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Practice.

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Discrimination against Foreigners.
The Wuerttemberg Patent Law in Administrative Practice.

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August 24, 2018

Abstract

Economists stress the leading role that inclusive institutions play among the various factors that foster a country's economic growth. In this article, we show that it might be misleading to mistake the codification of a formal rule for its effective administrative implementation. As the case of the German state Wuerttemberg demonstrates, a government's lip service to the principle of equal treatment does not guarantee that the local patent authority refrains from discriminating against foreign patentees by charging comparatively high patent fees. We conclude that the introduction of a stringent and formally fair patent law alone does not guarantee that foreign inventors' intellectual property rights are protected as well as those of the domestic patentees.

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Introduction

Economists stress the leading role that inclusive institutions play among the various factors that foster a country's economic development and growth. In this article, we show that it might be misleading to mistake the codification of a formal rule for its effective implementation. Our case in point is the formal introduction of the principle of national treatment into the patent laws of the German states. In 1842, the participants of the German customs union, the *Zollverein*, agreed on treating the inventors from all member states equally under each state-specific patent law. As the administrative practice of the Southwestern German state Wuerttemberg demonstrates, however, a government's lip service to the principle of equal treatment does not guarantee that the local patent authority really refrains from discriminating against foreign patentees. Trying to catch-up to more advanced German states such as Saxony or Prussia in the second half of the 19th century, Wuerttemberg decided to break codified rules to which the other states adhered. We conclude that the introduction of a stringent and formally fair patent law alone does not guarantee that foreign inventors' intellectual property rights are protected as well as those of the domestic patentees.

Following Douglass C. North's path-breaking contribution, economists (North/Thomas, 1973; North/Weingast, 1989; North, 1990; DeLong/Shleifer, 1993, Acemoglu/Johnson/Robinson, 2001; North/Wallis/Weingast 2009; Acemoglu/Robinson, 2012) interpret the establishment of inclusive institutions that guarantee free market access, secure property rights and reduce transaction costs as a necessary precondition for sustained economic growth. To prove the causal nexus between the quality of institutions and economic performance for the German industrialization, Acemoglu et al. (2011) analyze the long-term impact of the Napoleon-led French occupation of states in Northwestern and Western Germany that came along with radical institutional change such as the abolition of guilds and serfdom or the introduction of a civil legal code. The authors conclude that the longer a German state was under French rule the more firmly the new inclusive institutions became anchored in the German society and the higher was therefore subsequent economic growth. Based on these findings, Donges, Meier and Silva (2018) try to identify the channel through which the institutional reform influenced economic development the most. Using data about the distribution of valuable patents across German regions after 1877 (Streb/Baten/Yin, 2006), they observe that German counties with the longest period of French occupation had more than twice as many valuable patents per capita than unoccupied German counties that stuck to their traditional institutions for some additional time. That is why Donges, Meier and Silva (2018) claim that inclusive institutions are a first order determinant of innovation and therefore growth.

Most scholars who emphasize the positive effects of the codification of inclusive institutions implicitly assume that the administration will enforce them effectively. This is not something to be taken for granted. On the one hand, bureaucrats might be unwilling to implement the new rules because they still cling to the old ways of misusing their discretionary power for their personal benefit. Selgert (2018) discusses for the case of the German state Baden, which had also been under French occupation, how the Grand Duke of Baden established an efficient and uncorrupt administration in the decade after Napoleon's defeat. On the other hand, bureaucrats might not be allowed to enforce the new rules because their superiors have ordered them to follow instructions that are opposed to the official law. A case in point is the principle of national treatment found in every modern patent law that many patent authorities have disobeyed in the past.

To give local firms the opportunity to imitate foreign innovations at low cost, backward countries have always been tempted to discriminate against foreign inventors from more advanced countries. Antebellum America provides a classic example for a country that openly favored domestic inventors (Khan, 2005, p. 57). Initially, the US Patent Statute of 1793 had limited the right to acquire a US patent to American citizens alone. In the following decades, this discriminatory provision was relaxed to the extent that foreigners with permanent American residence became entitled to apply for an US patent too. The Patent Act of 1836 opened the American patent system finally also to foreign inventors living outside the US, who, however, had to pay a significantly higher patent fee than domestic inventors. Hard hit were above all the British inventors, who had to give \$ 500 for an American patent while for all other nationalities a fee of \$ 300 was enough.¹ To make it comparatively expensive for British inventors to hold an American patent was not without economic logic. Since Great Britain was the technologically most advanced country of the early 19th century, American firms could profit the most from selling unprotected British innovations in their large home market.

