TITLE: Patent Laws and Innovations: Analysis from Nineteenth-Century World's Fairs Datasets

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INTRODUCTION

Studying the patent system is one of the most critical fields in economics study. Invention-inducement theory which is the most familiar theory of the benefits of patenting indicates that the anticipation of receiving patents motivates useful inventions. Patents have long been regarded as a trade-off between innovation incentives and market competition and the proliferation of technology in society.

Two research questions drive this report. For the first question, can patent law influence the direction of innovation? The hypothesis is that patent law affects which specific industries receive innovation: where countries with patent law tend towards innovations that are protected by the patent system, and vice versa. As for the second question trying to answer, are patent laws a necessary condition for innovation? The hypothesis is negative, which is challenging the common understanding of patents protecting the existence of innovation. The impact of patents on innovation and economic performance is complex but essential to understand. If we hope the patent system could work well and become a significant public policy, we should try to figure out the relationship between patent law and innovation among different industries, and only then we could come up with the proper patent design.

The empirical analysis is based on Professor Moser's dataset on close to fifteen thousand inventions from the catalogues of two nineteenth-century world's fair which are the Crystal Palace Exhibition in London in 1851 and the Centennial Exhibition in Philadelphia in 1876. The highlight point of this dataset that Prof.Moser has collected is that it gives us a way to analyze the innovation, which is no longer a term that is usually captured as the quality and quantity of patents. This new source of the dataset which crosses many countries with and without patent system and records the inventions with high economic value because of the authority of the exhibits selection process. Thanks to the dataset, we could have a chance to answer the questions

of whether patent law could influence the direction of innovation among different industries and whether the patent law is a necessary condition for innovation which to test if the countries with patent systems have higher innovation than those countries without patent systems. The dataset is trying to give a close look at Northern Europe to compare better the significance of the difference in patent laws as the other unobservable influential factors are relatively small like culture, geographic, and so on.

EMPIRICAL EVIDENCE AND DISCUSSION

TABLE 3 -- COUNTRY CHARACTERISTICS

country	patent_length_in_1851	patent_length_in_1876	population_in_1851	population_in_1876	GDP_in_1851	GDP_in_1876	primary_education_in_1851	primary_education_in_1876
Austria	**15**	**15**	**3950**	**4520**	**6560**	**8420**	**389**	**426**
Bavaria	**15**		**4600**		**6790**			
Belgium	**15**	**20**	**4450**	**5100**	**8040**	**13700**	**549**	**582**
France	**15**	**15**	**36400**	**38400**	**60700**	**72100**	**515**	**737**
Netherlands	**15**	**0**	**3100**	**3620**	**5840**	**9950**	**541**	**639**
Spain	**15**	**15**	**14800**	**16200**	**16900**	**22300**	**401**	**401**
Norswe	**15**		**4880**		**5990**		**615**	
Britain	**14**	**14**	**25600**	**31400**	**60500**	**100000**	**555**	**680**
Prussia	**12**		**16900**		**25000**		**730**	
Saxony	**12**		**1990**		**2930**			
Wurttemberg	**10**		**1730**		**2560**			
Denmark	**0**	**5**	**1500**	**1890**	**2550**	**3780**		
Switzerland	**0**	**0**	**2380**	**2660**	**5240**	**5870**		**759**
Germany		**15**		**39200**		**71400**		**732**
Norway		**3**		**1740**		**2480**		**658**
Sweden		**3**		**4160**		**6930**		**568**

Notes: Patent length denotes the maximum duration of patent grants (Lener, 2000; Coryton, 1855). Data on population and GDP (in million 1990 dollars) are drawn from Maddison (1995, 2001). Population data for Bavaria, Prussia, Saxony, and Wiirttemberg from the Annuaire statistique (1916). Primary education is measured as the number of children in primary education per 1,000 persons between the age of 5 and 14 (Lindert, 2004). Sources of data: World's Fair Data in 1851 and 1876 collected by Petra Moser (2003).

Table 3 summaries the data about patent length, population, GDP, and primary education in 1851 and 1876. Those are essential and observable variables that might influence the innovation of countries. To make sure the influence in the change in innovation is made by patent law, we need the Chi-square test for testing if the distribution between countries is homogenous with the bound of some variables that we may expect in 1851 and 1876. As for the results of the Chi-square test, the p-value for both of the years is less than 0.0005. So we could reject the null hypothesis that there is no relationship between our categorical variables. So there exist

considerable differences in the distribution of exhibits among industries, and we could assume that those big differences are also statistically significant.

