

The market for patents in Sweden: past and present

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ABSTRACT

The worldwide revenues from the sale and licensing of patents have soared into the hundreds of billions of dollars in recent years. Consequently, the market for patents has become an important strategic option for firms to stay competitive, both by allowing them to leverage their own intellectual property rights (IPR), but also as a way of accessing important external technology. This article analyzes markets for patents in Sweden past and present by presenting and examining data on the market for patents in the 19th century as well more recently available data. We show that the origins of technology trade can be traced back to the 18th century and that an active national market for patents emerged by the end of the 19th century where intermediaries such as patent agencies and specialized marketplaces helped to broker deals between buyers and sellers of inventions. By contrast, today the domestic Swedish markets for patents is relatively insignificant, but Swedish firms instead act on international markets for patents. More firms are active on the demand side than on the supply side of the market, which indicates that the impact of a few large firms on the aggregate number is potentially large.

1. INTRODUCTION

On December 10, 2018 William D. Nordhaus and Paul M. Romer were awarded the Sveriges Riksbank Prize in Economic Sciences. Nordhaus for his work on climate change and Romer for his endogenous growth theory. What is perhaps less known is that Nordhaus early in his career

also worked on an endogenous theory of economic growth.¹ Even less known to the general public is probably that Nordhaus placed patents in the center of his analysis and that he probably was the first to introduce patent length as a parameter in patent policy design.²

In Nordhaus' model of invention, he stressed that inventions are produced within the economic system, that any invention is potentially an indivisible public good, and that an inventor is given a monopoly over the invention (i.e. a patent). In his analysis, he followed Schmookler's work concerning the role of the economic forces of the market as determinants of inventive activity.³ However, Nordhaus emphasized how what he denoted "markets for invention" create incentives for technological change. According to Nordhaus, the royalty each invention receives in the market, relative to general market price, induces technological change.⁴ Accordingly, this analysis puts markets for technology (MfT) at the center of economic growth as an important mechanism through which economic activity can determine inventive activity. Such a conception requires that inventions (equated with patents) can be traded or licensed on a market and royalties can be earned. In this paper, we ask questions about markets for patents in Sweden by looking at how these markets have emerged and evolved in Sweden. How did and do markets for patents function in Sweden? Who have been the main actors on markets for patents? What are the conceived effects of markets for patents, and what effects can be discerned in Swedish markets for patents?

The article presents an overview of markets for patents in Sweden, past and present. The aim is threefold. First, we aim to provide an overview of the theory of markets for technology, considering markets for patents a sub-category of such markets. Second, the article aims to provide empirical evidence of patent markets in the Swedish context by making use of data collected from the Swedish

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¹ William D. Nordhaus, *Invention, Growth and Welfare: A Theoretical Treatment of Technological Change* (MIT Press, 1969).

² William D. Nordhaus, "The Optimal Life of a Patent," Cowles Foundation Discussion Papers [Cowles Foundation for Research in Economics, Yale University, November 1967], <https://ideas.repec.org/p/cw/cwldpp/241.html>. copyright and related rights in the

information society ('Infosoc Directive').

³ Jacob Schmookler, *Invention and Economic Growth* (Harvard University Press, 1966).

⁴ More formally, Nordhaus stated that assuming that inventions are technically independent, i.e. the contribution to total productivity (A) per invention does not depend on whether other inventions are used, the i th invention contributes to total productivity by ΔA_i . If this holds, then the royalty of the i th invention (s_i) as a proportion of the market price is equal to the ratio of the change in productivity due to the i th invention such that: $s_i/p = \Delta A_i/A$.

⁵ Nordhaus used the term "markets for invention".

⁶ Ashish Arora, Andrea Fosfuri, and Alfonso Gambardella, *Markets for Technology: The Economics of Innovation and Corporate Strategy* (MIT Press, 2001); A. Arora and A. Gambardella, "Ideas for Rent: An Overview of Markets for Technology," *Industrial and Corporate Change* 19, no. 3 (June 1, 2010): 775–803, <https://doi.org/10.1093/icc/dtq022>.

⁷ Henry William Chesbrough, *Open Innovation: The New Imperative for Creating and Profiting from Technology* (Boston, Mass: Harvard Business School Press, 2003);

National archive (Riksarkivet) as well as the archives of the Swedish Patent Office (PRV) and by providing historical and contemporary examples of how these markets were used. Our third aim is to point out directions for future research on markets for technology and markets for patents.

The article continues as follows: section 2 lays out the theoretical arguments regarding the existence and functioning of MfT. Section 3 traces the origins of patent trade in Sweden back to the 18th century and ends with current empirical observations of the Swedish market for patents. Section 4 concludes and presents directions for future research.

2. MARKETS FOR TECHNOLOGY

MfT, that is, trade in technology disembodied from physical products, have received increased attention by scholars during the last 15 years due to their effects on industry structure and corporate strategy.⁶ By stimulating trade in intellectual resources, property rights and ideas, MfT open up industries, especially knowledge-based ones. There are parallel discussions, both internationally and in Sweden, in spread of the open innovation paradigm, which argues for increased technology trade and external knowledge acquisition by firms.⁷ One of the main determinants of this development is widely seen to be the emergence of intellectual property rights (IPR), such as patents, which enables the separation of the intangible (the technology) from the tangible (the product) and makes it possible for economic forces of supply and demand to act upon this type of property.⁸ Technology trade thus allows for increasing economic efficiency by reallocating property rights to actors who are betting at commercializing the technology because of their better access to complementary assets. Akcigit et al emphasize this role of MfT in “correcting the misallocation of ideas across firms”

and that MfT also may influence firms’ R&D decisions.⁹ In this way, such markets are conducive for specialization of inventive activity as productive inventors may profit from their inventions through the market.¹⁰ This type of specialization in invention does not take place within internal R&D labs of large firms, but through the use of property rights provided by the patent system to furnish an active market.

MfT can also stimulate the diffusion and use of existing technologies. Codification of technology into an intellectual property right (IPR), for instance a patent, implies that it will be easier for both buyers and suppliers to make use of new inventions and technology through licensing. In these markets, several actors are active: firms, inventors who buy and sell their inventions and ideas, as well as intermediaries who facilitate technology transactions. The potential welfare effects have been estimated to be large. Akcigit et al find that a shutdown of MfT would decrease economic growth in the US, while a situation where each seller matches with a perfect buyer has the potential to increase the growth rate of the economy by up to 50 percent conjoint with significant welfare improvements.

While the notion of MfT has made it possible to investigate the effects of such markets, critical voices have been raised regarding MfT status as proper markets.¹¹ The interactive nature of the innovative process from conception to marketable product calls for further investigation of different subsets of MfT, and who are acting in such submarkets. This feature points to the diversity of MfTs and what type of marketplaces can facilitate technology trade, where Akcigit et al note that “[t]o date, online intellectual property platforms have failed to arbitrage the market.”¹² Instead, these authors emphasize the role of the patent agents in MfTs, since patents are often sold and bought through intermediaries due to the sensitivity of IPR.

Ove Granstrand, “The Economics and Management of Technology Trade: Towards a pro-Licensing Era?,” *International Journal of Technology Management* 27, no. 2–3 (2004): 209–240; Nicolette Lakemond and Fredrik Tell, eds., *Öppen Innovation: I Teori Och Praktik* (Lund: Studentlitteratur, 2016).

⁸ Alfonso Gambardella, Paola Giuri, and Alessandra Luzzi, “The Market for Patents in Europe,” *Research Policy* 36, no. 8 (October 2007): 1163–83, <https://doi.org/10.1016/j.respol.2007.07.006>; D. F. Spulber, “HOW PATENTS PROVIDE THE FOUNDATION OF THE MARKET FOR INVENTIONS,” *Journal*

of Competition Law and Economics 11, no. 2 (June 1, 2015): 271–316, <https://doi.org/10.1093/joclec/nhv006>; Gaétan de Ras-senfosse, Alfons Palangkaraya, and Elizabeth Webster, “Why Do Patents Facilitate Trade in Technology? Testing the Disclosure and Appropriation Effects,” *Research Policy* 45, no. 7 (September 2016): 1326–36, <https://doi.org/10.1016/j.respol.2016.03.017>.