To what extent a domestic manufacturer profited from patent discrimination against foreigners depended largely upon the volume of its export activities because any additional profit a firm could get from preferential treatment at home could potentially be offset by a decrease in export gains that resulted from foreign retaliatory measures (Geng/Saggi, 2015, p. 15). That is why open patent discrimination against foreigners became a less attractive policy measure during the second half of the 19th century, when globalization led to strongly increasing international trade flows (O'Rourke/Williamson, 1999). In an international attempt to end the era of patent discrimination the founding members Belgium, Brazil, France, Guatemala, Italy,

¹ American applicants had to pay a fee of only \$ 30.

the Netherlands, Portugal, Salvador, Serbia, Spain, and Switzerland established the Paris Convention for the Protection of Industrial Property in March 1883. The United Kingdom joined this agreement in 1884, the United States of America in 1887, and Germany in 1903 (Seckelmann, 2006, pp. 226-228).² The most important outcome of the Paris Convention was the principle of national treatment that required that each national patent law treated domestic and foreign patent applicants equally.³ This rule has been retained until today. Notably, article 3 of the Agreement on the Trade Related Aspects of Intellectual Property (TRIPS) from April 1994 confirms the Paris Convention and obliges all member states of the World Trade Organization (WTO) to comply with the principle of national treatment.⁴

Arguably, national governments decided to give up discriminating against foreigners and to join the Paris Convention because they assumed that their domestic industries would realize net gains from enjoying secure intellectual property rights in their various export markets. Even better than a world where everybody adheres to the principle of national treatment, however, is a world where everybody except oneself is doing so. Because written law could no longer comprise any formal discriminatory clauses, discrimination against foreigners had to manifest itself now in informal administrative or juridical procedures that outsiders could not easily observe (or prove). Webster et al. (2014) argue that patent examiners' task to evaluate the inventiveness or non-obviousness of a patent application gives them the leeway in decision-making to prefer domestic inventors. Analyzing the examination practice of European and Japanese patent offices between 1990 and 1995, they find that domestic inventors are more likely to get a patent grant than foreign ones. Mai and Stoyanow (2014) assume that judges favor domestic firms in patent litigations. Based on information about the outcomes of all intellectual property rights litigations that took place in Canada between 2007 and 2010, they calculate that foreign firms face a smaller probability of winning the case.

Another way to discriminate against foreigners is to delay their patent grants to give domestic inventors the time to gain a competitive edge by filing many improvements around the original foreign patent application (Kotabe, 1992). Richter and Streb (2011) show that the

² Status April 2018, 177 states have joined the Paris Convention for the Protection of Industrial Property.

³ The original Paris Convention was written in French. Article 2 reads: "Les sujets ou citoyens de chacun des États contractants jouiront, dans tous les autres États de l'Union, en ce qui concerne les brevets d'invention, les dessins ou modèles industriels, les marques de fabrique ou de commerce et le nom commercial, des avantages que les lois respectives accordant actuellement ou accorderont par la suite aux nationaux. En conséquence, ils auront la même protection que ceux-ci et le même recours legal contre toute atteinte portée à leurs droits, sous réserve de l'accomplissement de formalités et des conditions imposées au nationaux par la législation intérieure de chaque État." The World Intellectual Property Organization (WIPO) provides the original version of the Paris Convention in the historical archives of its homepage.

⁴ <https://www.wto.org/english/docs_e/legal_e/27-trips-03_e.htm>, access on 15th June 2018.

