historical US data however one must be careful which measure to use when comparing. According to Lamoreaux and Sokoloff many US assignments were not complete transfers, but the patentee often maintained a stake in the patent. If considering only cases where the patent holder relinquished his stake in the patent the average transfer rate for the US during 1870-71, 1890-91 and 1910-11 is 13.9 percent⁴¹. However, considering that all US patents were valid for 17 years and both Sweden and Germany introduced an annual fee system one could question how comparable these rates are.

As can be seen in figure 3 the evolution of patent transfers in Sweden over the whole period shows considerable fluctuations, with peaks in 1891-1892 when over a fifth of all patents were transferred. Furthermore, in the end of the investigated period the share of patent

⁴⁰ *ibid.* pp. 924

⁴¹ Lamoreaux and Sokoloff, "Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries." pp. 28

transfers diminished and reached levels similar to that of the early 1870s. This is interesting for two reasons. First, considering the possibility of a potential downward bias in the first sub-period it is clear that strong patent protection was not a prerequisite for technology trade to occur. Actors in the technology market were obviously well equipped to both find and evaluate the quality of patented inventions.

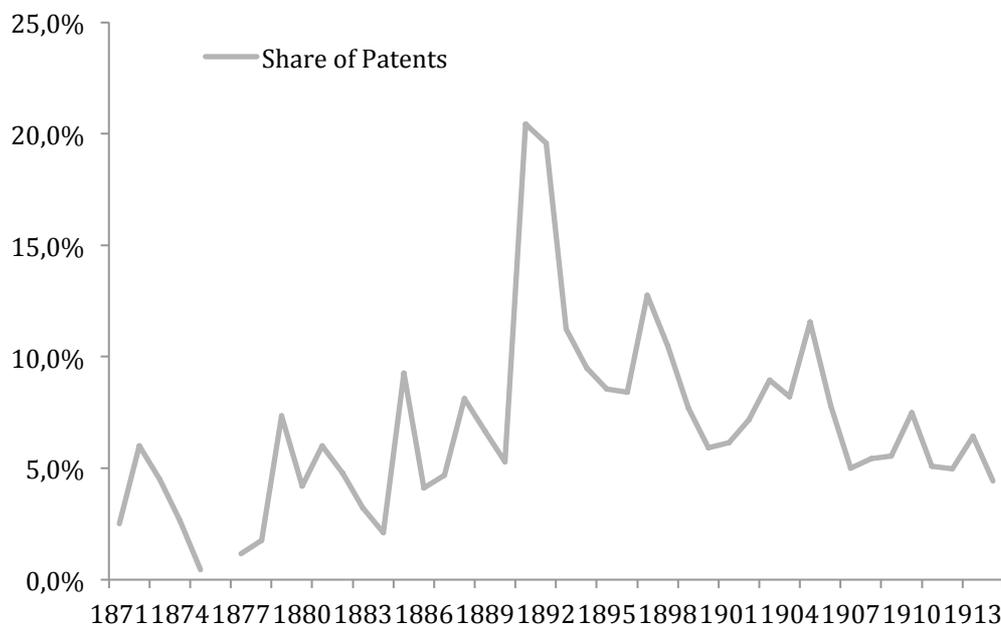


FIGURE 3

Patent Transfers in Sweden 1871-1914

Source: PRV, patent register & Kommerskollegium and author's own calculations

The transfer data also shows that for both sub-periods transferred patents were of higher quality when measured as years of patent life (see figure 4). Although, considering the changes in the patent law the periods are not directly comparable. Between 1871-1884 the patent duration was decided by the *Commerce Collegii* based on an estimation of the importance of the invention made by the government officials. Even so, patents considered more “important” were also traded more frequently even though the difference is not a large one. The introduction of the new patent law with its examinations of the applications and the annual patent fee however clearly separated high quality and economically valuable patents from lesser ones⁴². Most of the transferred patents were kept in force for the maximum of 15 years, while most patent holders in general did not even pay the first annual fee letting the patent expire after only one year. This feature of transferred patents is interesting if you consider Boldrin and Levine’s wish to phase out patent durations. In general, there is reason

⁴² Although I do not have data on transactions prices of the Swedish transfers Nicholas (2013:125) show that similar patents transferred in Japan during the same time had an average value of \$102,000. See footnote 4 for a contemporary comparison.

to question whether any trade in technology would occur if patent durations were lowered significantly. The buyers in the transaction obviously paid a premium for the remaining time of patent protection. Also, having a annual fee probably helped