⁹ Ufuk Akcigit, Murat Alp Celik, and Jeremy Greenwood, “Buy, Keep, or Sell: Economic Growth and the Market for Ideas,” *Econometrica* 84, no. 3 (2016): 982, <https://doi.org/10.3982/ECTA12144>.

¹⁰ Naomi R Lamoreaux and Kenneth L Sokoloff, “Market Trade in Patents and the Rise of a Class of Specialized Inventors in the 19th Century United States,” *American Economic Review* 91, no. 2 (May 2001): 39–44, <https://doi.org/10.1257/aer.91.2.39>.

¹¹ Joshua S. Gans and Scott Stern, “Is There a Market for Ideas?,” *Industrial and Corporate Change* 19, no. 3 (June 1, 2010): 805–37, <https://doi.org/10.1093/icc/dtq023>.

¹² Akcigit, Celik, and Greenwood, “Buy, Keep, or Sell,” 947.

Although there has been a surge in the research on MfT following the influential publication of *Markets for Technology: The Economics of Innovation and Corporate Strategy* by Ashish Arora, Andrea Fosfuri, and Alfonso Gambardella,¹³ neither the term in itself nor the empirical phenomenon are new to the world or to economic research. An early and influential study of the market for technology licenses was the one by Caves et al.¹⁴ Caves et al identified several of the market imperfections addressed by recent research and they also lay out a framework for analysis of technology markets in identifying some of their most important characteristics. The authors summarize salient features as “small-numbers bargaining”, “impacted information and opportunism”, “uncertainty”, “risk aversion” and “transaction costs”.¹⁵ The interaction of these characteristics causes imperfections in MfTs, and make them susceptible to market failures.

Since the mid-1990s, scholars concerned with the economics of innovation have paid increasing attention to the now pervasive phenomenon of technology licensing and the selling and buying of IPR, most commonly patents.¹⁶ In their review of the field Arora and Gambardella point out that this research was prompted by two factors.¹⁷ First, the apparent paradox that despite the notion that continued specialization has been a major source for economic growth during the 20th century, many industries were characterized by internalization of innovation in large firms. Second, the increasing opportunities for unbundling technology from physical goods and products through the use of IPR.

In Figure 1 we disentangle some concepts used in the discourse on MfT (shaded in the figure) and present an overview of the research field. We view MfT as an umbrella term that consists of different kinds of markets for the trade of technology and ideas. Sometimes the concepts *Market for Ideas* or *Markets for Innovation* are used interchangeably with MfT. In this article we zoom in on markets for IPR and more specifically on markets for patents, where the commodity or asset being transacted on this market is patents. Just as the concept of MfT includes many different types of “goods”, it can also include a variety of different types of transactions.¹⁸ In terms of patents the two most common types of transactions are patent transfers and patent licensing.¹⁹ In the first case, the patent is fully or partially transferred by the original owner to a buyer. In the case of a licensing contract the licensor (owner) gives the licensee (buyer) a temporary right to use the patented invention under various pre-determined conditions such as royalty fees to be paid, either for a fixed sum or as a percentage of revenues attributable to the licensed patent. Cross-licensing, when two or more actors grant a license to each other in exchange for one or more patents that each actor owns, is also common in MfT. Lastly, patents can be used as security in financial transactions, which may help the inventor to raise necessary capital for production or commercialization.²⁰ Furthermore, transactions can be either horizontal or vertical.²¹ Horizontal transactions refer to transactions between already established producers in an industry and vertical transactions represent the transfer of a technology from an upstream producer/supplier who does not have any commercial interests in the downstream product market.

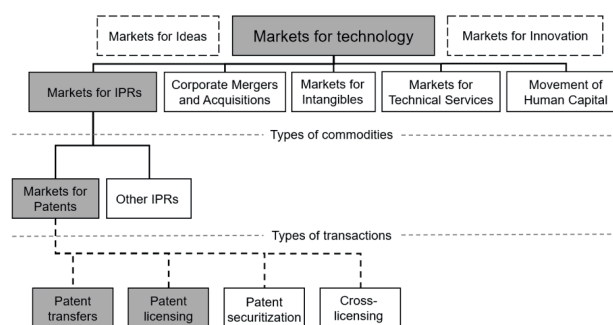


Figure 1: Overview of markets for technology and markets for patents

3. MARKETS FOR PATENTS IN SWEDEN IN THE 19TH CENTURY

The shaded parts of Figure 1 above also contextualize the article empirically as we move from theory to data. In the following two sections we present data on the markets for patents in Sweden, focusing on patent transfers and licensing, but with an emphasis on patent transfers. The historical data is based on a newly constructed database consisting of all granted Swedish patents and privileges 1819-1914.²² In addition to detailed information on patent characteristics, inventors and patentholders, the database also contains information on around 5,000 patent transfers. Along with digitized data from Swedish industry journal *Norden* we use this data to show how a marketplace for inventions was created in Sweden at the turn of the 20th century. Following this, we move to the present to show the development of markets for patents in Sweden 1990-2017.

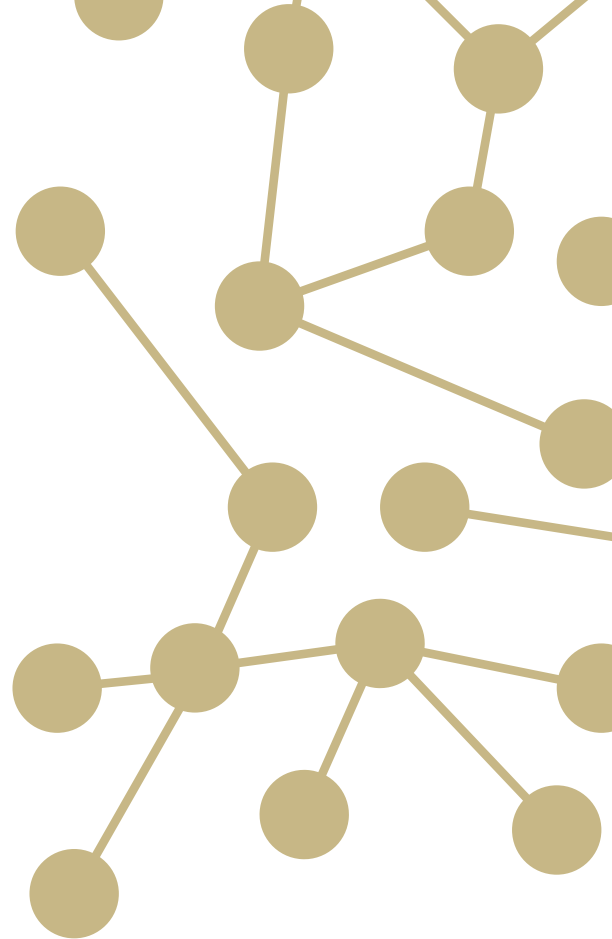
3.1 Early developments

The first recorded IPR trade in Sweden involves the Swedish botanist Carl Linnaeus. Linnaeus was a professor at Uppsala University between 1741 and 1772, and is renowned for developing the botanical classification system. In 1762 Linnaeus had devised a method to inoculate genuine pearls in clams. He then presented his invention to a parliamentary committee who was prepared to reward him for his work. However, a trader from Gothenburg by the name of Peter Bagge approached the committee and offered to pay Linnaeus 6,000 silver daler (approximately \$45,000 today) under the condition that he was given the sole right to the invention and would be allowed to practice it unhindered in the Kingdom without intrusion by others.²³ Bagge furthermore asked that this right would be inherited by his descendants and promised to use the invention in the best manner possible for the good of the kingdom. As a result, the King granted Bagge a *privilegia exclusiva* based on Linnaeus invention on September 7, 1762 under the condition that Bagge would leave a copy of the described invention to the parliamentary committee for future use.²⁴

What happened to Linnaeus’ new method after this transaction was made is not clear, but the privilege was

still in force in 1819 when the new law for *privilegia exclusiva* was promulgated. Notwithstanding, Bagge obviously recognized a good enough business opportunity to be prepared to pay a significant amount of money in advance for its right of use and the right to exclude others from the same use. Division of labor followed. We may assume that Linnaeus had little interest or business acumen to fully bring his invention to the market and make a profit from it. A trader such as Bagge was most likely both better economically situated as well as he had superior access to the complementary assets needed to exploit the invention commercially.²⁵ To our knowledge, this is the earliest Swedish record and example of a market for technology, where the underlying asset being traded is the right to an invention or process.