German patent authority obviously used this strategy to support the domestic machine tool industry in the 1920s when the review period for American filers took more than twice as long as for German ones. The problems American manufacturers faced in dealing with the German patent office is illustrated by the experience of Sol Einstein, head of the design engineering department of the Cincinnati Milling Machine Company: “It was difficult to get a German patent granted due to the opposition from German manufacturers. I therefore was sent to Germany to straighten out the difficulties our attorney experienced. When our opponents found out that I was in Germany to attend a hearing before the patent office, from month to month they postponed the hearings in the hope I would not stay in Germany. Finally, after three months of delaying, the hearing was set. [...] Our opponents were willing to withdraw their position if we would grant them a license for using all twelve machines they had built. I insisted, however, on a ruling by the patent office, which finally granted the patent with very broad claims.” However, “through the united effort of a larger number of German companies, the patent, after four years in existence, was declared invalid.”⁵

This was not the first case of discriminating against foreigners in the history of German patent administration. We will show in the following that the patent authority of the Kingdom of Wuerttemberg, which is today one of the most innovative and prosperous European regions⁶, chose in the 19th century a less subtle way to prefer local patentees by imposing significantly higher patent fees to foreign inventors. We will argue that this administrative practice was not easily observable and gave the patent authority therefore the freedom of action to discourage foreign inventors from seeking long-term patent protection in Wuerttemberg. To prove this claim we will first elaborate the patent law of Wuerttemberg and discuss the possible reasons why a foreign patentee had to pay higher patent fees than a local one. In the second step, we will provide statistical evidence to prove the hypothesis that discrimination against foreigners did take place in Wuerttemberg.

The patent law of Wuerttemberg

Before 1877, no nation-wide patent law existed in Germany. Instead, the larger German states had established their own state-specific patent laws that differed considerably with respect to the examination procedure and the patent fees demanded (Donges/Selgert 2019). The

⁵ CHSL, Milacron, Series: Executives Personal History (Schwartz), Box B-H, Folder Sol Einstein: Einstein, Sol, I do remember – men, machines, and the plants behind the Cincinnati Milling Machine Company, August 1972, p. 7.

⁶ Greater Stuttgart (NUTS-2 level) is actually ranked fourteenth among the twenty regions of the European regions with a GDP per capita that is 50 percent or more above the EU average. See Eurostat news release 52/2017.

Prussian patent law, which is often referred to as exemplary for the German innovation system of the 19th century as a whole, was in fact rather the exception. Even if the very low patent fees give the impression that the Prussian legislator designed the patent system in a way that provided for many, also less wealthy inventors the opportunity to get patent protection, Prussian examination practice was rather restrictive. The Prussian patent inspectors rejected up to 90 percent of the patent applications judging them not to meet the requirement of novelty and inventive ingenuity. While the Prussian patent law mirrored many characteristics of the American patent law, most German middle states such as Bavaria or Saxony decided to follow the British example and established only a weak examination procedure. As a result, patents per capita were much higher in these states than in Prussia. In the 1860s, for example, Saxony and Bavaria granted annually 70 and 20 patents per one million inhabitants respectively whereas the Prussian number came only to 3.6 (Donges/Selgert, 2019).

Using the Bavarian patent legislation of 1825 as a model (Gehm, 2001, p. 87; Seckelmann, 2006, pp. 100-104), Wuerttemberg introduced its own patent rules within the trade act of 1828.⁷ The legislator especially copied the weak Bavarian examination procedure. That is why the patent authority of Wuerttemberg refused only about ten percent of all patent applications (Vischer, 1875, p. 498), which is in stark contrast to the Prussia rejection rate of 90 percent. Notwithstanding the basic similarity with the Bavarian patent law, the patent system of Wuerttemberg also possessed some rather unique features that allowed for discriminating against foreigners. First, privileged access to information about inventions of third parties was provided for locals. In contrast to the current practices, under the patent law of Wuerttemberg, a patentee was generally not obliged to publish the description of his⁸ patent during its life span. Residents of Wuerttemberg, however, had the right to see the patent description in the last year before a patent finally expired.⁹ This privilege gave the locals a head start when it came to imitating an innovation which patent protection was elapsing.

Another special feature of the patent law of Wuerttemberg was that the same patent fee did not apply to all patents. Instead, the patent authority was free to assign to each patent an individual fee that could range between five and twenty South German guilders per year.¹⁰ Table 1 reveals that foreign inventors had to pay on average a much higher patent fee than the

⁷ See *Allgemeine Gewerbe-Ordnung vom 5. Mai 1828*, in: *Regierungs-Blatt für das Königreich Württemberg vom Jahr 1828*, pp. 237-286. The patent rules can be found under Articles 143 to 163. The revised trade act of 1836 confirmed the patent legislation of 1828. See Articles 141 to 160 of the *Revidierte allgemeine Gewerbe-Ordnung vom 5. August 1836*, in: *Regierungsblatt für das Königreich Württemberg 1836*, pp. 385-434.