FIGURE 1. SHARE OF EXHIBITS AMONG SEVEN INDUSTRIES IN 1851

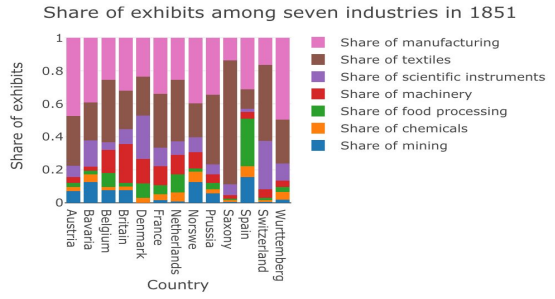
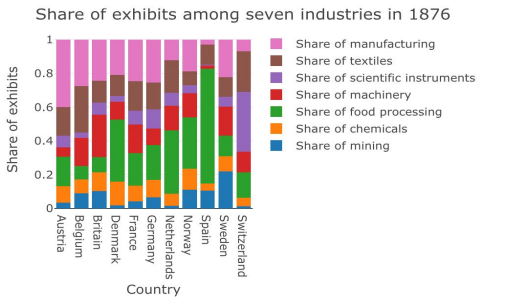
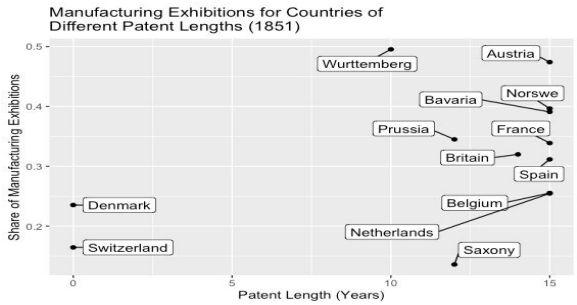


FIGURE 2. SHARE OF EXHIBITS AMONG SEVEN INDUSTRIES IN 1876



Notes: "Share of exhibits" measures the proportion of a country's exhibits that occurs among the industries: mining, chemicals, food processing, machinery, scientific instruments, textiles, and manufacturing. Innovation measured by the "share of exhibits". Sources of data: World's Fair Data in 1851 and 1876 collected by Petra Moser (2003).

FIGURE 3. SHARES OF EXHIBITS IN MANUFACTURING AGAINST PATENT LENGTH IN 1851



Notes: "Share of exhibits in manufacturing" measures the proportion of a country's exhibits that occurs in the industry class "manufacturing". "Patent length" measures the maximum duration of a patent grant in 1851 as reported in Coryton (1855) and Lerner (2000). Sources of data: World's Fair Data in 1851 and 1876 collected by Petra Moser (2003).

To verify the hypothesis that "patent law can affect the direction of innovation", one can compare the share of industrial innovation in the same period of each year between countries with and without patent laws. If the countries with patent law have roughly the same share of innovation for one specific industry as countries without patent law, we can reject our hypothesis. Otherwise, our hypothesis is tenable. In 1851, Denmark and Switzerland did not have patent laws. From Figure 1, we could see that Denmark and Switzerland have a relatively small share of innovation in mining and manufacturing and a large share in textiles and scientific instruments. Moreover, in Figure 3, we could see it clearly that Denmark and Switzerland are laying below while other countries are laying above. In 1876, the Netherlands and Switzerland did not have patent laws. From Figure 2, we could see that Denmark and the Netherlands have a relatively small share of innovation in mining and manufacturing and a large share in textiles and scientific instruments. That could give us a sense that parentless counties have higher innovation

rates on the industries which do not strongly depend on patent protection, instead, other alternative mechanisms like by keeping secret and hard in reverse-engineering are more effectively. Also, we could test our hypothesis by comparing the change in patent law to result in the change in the direction of innovation in different industries. We take Denmark and the Netherlands as examples. Because Demark which had no patent law in 1851 but established patent law in 1876 and the Netherlands which had patent law in 1851 but abolished the patent law in 1876. From Figure 4, we could see that after Denmark established the patent law, fields in chemicals and food processing, mining increased significantly. Remarkably, the mining industry has grown faster even though it had no mining innovation in 1851. As for the Netherlands, refer to Figure 5, after the Netherlands abolished its patent system, the fields in food processing had increased significantly. Those are convincing examples for us to test our hypothesis is correct.