The legal status of IPR transferability thus goes far back in Swedish history and has most likely been an important part of legislation regarding the early *privilegia exclusiva*. In the first Swedish patent law from 1819 it is clearly stated in the sixth paragraph that “*privilegia exclusiva* can as other property be inherited or gifted and also through sale or transaction transferred to another Swedish citizen” (authors’ translation).²⁶ This is repeated in subsequent patent laws in 1834 and 1856. In 1856 however, it was also allowed to transfer rights to foreigners as long as they used a Swedish agent.²⁷



¹³ Arora, Fosfuri, and Gambardella, *Markets for Technology*. The same thing could arguably be said about Naomi Lamoreaux and Kenneth Sokoloff’s pioneering work *Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries* (Lamoreaux and Sokoloff 1999).

¹⁴ Richard E. Caves, Harold Crookell, and J. Peter Killing, “The Imperfect Market for Technology Licenses,” *Oxford Bulletin of Economics and Statistics* 45, no. 3 (1983): 249–267.

¹⁵ Caves, Crookell, and Killing.

¹⁶ Ashish Arora and Alfonso Gambardella, “The Changing Technology of Technological Change: General and Abstract Knowledge and the Division of Innovative Labour,” *Research Policy* 23, no. 5 (1994): 523–532; Ashish Arora and Andrea Fosfuri, “Wholly Owned Subsidiary versus Technology Licensing in the Worldwide Chemical Industry,” *Journal of International Business Studies* 31, no. 4 (2000): 555–572; Bharat N. Anand and Tarun Khanna, “The Structure of Licensing Contracts,” *The Journal of Industrial Economics* 48, no. 1 (2000): 103–35; Arora, Fosfuri, and Gambardella, *Markets for Technology*; Ashish Arora and Andrea Fosfuri, “Licensing the Market for Technology,” *Journal of Economic Behavior & Organization* 52, no. 2 (October 1, 2003): 277–95, [https://doi.org/10.1016/S0167-2681\(03\)00002-7](https://doi.org/10.1016/S0167-2681(03)00002-7); Ashish Arora and Marco Ceccagnoli, “Patent Protection, Complementary Assets, and Firms’ Incentives for Technology Licensing,” *Management Science* 52, no. 2 (2006):

293–308; A. Fosfuri and M. S. Giarratana, “Introduction: Trading under the Buttonwood—a Foreword to the *Markets for Technology and Ideas*,” *Industrial and Corporate Change* 19, no. 3 (June 1, 2010): 767–73, <https://doi.org/10.1093/icc/dtq025>; Gambardella, Giuri, and Luzzi, “The Market for Patents in Europe”; Alfonso Gambardella, Dietmar Harhoff, and Bart Verspagen, “The Value of European Patents,” *European Management Review* 5, no. 2 (2008): 69–84, <https://doi.org/10.1057/emr.2008.10>; Carlos J. Serrano, “The Dynamics of the Transfer and Renewal of Patents,” *The RAND Journal of Economics* 41, no. 4 (2010): 686–708.

¹⁷ Arora and Gambardella, “Ideas for Rent.”

¹⁸ Thierry Madiès, Dominique Guellec, and Jean-Claude Prager, eds., *Patent Markets in the Global Knowledge Economy: Theory, Empirics and Public Policy Implications*. (Cambridge University Press, 2014).

¹⁹ Ashish Arora, “Patents, Licensing, and Market Structure in the Chemical Industry,” *Research Policy* 26, no. 4–5 (1997): 391–403; Bharat N. Anand and Tarun Khanna, “The Structure of Licensing Contracts”; Lamoreaux and Sokoloff, “Market Trade in Patents and the Rise of a Class of Specialized Inventors in the 19th Century United States”; Arora and Fosfuri, “Licensing the Market for Technology”; Andrea Fosfuri, “The Licensing Dilemma: Understanding the Determinants of the Rate of Technology Licensing,” *Strategic Management Journal* 27, no. 12 (December 1, 2006): 1141–58, <https://doi.org/10.1002/smj.562>; Carsten Burhop, “The

Transfer of Patents in Imperial Germany,” *The Journal of Economic History* 70, no. 4 (2010): 921–939; Serrano, “The Dynamics of the Transfer and Renewal of Patents.” The term assignment is used interchangeably with transfer in the literature.

²⁰ Madiès, Guellec, and Prager, *Patent Markets in the Global Knowledge Economy: Theory, Empirics and Public Policy Implications*.

²¹ Arora, Fosfuri, and Gambardella, *Markets for Technology*.

²² David E. Andersson, *The Emergence of Markets for Technology: Patent Transfers and Patenting in Sweden, 1819–1914*, Doctoral Thesis 179 (Uppsala: Department of Business Studies, 2016).

²³ Exchange rates calculated using the “Historical Currency Converter”: Rodney Edvinsson and Johan Söderberg, “A Consumer Price Index for Sweden, 1290–2008,” *Review of Income and Wealth* 57, no. 2 (2011): 270–292.

²⁴ At this point in time, *privilegia exclusiva* was regulated by article 29 in the general legislation on manufacturing privileges from 1739.

²⁵ J. A. Markman, “En Uppfinning Av Linné,” *Svenska Patentkontorets Cirkulär* 14, no. 2 (1922): 83–84.

²⁶ Kongl. Maj:ts nådiga förordning angående Hwad iakttagas bör wid förekommande frågor om *Privilegia Exclusiva* för nya i Riket förut okända Slöjde-inrättningar, konster eller wäsentliga Konst-förbättringar. Stockholm, 1819.

²⁷ See Swedish Code of Statutes (SFS) 1834:41, §18 and 1856:49, §1 and §11.