⁸ The use of the possessive proverb "his" indicates that, in the 19th century, most patents were held by male inventors. See Khan (2017).

⁹ See Article 150 of the trade act of 1828.

¹⁰ See Article 151 of the trade act of 1828.

residents of Wuerttemberg did. Surprisingly, foreigners from non-German countries did not bear the highest patent fees. Instead, the extra financial burden was especially high for patentees who lived in German states that became not a member of the German Customs Union (*Zollverein*) founded in 1834 (Keller/Shiue, 2014; Ploeckl, 2015).¹¹ Even inventors who resided within the borders of the *Zollverein* (but not in Wuerttemberg) had to pay a patent fee that was about 75 percent higher than the average patent fee of a resident from Wuerttemberg.

Table 1 Average patent fee and life span of patents in Wuerttemberg, 1844-1868

Patentees' country of residence	Annual patent fee	Assigned life span	Realized life span
Wuerttemberg	7.0 fl	6.7 years	5.1 years
German Customs Union	12.3 fl***	5.1 years***	3.9 years***
German states outside the Customs Union	16 fl***	6.2 years	4.3 years
Non-German states ^a	13.4 fl***	5.1 years***	3.9 years***
Total	9.8 fl	6.1 years	4.6 years

^a States that did not become part of the German Empire in 1871.

Source: Own calculations based on patent fees were taken from the original letters patents that are shelved in the *Staatsarchiv Ludwigsburg*.

Note: Asterisks indicate whether the mean values are significantly different from Württemberg. Significance levels are *** p<0.01, ** p<0.05, * p<0.1

Differences in the average life span of patents were less pronounced. Inventors were allowed to suggest the life span of their patent, which could be held up to ten years,¹² and, according to Gehm (2001, p. 157), the patent authority usually accepted their proposals. An inventor, however, was not forced to hold his patent until it expired but could give it up earlier when keeping it seemed no longer worth the annual patent fee. The fact that the ex-ante assigned life span was mostly longer than the ex-post realized life span suggests that inventors' expectations about the future profitability of their inventions were often too optimistic.

How did the patent administration explain the differences in patent fees? In a report, published in 1875, the patent authority of Wuerttemberg claimed to have been guided by two major principles when fixing patent fees in the last 25 years (Vischer, 1875, p. 495). The first principle applied to all inventors stipulating that the patent fee should increase with the expected profit the inventor would gain from his patent.¹³

¹¹ We assigned states that joined the German Customs Union after 1834 to one of the other two groups until the date of their entry.

¹² See Article 149 of the trade act of 1828. For a similar procedure in Italy see Nuvolari/Vasta (2015).

¹³ Lehmann-Hasemeyer/Streb (2016) show that investors at the Berlin stock exchange expected a corporation's profit to correlate positively with its patenting activities.

Table 2 Little evidence for retaliation fees

Country	Fee for a full-term patent in £	Mean (stdv) annual patent fees in Wuerttemberg in fl ^a	Number of patents with information on fees
Great Britain	180	15.7 (4.6)	15
Austria	155	11.4 (4.8)	13
Russia incl. Finland	155	10.8 (4.9)	6
Belgium	84	7.5 (3.5)	2
Netherlands incl. Luxembourg	62	10 (0)	2
Spain	60	13.8 (2.5)	4
France	60	14.8 (4.6)	70
Italy	54	12.0 (5.7)	5
USA	44 until 1861, 7 afterwards	11.3 (4.4)	8
Bavaria (since 1853) incl. Palatine	24	13.1 (4.8)	24
Baden	15	9.3 (4.5)	30
Saxony	11	15.0 (4.9)	24
Hanover	9	15.0 (5.0)	3
Wuerttemberg (average)	8,5	7.0 (3.3)	389
Sweden	8	10.0 (0.0)	2
Hesse Nassau	6	8.8 (2.5)	4
Hesse-Darmstadt	3	10,6 (6.4)	9
Frankfurt/Main	2,5	14.0 (5.5)	5
Kur Hesse (Hesse-Kassel)	1,5	15.0 (7.1)	2
Prussia	0.4	12.7 (4.5)	98
Hamburg	0	15.0 (7.1)	2
Schleswig	0	20.0 (0.0)	1
Switzerland	0	11,4 (5.0)	14

^a One British pound equaled 11.9 South German guilders.