FIGURE 4. DENMARK : SHARE OF EXHIBITS AMONG SEVEN INDUSTRIES IN 1851 AND 1876

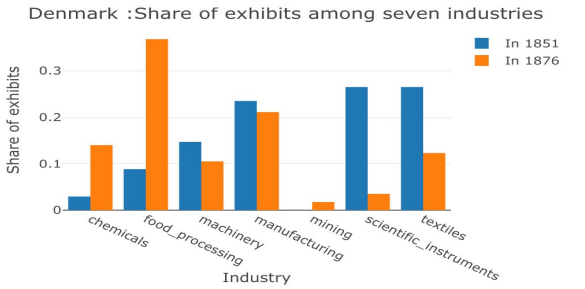
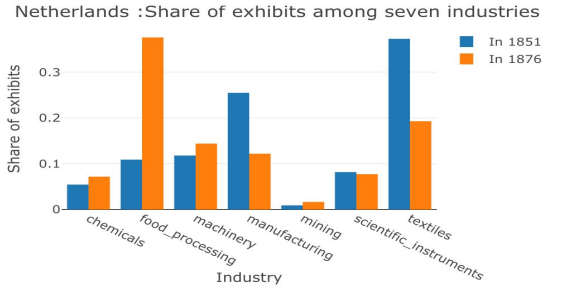


FIGURE 5. NETHERLANDS : SHARE OF EXHIBITS AMONG SEVEN INDUSTRIES IN 1851 AND 1876

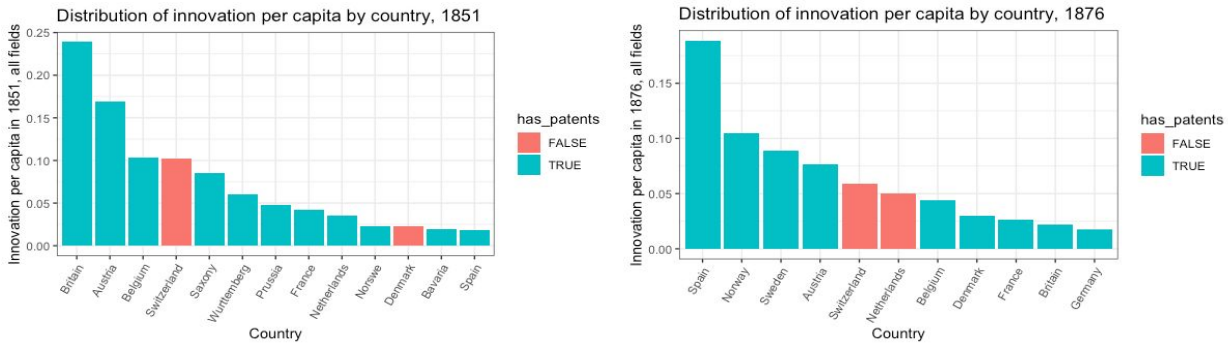


Notes: "Share of exhibits" measures the proportion of a country's exhibits that occurs among the industries: mining, chemicals, food processing, machinery, scientific instruments, textiles, and manufacturing. Innovation measured by the "share of exhibits". Sources of data: World's Fair Data in 1851 and 1876 collected by Petra Moser (2003).

To test hypothesis two, which is that patent law is not a necessary condition for innovation (here we use total exhibitions per capita to denote the innovation of one country). The necessary condition means patent laws are one of the conditions for innovation; there might be other conditions together with patent laws. So we have three ways to prove a necessary condition. If patent law is a necessary condition, then it must fulfil one of the statements below. 1) If patent laws do not exist, then the innovation does not exist either. 2) If patent laws and other needed conditions exist, then innovation exists. In this report, we use statement 1 to test the hypothesis that patent law is not a necessary condition for innovation. If there exists a situation where there

are no patent laws but still exist innovation, then we could prove the statement 1 is not valid such that our hypothesis is correct.

FIGURE 8. DISTRIBUTION OF INNOVATION PER CAPITA BY COUNTRY IN 1851 AND 1876



Notes: "Innovation per capita" measures the proportion of a country's total exhibits that occurs in the current year's World Fair and divided by its current population. Sources of data: World's Fair Data in 1851 and 1876 collected by Petra Moser (2003).

Through Figure 8, we can see that after abolishing the patent laws, the Netherlands had increased its innovation per capita. For Demark, after establishing the patent laws, it increased the innovation per capita as well. However, the case of Netherlands is convinced to argue that even if the patent laws do not exist, the innovation could also increase such that our hypothesis is correct that patent laws are not a necessary condition for innovation. Moreover, it is also an interesting question to find out why after the Netherlands abolished the patent law, the innovation indeed increased.

CONCLUSION

Based on the empirical evidence and analysis above, we prove our two hypotheses which are patent law influence the direction of innovation and patent law is not a necessary condition for innovation. In countries without patent law, inventors focus on industries which alternative mechanisms (like secrecy and hard to reverse-engineering) are effective like food processing, scientific instruments. As for the patent system, it is not necessary for the creation of innovation and the paucity of the economic evaluation of the patent system need to be considered for policy implications. To further understand the effect of the patent system on society development, we need to involve new fields of industries and standard criteria to evaluate the quality of inventions as for this globalization era.

Work Cited

Moser, P. (2003). How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World Fairs. doi:10.3386/w9909