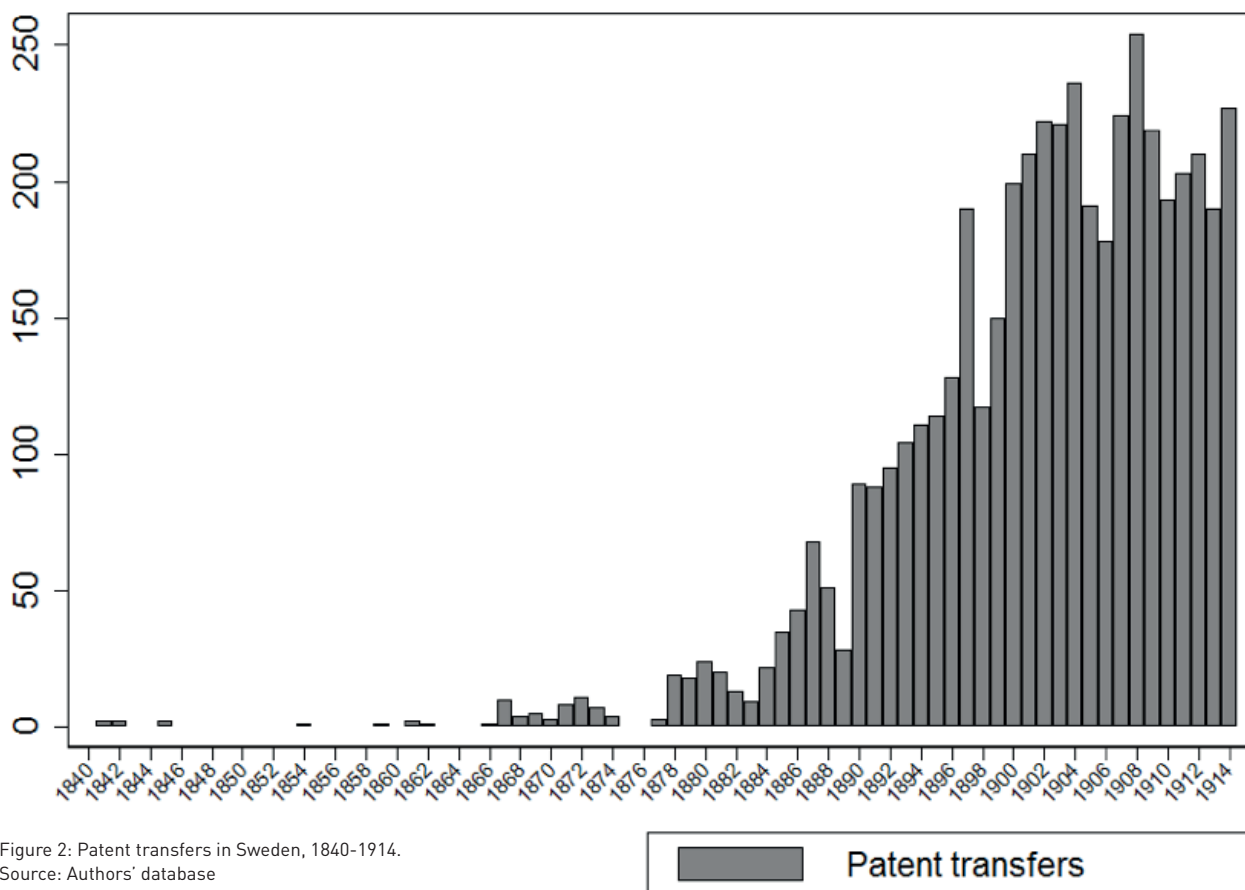
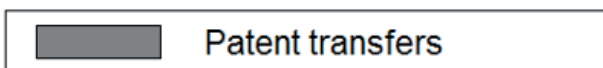


Figure 2: Patent transfers in Sweden, 1840-1914.
Source: Authors' database



Even though the transferability of IPR thus has a long history in Sweden, the beginning of the 19th century saw relatively little activity in markets for patents. The relative quiet market, both in absolute and relative terms, could in part be attributed to relatively weak property rights and a high propensity to litigate, which in turn increased uncertainty about the value of granted patents.²⁸ Based on data collected from the Swedish National Archive and the archives of the Swedish Patent Office, Figure 2 shows the evolution of patent transfers during the 19th century and to the start of World War II. As can be seen, before the 1870s there were few transfers of granted patents taking place. However, in the 1880s this changed and patent transfers steadily increased. In total about 12 percent of all granted patents 1885-1914 were transferred at least once.²⁹ This is in line with historical research from the US, Germany and Japan indicating that early markets for patents

emerged globally during a time when patenting activity was becoming increasingly international.³⁰

3.2 The “Inventor Exchange”: A 19th century marketplace for inventions

As patenting and patent transfers increased, the actors involved realized that using a market for patents involved transaction costs, including those associated with finding buyers or sellers of relevant patents, ascertaining patent quality and usefulness, and the enforceability of property rights. The appearance of such transaction costs induced initiatives to structure and facilitate the operation of a marketplace. The recently established patent agencies of the time became one significant actor in trying to achieve this objective. Early Swedish patent agencies such as L. A. Groth & Co and Stockholms Patentbyrå Zacco & Bruhn

²⁸ David E. Andersson and Fredrik Tell, “From Fighting Monopolies to Promoting Industry: Patent Laws and Innovation in Sweden 1819-1914,” *Economic History Yearbook*, forthcoming.

²⁹ Andersson, *The Emergence of Markets for Technology*.

³⁰ See for example: 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), <https://doi.org/10.3386/h0098>; Burhop, “The Transfer of Patents in Imperial Germany”; Tom Nicholas and Hiroshi Shimizu, “Intermediary Functions and the Market for Innovation in Meiji and Taishō Japan,” *Business History Review* 87, no. 1 (2013): 121-149.

³¹ David E. Andersson and Fredrik Tell, “Patent agencies and the emerging market for

patenting services in Sweden, 1885-1914,” *Entreprises et histoire* 82, no. 1 (2016): 11, <https://doi.org/10.3917/eh.082.0011>.

³² Norden can best be described as a Swedish version of the *Scientific American*.

³³ David E. Andersson and Fredrik Tell, “The Structure of Markets for Technology: New Evidence from Swedish Patent Data and Patent

were important intermediaries in the Swedish market for patents. These patent agencies seized the opportunity to make patent trade an important part of their business model.³¹ Some patent agencies, like the Wawrinsky agency, even produced their own journal where they published advertisements for patents for sale. Not only patent agencies emerged as providers of marketplaces for technology, where they could act as brokers. The Association of Swedish Inventors (Sveriges uppfinnareförening) took further measures and founded an “Inventor Exchange” (Uppfinnarebörs) in 1886 in prominent industry journal Norden, publishing the Swedish Journal of Patents and Trademarks as a weekly supplement.³² Acknowledging the problem of transaction costs the inventors’ association wrote in the first edition that:

“An exchange, a marketplace, where those who wish to acquire or sell inventions can find their customers still does not exist in our nation and in this we find one of the reasons why inventors in spite of our relatively good patent law in general obtain little benefit from their inventions. It is often observed that he who has managed to produce a valuable invention only occasionally possesses the traits required to bring it to the market.../.../... It would therefore be of mutual benefit, and foster the industrial life, if these two categories of intellectual workers had a somewhat more secure way to find each other than merely by chance.” (authors’ translation) (Norden, Journal of Patents and Trademarks, May 28, 1886, p. 159)

The “Inventor Exchange” made it possible for anyone to publish advertisements (up to three times free of charge) for the sale or acquisition of inventions. The popularity of the journal indicates that this was most likely one of the most efficient ways to attract attention to your inventions. During the next twenty years the “Inventor Exchange” received more than a thousand advertisements for the sale, licensing or acquisition of different inventions. It seems, however, that secure property rights were indeed a prerequisite for the marketplace to function. Andersson and Tell found that no less than 741 advertisements included references to granted patents.³³ The Inventor Exchange was not a “lemons” market and seems to have been a relatively successful marketplace. Patents for sale in the marketplace on average was of higher quality than other patents measured as number of patent fees paid.³⁴

Figure 3 shows an advertisement from the Inventor Exchange in the left column, and patents for sale in Wawrinsky’s *Patentunderrättelser* in the right column. We suggest two conspicuous features of these advertisements: First, all of them include references to granted Swedish patents. Second, all of them explicitly refer to the use of intermediaries, in this case Swedish patent agencies. We believe this highlights two features of markets for patents mentioned above: the importance of IPR for secure transactions and the importance of intermediaries to lower transaction costs. As more modern patent laws partly alleviated the appropriation problem inherent in the creation of new ideas this was still not enough for a market to emerge. Intermediaries and a more formal infrastructure were still needed to furthermore lower risk and uncertainty surrounding this type of transactions.