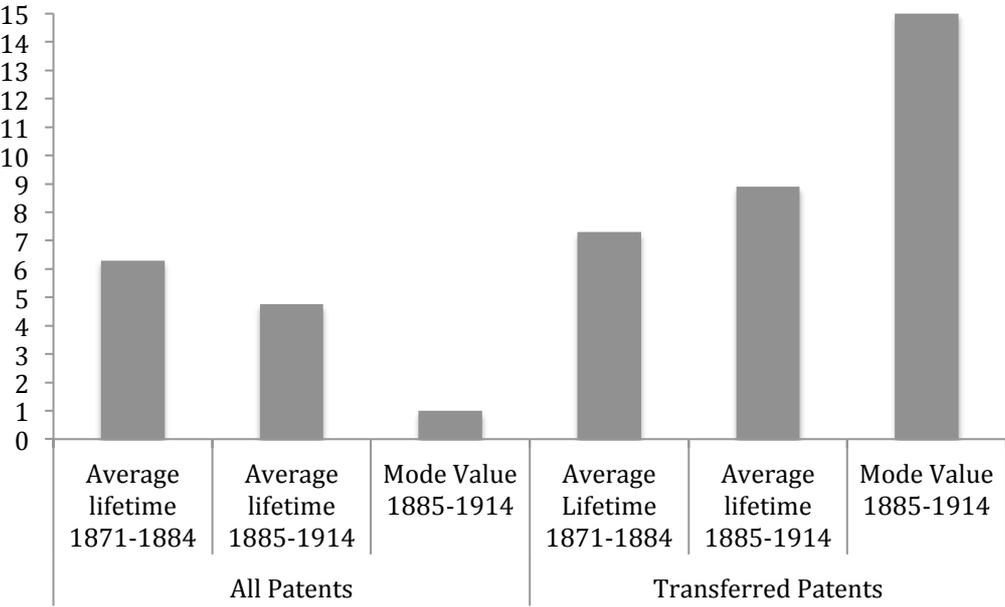


FIGURE 4

Source: PRV, patent register & Kommerskollegium and author's own calculation

Another important change also reflected in the patent transfer data is the growing importance of firms in patenting. Table 3 shows how the pattern of patents transfers changed from being an intra-personal trade to one between individuals and firms. In the first sub-period all transferred patents were patented by individuals and 58 percent were transferred to other individuals while during the second period 87 percent of the transfers originated with individuals, but 78 percent ended up in firms.

TABLE 3
Individual vs firm transfers

	From/to	Firm	Individual	Total
1871-1884	Firm	-	-	-
	Individual	42%	58%	100%
	Total	42%	58%	100%
1885-1914	Firm	11%	2%	13%
	Individual	67%	20%	87%
	Total	78%	22%	100%

Source: PRV, patent register & Kommerskollegium and author's own calculations

PRELIMINARY CONCLUSIONS

My results show that patent transfers on average doubled after the new patent law in 1884, but that the effect dissipated somewhat by the end of the period. For the sub-period of 1871-1884 about 4 percent of all patents were transferred and between 1884-1914 the same number was 8 percent. Secondly, for the period 1885-1914 transferred patents on average had a lifetime twice as long as non-traded patents and most of the traded patents were kept alive the maximum time of 15 years while patents in general expired after only one year. Thirdly, during the period transfers went from being of an individual-to-individual type to a more specialized division where inventions were transferred from inventors to firms. Transferred patents furthermore originated from individual inventors almost exclusively. In general, my results seem corroborate the theory that stronger patent protection encourages patent trade, albeit perhaps not as strongly as current research suggest. IPR can be an important source of revenues for firms today and it was probably an important source of revenue for individual inventors during the 19th century where a market for technology clearly existed in Sweden long before the stronger IPR legislation of 1884 (and certainly before that of the TRIPS agreement). However, the new fee structure seems to have made it easier to separate valuable patents from others. Based on these results, weaker patent protection that has been suggested, such as lowering patent duration would probably result in less transfer of patents and technology trade.

LIMITATIONS AND FURTHER RESEARCH

This paper only presents the first empirical results from the construction of a new patent database for Sweden 1746-1914. As such in this paper I mainly use aggregated macro data and 1/3 samples of several years. As a result, only 17,000 patents are used whereas the full database will contain all 45,000 patents. Furthermore, a more rigorous statistical analysis is needed. As more detailed micro level data becomes available a full micro oriented statistical analysis will be performed on how the new patent law of 1884 affected both patent transfers and innovation in Sweden.

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