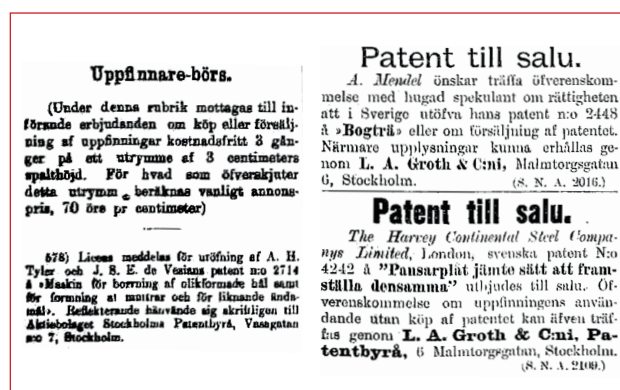


Figure 3: The Inventor Exchange and patents for sale. Sources: (left) Norden, vol. XXVIII, no. 1, p. 12 (January 5, 1900), (right) Patentunderrättelser, vol 1., no. 25, p. 1 (June 25, 1896)

3.3 Some examples of important patent transfers in Swedish history

The market for patents has also left its mark on Swedish business history and has at times played a crucial role in the very formation of noteworthy Swedish industrial enterprises. Although Swedish industrialist and inventor Gustav de Laval was one of the founders of AB Separator to exploit his improved milk separator in 1878, the basis of the firm was in fact a patent transfer and the division of labor made possible by markets for patents.³⁵ De Laval’s

Advertisements 1885-1914,” Working Paper, 2015.

³⁴ George A. Akerlof, “The market for lemons: Quality, uncertainty and the market mechanism,” in *Uncertainty in Economics*, ed. Peter Diamond and Michael Rothschild (Academic Press, 1978), 235-51, <https://doi.org/10.1016/B978-0-12-214850-7.50022-X>; Andersson and Tell, “The Structure of Markets for Technology: New Evidence from Swedish Patent Data and Patent Advertisements 1885-1914.”

³⁵ AB Separator changed its name to Alfa Laval in 1963.

business partner Oscar Lamm Jr. was able to raise funds thanks to de Laval's patent that was transferred to Lamm's company in 1879, leading to the subsequent formation of AB Separator in 1883.³⁶ Figure 4 shows the registration of the transfer to Lamm in the register of the Swedish kommerskollegium.³⁷ Furthermore, the real breakthrough for AB Separator did not come until the revolutionary "Alfa"-patent was in fact acquired in another patent transfer by Alfa Laval in 1889 from the German inventor von Bechtolsheim.³⁸ According to Larsson and Tell, Alfa Laval's patent strategy was crucial to the success of the firm and clearly involved the market for patents as emphasized by Gustav de Laval himself.³⁹

"we must not only improve our own machines, we must spare no costs in acquiring patents that in the hands of the competition would be devastating to Separator"⁴⁰ [authors' translation]

Moreover, one of Alfa Laval's main competitors at the time, the Danish firm Burmeister & Wain, used the market for patents as it bought a patent similar to Laval's from Danish firm Nielsen & Petersen in 1882.⁴¹

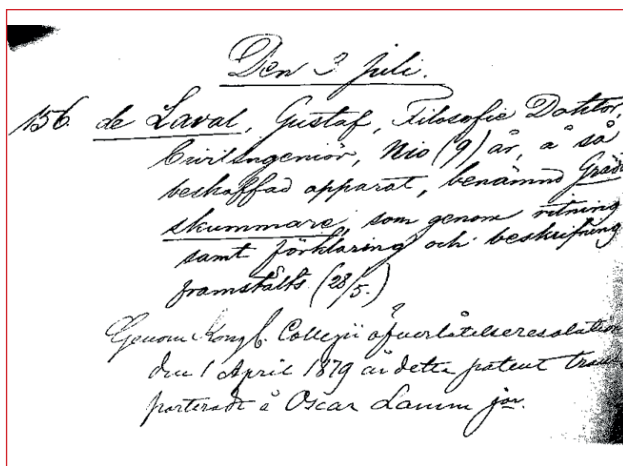


Figure 4: Registration of the transfer of Gustav de Laval's separator patent
Source: Riksarkivet, Kommerkollegium, Huvudarkivet, Ingående diariér över patent (Clc) 14.

Another well-known Swedish firm based on a patent transfer is Atlas Copco. The firm AB Diesels Motorer, which together with AB Atlas, was to form what today is Atlas Copco in 1917, was founded on the basis on the acquisition of Rudolf Diesels Swedish patent in 1898 by the well-known Swedish industrialists the Wallenberg family.⁴² The patent application dated to 1892, giving the newly established firm nine years of patent protection in Sweden to develop its business.

Even though we do not have time series data on actual prices paid for transferred patents, some examples do exist which indicate that the sums involved were considerable even by today's standards. For example, the Rudolf Diesel patents acquired by the Wallenberg family was valued at SEK 150,000 in 1898 (approx. \$1,114,000 today).⁴³ On another occasion, AB Separator bought the patents inventions made by mechanic Carl August Johansson from him and his two partners. Separator reportedly paid SEK 21,000 (approx. \$167,000 today) in 1886.⁴⁴

4. THE PRESENT SWEDISH MARKET FOR PATENTS: DOMESTIC AND INTERNATIONAL OBSERVATIONS

Available data about present day markets for patents in Sweden is not as detailed as the historical data on the functioning of past patent markets. However, there are some data accessible on the relative size and potential volume of the market and firm activity. Recent research has also made available new data on the number of patent transfers by Swedish firms, which we can compare with our historical counterpart.

4.1 Swedish and international markets for technology

The current situation with respect to Swedish markets for technology is, to a great extent, a story about Swedish telecom firm Ericsson that has been actively monetizing IPR during the last 15-20 years. In 2012, the company passed the billion-dollar mark in revenues generated solely from the sale and licensing of their patents and this business continued to increase in the years thereafter, resulting in

³⁶ Swedish patent granted 1878-07-03 and transferred to his business partner Oscar Lamm 1879-04-01.

³⁷ Kommerkollegium was responsible for issues regarding patents until the Swedish Patent Office was founded in 1885 which in turn was housed in kommerkollegium before it became an independent government agency in 1892.

³⁸ See Swedish patent no. 2708.

³⁹ Mats Larsson and Fredrik Tell, "Två Snilleföretags Patentstrategier Runt Förärra Sekelskiftet," in Patent Och Pirater: Patentstrategier Och Varumärken under 100 År, Näringslivshistoria 3 (Stockholm: Centrum för näringslivshistoria, 2010), 92-130.

⁴⁰ Wohlerl, Wohlerl, Klaus. Framväxten Av Svenska Multinationella Företag: En Fallstudie Mot Bakgrund Av Direktinvesteringsteorier: Alfa-Laval Och Separatorindustrin 1876-1914., 80.

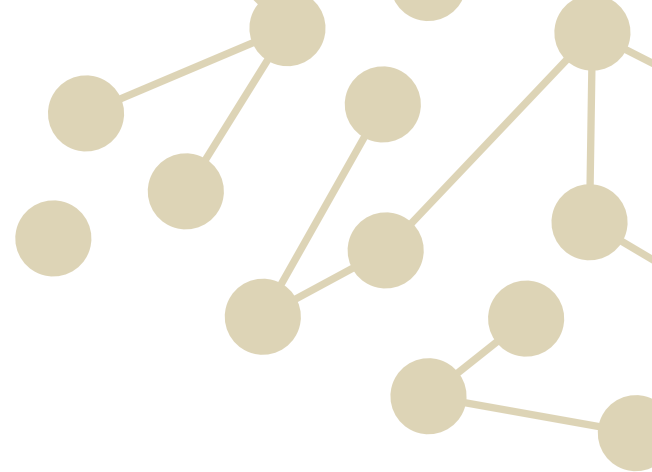
⁴¹ Klaus Wohlerl, Wohlerl, Klaus. Framväxten Av Svenska Multinationella Företag: En Fallstudie Mot Bakgrund Av Direktinvesteringsteorier: Alfa-Laval Och Separatorindustrin 1876-1914. (Almqvist & Wiksell International, 1981).

⁴² Torsten Gårdlund, Atlas Copco 1873-1973: Historien Om Ett Världsföretag i Tryckluft (Nacka: Atlas Copco AB, 1973). Patent database, Swedish patent No. 5804 granted 1895-01-31 and transferred to AB Diesels Motorer 1898-06-30.

⁴³ Gårdlund.

⁴⁴ Wohlerl, Wohlerl, Klaus. Framväxten Av Svenska Multinationella Företag: En Fallstudie Mot Bakgrund Av Direktinvesteringsteorier: Alfa-Laval Och Separatorindustrin 1876-1914., 77. Although the patents are not mentioned by their number, they are mostly likely Swedish patents no: 296, 309, 422, 432 and 607. Johansson is furthermore registered as Johansson in the patent register.

⁴⁵ Johanna Gustafsson and Sara Lodén, "Main Determinants of Patent Transfers in Sweden: An Empirical Study of the Market for Ideas" (Master Thesis, KTH, 2018), <http://www.diva-portal.org/smash/get/diva2:1258451/FULLTEXT01.pdf>.



a ten-fold nominal increase between 2005 and 2015. Ericsson's dominant position is also evident in patent counts where the company, including subsidiaries, makes up almost a quarter of all patent applications made by Swedish firms over the period 2000-2016, its patenting more than doubles that of the second most active Swedish firm, Astra Zeneca.⁴⁵ Ericsson has mainly generated revenues from different licensing deals. Former Ericsson CEO, Carl-Henric Svanberg, stated that Apple's iPhone was one of the greatest things to happen to Ericsson, since Apple was required to reach a licensing agreement with Ericsson in 2006 to be able to launch the first version of its smart phone.⁴⁶ A new licensing agreement with Apple was reached in 2015. On the other side of the Baltic Sea, Nokia, once the leading firm in the mobile phone industry, sold its phone business to Microsoft in 2013. However, the Finnish company held on to their 30,000+ patent portfolio, which meant that Microsoft had to pay a 10-year license on the patents to be able to use Nokia's inventions in mobile phone technology. Previously, Nokia had only used their patents defensively to protect its phone business. Using the market for patents however turned out to be a shrewd business move as other mobile phone manufacturers such as LG soon had to license Nokia's patents as well and on February 1, 2016 they reached a similar license agreement with mobile phone giant Samsung, reportedly worth up to \$1.4 billion.⁴⁷

However, even though licensing is more common, large acquisitions of blocks of patents is also frequent and an important part of companies' IPR strategies. The last ten years have seen the striking of several massive patent deals, which has drawn the attention of the public. The most well-known is probably Google's 2011 acquisition of Motorola Mobility along with its patent portfolio of 24,500 patents for \$12.5 billion to protect the Android ecosystem. A year earlier, Microsoft, Apple, EMC and Oracle bought a patent portfolio of 882 patents from software firm Novell for \$450 million and only six months later in 2011 some of the same firms acquired 6,000 patents from Canadian telecom firm Nortel for \$4.5 billion. In addition to its acquisition of Motorola Mobility, Google also secured 1,023 patents from IBM the same year.⁴⁸ Table 1 summarizes some of the largest and most publicized patent deals in recent years.

With exception of these high profile patent deals, gauging the total size and value of markets for patents today is inherently difficult since many transactions occur between affiliated actors. Another reason being that patents transactions are often taking place as bilateral agreements made under conditions of secrecy.⁴⁹ However, some data is available that can help us get a picture of the potential size of these markets. According to the International Monetary Fund, payments for the use of IPR passed \$400 billion globally in 2017.⁵⁰ This data also fit reasonably well with some of the earlier estimates made by Athreye and Cantwell, and Arora and Gambardella.⁵¹ Breaking

Table 1: Important patent deals

Owner	Buyer/licensee	# of patents	Total Value	Year
Nortel	Rockstar β	6,000	\$4.5 bn	2011
Motorola	Google	24,500	\$12.5 bn	2011
Novell	CPTN*	882	\$450 mn	2010
Nokia	Microsoft/LG/Samsung	>30,000	>\$1.4 bn	2013-2016
IBM	Google	1,023	N.A.	2011
Ericsson	Apple	>37,000	SEK 2-6 bn	2015
IBM	Google	217	N.A.	2012
Kodak	Intellectual Ventures \dagger	1,100	\$527 mn	2013

Notes: *Consortium consisting of Microsoft, Apple, EMC and Oracle. \dagger Patent aggregator. β Consortium consisting of Rockstar, Sony, Microsoft, RiM, Ericsson and EMC

⁴⁶ Carl-Henric Svanberg, Ericssons kris och resan tillbaka (Ekerlids, 2015).

⁴⁷ Shawn Knight, "Nokia's 30,000+ Patent Portfolio Continues to Generate a Sizable Income," Techspot (blog), February 1, 2016, <https://www.techspot.com/news/63670-nokia-30000-patent-portfolio-continues-generate-sizable-income.html>.

⁴⁸ K. N. C., "Doing the Maths," Babbage, The Economist (blog), August 17, 2011, <https://www.economist.com/babbage/2011/08/17/doing-the-maths>.

⁴⁹ Arora and Gambardella, "Ideas for Rent"; Federico Caviggioli and Elisa Ughetto, "The Drivers of Patent Transactions: Corporate Views on the Market for Patents," R&D

Management 43, no. 4 (September 1, 2013): 318-32, <https://doi.org/10.1111/radm.12016>; Antonio De Marco et al., "Global Markets for Technology: Evidence from Patent Transactions," Research Policy 46, no. 9 (November 2017): 1644-54, <https://doi.org/10.1016/j.respol.2017.07.015>.

⁵⁰ However, this data also includes the use, through licensing agreements, of produced originals or prototypes (such as copyrights on books and manuscripts, computer software, cinematographic works, and sound recordings) and related rights (such as for live performances and television, cable, or satellite broadcast). An interesting fact is that according to the IMF data, the world

in total seems to be running a deficit in the charges for the use of IPR, meaning that payments are larger than receipts. In theory of course, these should be equal. See <https://data.worldbank.org/> for more.

⁵¹ Suma Athreye and John Cantwell, "Creating Competition?: Globalisation and the Emergence of New Technology Producers," Research Policy 36, no. 2 (March 1, 2007): 209-26, <https://doi.org/10.1016/j.respol.2006.11.002>; Arora and Gambardella, "Ideas for Rent."

down these numbers on a country level, Figure 5 shows the net charges for the use of IPR for different countries in current US dollars. In panel A, we compare Sweden with other large industrial nations in Europe, such as Germany, France and the UK. Panel B shows the same data for the US, the EU and China. We want to highlight a few conspicuous features. First, Sweden has seen a significant increase in revenues from IPR since the early 1990s while for example Germany was running a large deficit until as recently as 2010. This is also consistent with similar data provided by Statistics Sweden.⁵² Second, the dominance of the US over the EU is clear, emphasizing the commanding role of the US as world technology leader. Furthermore, as China's economic development has picked up, the country has been a big importer of technology through the use of IPR in the last 10-15 years. Third, it is important to keep in mind the large influence of single firms such as Ericsson in the Swedish data who most likely represent a large part of the total national net revenue. At the same time, in per capita terms, Sweden positions itself well ahead of the US.

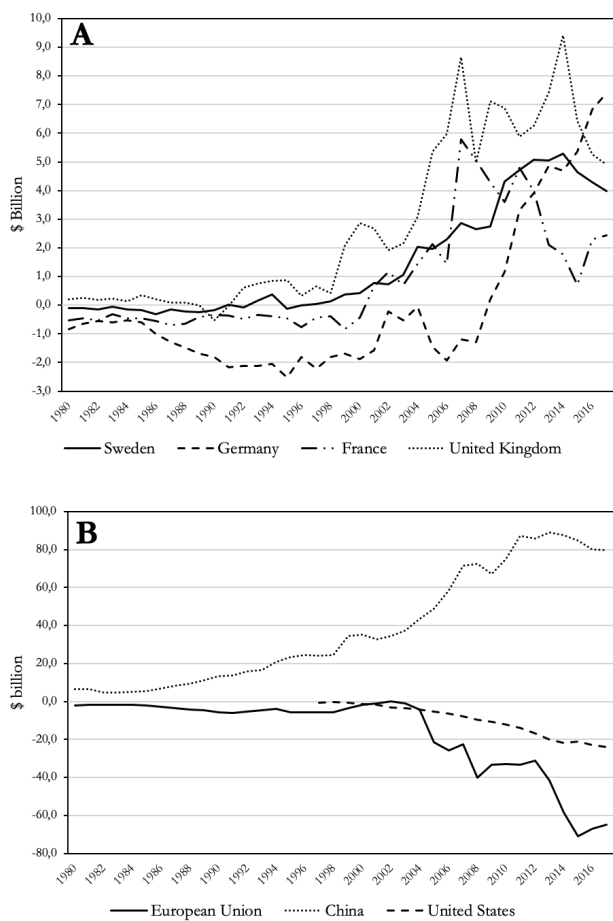


Figure 5: Net charges for the use of IPR, current \$US
Source: International Monetary Fund, Balance of Payments Statistics Yearbook and data files.

We know that Ericsson represents an important part of Sweden's share of markets for technology. But what about Swedish firms in general? The Swedish data from the EU led Community Innovation Survey (CIS) can give us an indication of to what degree Swedish firms use IPR and participate in activities in the market for technology. The survey is based on a population of 36,039 firms with more than ten employees, from which a sample of 9,297 firms was randomly drawn. The survey had a response rate of 82%, which means that the data below is based on 7,624 Swedish firms. According to Statistics Sweden 52% of these firms were involved in some kind of innovative activity during 2014-2016.⁵³ Figure 6 shows the use of different IPR by Swedish firms by number of employees. About, 20% report that they had applied for a patent, while about 13% had applied for a trademark and as much as 42% had registered a design. Since IPRs are important assets in the market for technology this can give us an indication of the number of potential Swedish firms on the supply side of the market without taking into consideration that past activities can of course play an important role in influencing firms' strategic positions. Furthermore, the CIS data also do not give us information on the number of IPRs applied for or registered.

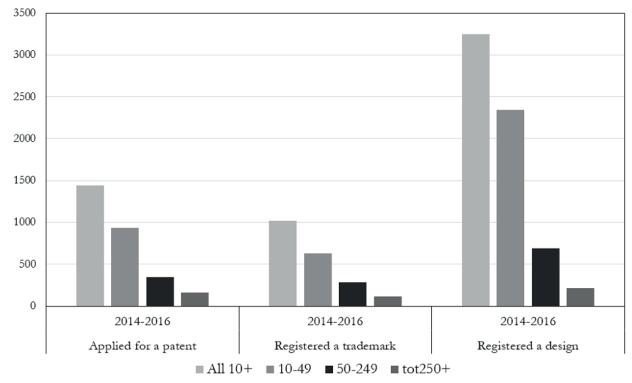


Figure 6: The use of IPR among Swedish firms
Source: Statistics Sweden (SCB), CIS, Innovation activity among enterprises

A more direct measure of participation in MfT is to consider to what extent Swedish firms leverage their internal IPR or use externally developed technology in their businesses. Figure 7 gives a glimpse of this by showing the number of Swedish firms that have either licensed out or sold IPR or licensed in or bought IPR by number of employees. The data reveals that there are more firms that buy or license-in IPR than firms who sell or license-out IPR. Recall that Figure 7 shows the number of firms and not the total value. About 6,5% of all firms are part of the supply side of the market, while ca. 12% of all firms form part of the demand side of the market. This is of course not to say that one firm can't be active on both sides of the market, this is most likely often the case. However, the data indicates that in general more Swedish firms do seem to be on the demand side. This emphasizes the significance of large Swedish high-tech firms driving the large volumes of Swedish technology exports through IPR. This indicates that although on a general level Sweden is performing well in the markets for technology, in mere numbers more Swedish firms actually rely on and pay for externally developed IPR.

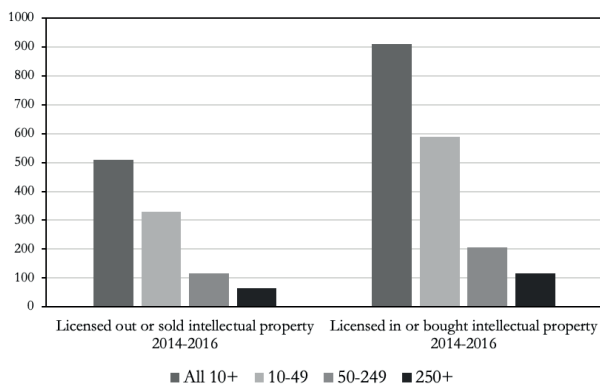
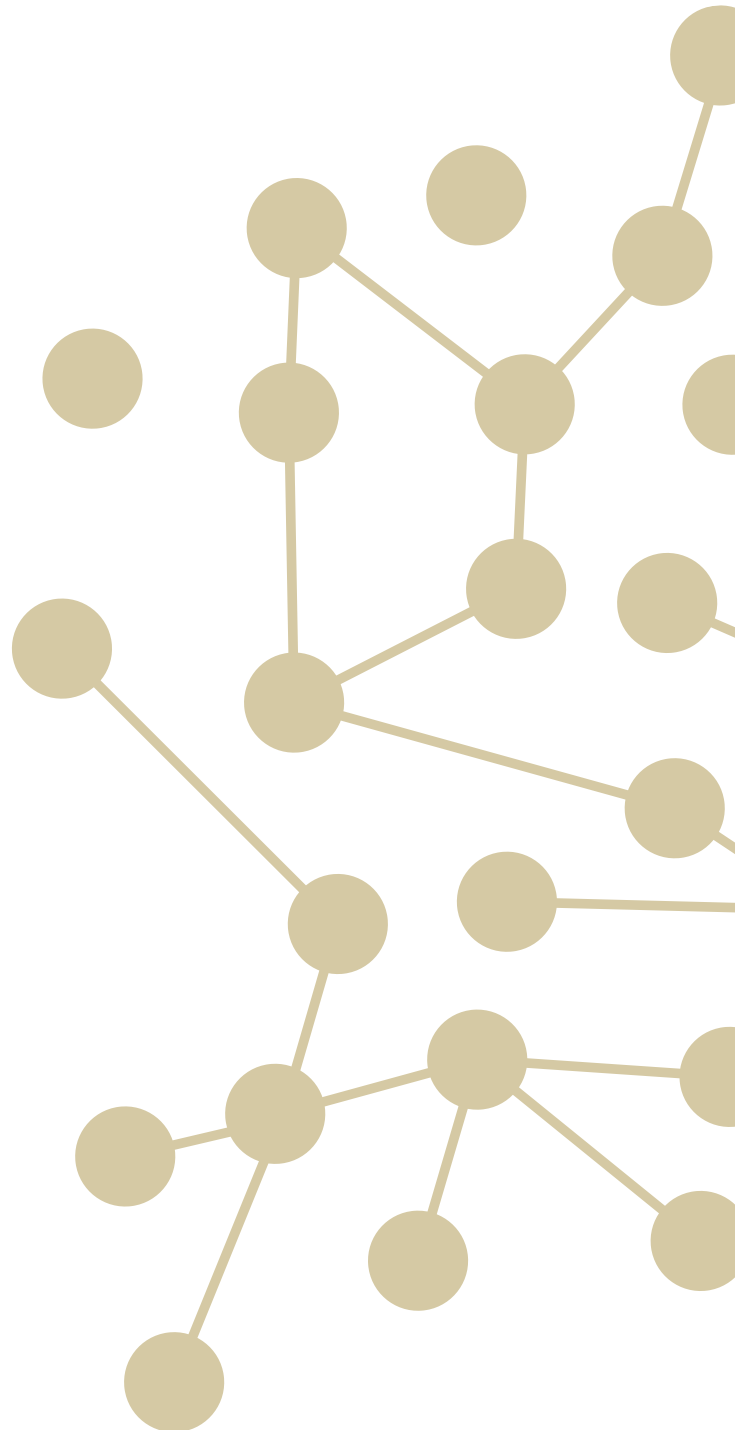


Figure 7: Participation in markets for technology among Swedish firms
Source: Statistics Sweden (SCB), CIS, Innovation activity among enterprises



⁵² See Tjänstehandel. Export och import efter kontopost, år 1982–2017, kontopost "8 nyttjande av immateriella rättigheter", <http://www.statistikdatabasen.scb.se>. Data is however only available from 1998.

⁵³ "Innovationsverksamhet i Svenska Företag

2014–2016" (Stockholm: SCB, Statistiska centralbyrån, 2018), https://www.scb.se/contentassets/9e6a00ac2fc7421cabab329528166232/uf0315_dok_2014-2016_cl_180214.pdf.

⁵⁴ Gustafsson and Lodén, "Main Determinants of Patent Transfers in Sweden: An Empirical Study of the Market for Ideas." For PATLink see: <https://data.houseoffinance.se/otherDB/patlink>.

4.2 The Swedish market for patents

We now turn specifically to the market for patents. Recently, new data on the Swedish market for patents has become available through the PATLink project and the work of Gustafsson and Lodén.⁵⁴ Examining this data reveals some patterns regarding the transfer of patents at PRV as well as the transfer of patents by Swedish patent-holders at the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO) for the period 1990-2016. First, Figure 8 shows that the Swedish market for patents per se, that is, patent transfers regarding patents applied for at PRV, is far smaller today than its historical equivalent shown in Figure 1. Except for the peak in 2005, which according to Gustafsson and Lodén is due to a large number of patents being sold by Sandvik Intellectual Property AB to various different buyers, transfers of national PRV patents rarely amount to 40 per year compared to more than 200 yearly transfers in the beginning of the 20th century. The low numbers in the late 1980s should perhaps be viewed with a bit of caution.

The decline in domestic patent transfers filed can be explained by the increasingly international MfT, were most Swedish firms are active today and a more general trend of less patent applications being filed at smaller national offices such as PRV. This is also evident in Figure 9, which shows the transfer of Swedish patents filed to EPO and USPTO in addition to PRV. Here instead a large increase in patent transfers by Swedish firms is visible. A more than six-fold increase in the number of transferred patents has taken place since the early 1990s.

According to Gustafsson and Lodén, this implies a transfer rate of around 15% in 1998 to a transfer rate around close to 45% in 2012.⁵⁵ However, these numbers

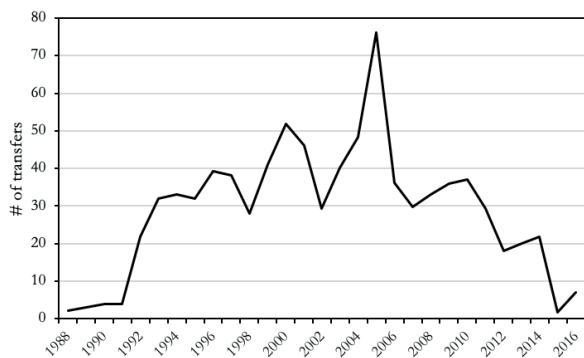


Figure 8: Patent transfers filed to PRV
Source: Gustafsson and Lodén (2018)

are most likely inflated by intra-firm transfers, and by transfers between individuals and firms. Even so, they indicate that the Swedish activity on the markets for patents currently is substantial.

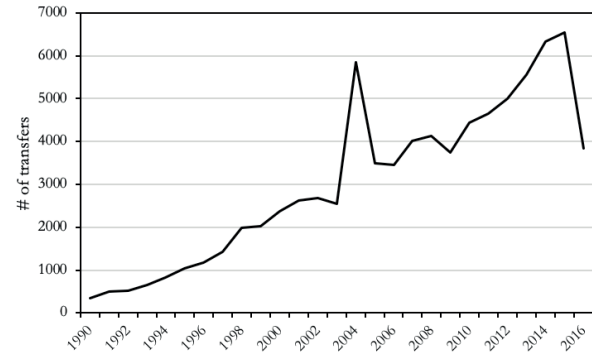


Figure 9: Swedish patent transfers filed to PRV, EPO and USPTO
Source: Gustafsson and Lodén (2018)

5. CONCLUDING REMARKS

In this article, we have presented and discussed historical and contemporary data on markets for patents. First, as we showed with the example from Carl Linnaeus, the transferability of IPR has a long history in Sweden going back all the way to the 18th century. The rapid increase in volume relating to the use of IPR in general, but also the growth in patent transfers in the 1990s, bear similarities to the rise in patent transfers starting in the 1880s. Not surprisingly, increases in patent transfers happened concomitantly with patenting booms. The surge in patenting that took place in the 1980s is sometimes referred to as the “pro-patenting era” and scholars such as Granstrand have referred to the 2000s as the “pro-licensing era”.⁵⁶ Perhaps a more accurate description would be to refer to the more recent period as the “second” pro-patenting or pro-licensing era. Whatever the label, it seems to indicate that there was a first emergence of markets for patent during the late 19th century and then a second re-emergence in the late 20th century. This begs the question of what happened in between? Our historical data ends in 1914 and does not pick up until 1990, which directs attention to a large empirical deficit and a data gap covering most of the 20th century. Thus, there is a void in our knowledge about the role of IPR during post-war industrialization in Sweden.

⁵⁵ Gustafsson and Lodén, 61. See Figure 10.

⁵⁶ Ove Granstrand, *The Economics and Management of Intellectual Property* (Edward Elgar Publishing, 1999); Samuel Kortum and Josh Lerner, “What Is behind

the Recent Surge in Patenting?,” *Research Policy* 28, no. 1 (January 1999): 1–22, [https://doi.org/10.1016/S0048-7333\(98\)00082-1](https://doi.org/10.1016/S0048-7333(98)00082-1); Granstrand, “The Economics and Management of Technology Trade.”

⁵⁷ These firms include for example: Intellectual Ventures, OceanTomo, NineSigma, InnoCentive etc.

Second, the historical and contemporary empirical observations reported here indicate that markets for patents can be conceived as a case of MfT. As suggested by theory, patents are a form of IPR that allows for commercial trade, which, in turn induces division of innovative labor. Aggregated data and selected examples reveal that technology trade had beneficial economic effects. It is more difficult to ascertain the more precise workings of these markets, for instance in terms of search and enforcement costs, as well as price levels for IPR transfers and licensing. This predicament alludes to, as exemplified both in historical and contemporary data, a valuation problem regarding the transactions on these kinds of markets. Information on the real value of licensing deals and patent acquisitions is scarce and not available in any organized fashion. Here we believe there is a real opportunity for research, both by economic historians and scholars in economics of innovation and technology, to make important contributions.

Third, at least historically, there was a role for intermediaries such as patent agencies to act as brokers and market makers. Our discussion shows how patent agencies, as well as the inventors' associations, at the turn of the last century made efforts to facilitate and organize markets for patents. From what we can gauge drawing upon aggregate data on volumes of patents transferred, their efforts were not in vein. All of the patent agencies mentioned in this article are still active in Sweden today, but there is little systematic knowledge on what their roles in contemporary market for patents are. In contemporary MfT a more complex picture of emerges, where firms such Sandvik have their own IPR companies, but where patent aggregators, IPR investors and open innovation intermediaries are active as well.⁵⁷ The division of labor and economic effects of such developments are yet to be fully understood.



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