Sources: Andersson/Tell (2019, Table 1), Donges/Selgert (2019, Table 1), Lerner (2000, Table 3), Nicholas (2011, p. 331), Sáiz/Amengual (2018, Table 1). The patent fees of Austria were taken from the *Kaiserliches Patent vom 15. August 1852*. Because of missing information, we excluded Algeria, Brunswick, Oldenburg, Sardinia and the Vatican State. Depending on the state-specific patent law “full-term” can mean ten or fifteen years.

The second principle was only relevant for foreign patentees because it demanded that their patent fee should have been the higher the more a resident of Wuerttemberg had to pay to keep a patent in force in the foreign inventor’s country of origin. Similar to a trade war involving punitive tariffs, the patent authority apparently responded to high foreign patent fees for domestic inventors with high domestic patent fees for foreign ones.¹⁴ Table 2, however, did not show a clear-cut correlation between the patent fees in an inventor’s home country and the

¹⁴ Clemens and Williamson (2004) argue that in the 19th-century-world without international coordination raising tariffs to retaliate against an increase in foreign tariffs might have been a growth-enhancing activity.

patent fees he had to remit in Wuerttemberg. Rather, it looks like patent holders from industrialized countries such as Great Britain, France or Saxony generally had to pay the highest patent fees.

Before we will employ regression analysis to explore in more detail whether the patent authority actually followed the retaliation principle in administrative practice, we want to discuss two additional motives the patent authority might have had, even if it did not publicly admit it. The first motive is a fiscal one. The patent authority might have been tempted to raise patent fees for residents of wealthy foreign states in order to increase the state revenue in Wuerttemberg. We cannot rule out a revenue-generating patent policy, but doubt that the fiscal motive played a big role. Between 1849 and 1873, the Württemberg State took a sum total of 60,000 South German guilders from patent fees (Vischer, 1875, p. 498), which corresponded to an annual average of less than 0.2 percent of total government revenue in this period (Mauersberg, 1988, p. 171).

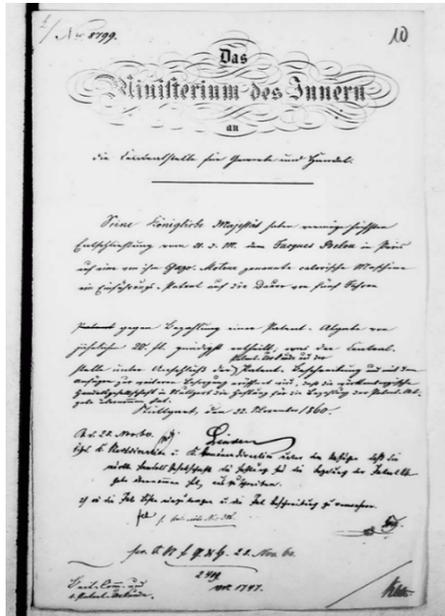
Finally, we need to clarify whether the patent authority might have had an interest in discriminating against foreign inventors. In Wuerttemberg, the patent authority was a sub-committee of the so-called *Centralstelle fuer Handel und Gewerbe* which was founded to support the ministry of the interior in matters of promotion of trade and industry. Although this committee included civil servants, the majority of its members were local business men who had been elected to the post by their peers. Among these, the entrepreneur Ferdinand von Steinbeis stood out, who had dedicated himself to the industrialization of Wuerttemberg and headed the *Centralstelle* between 1856 and 1880.¹⁵ The descriptive statistics presented in Tables 1 and 2 raise the suspicion that the local business men around Steinbeis used their influence to push through comparatively high patent fees for foreign inventors in order to discourage them to acquire a patent in Wuerttemberg or, if they did, to keep it long. Because the patent fees of the individual patent documents were not made public, it was generally not easy to discover such a difference in treatment. Such a discriminatory strategy would have been illegal, however, if the foreign inventors resided within the borders of the *Zollverein* because, in 1842, Wurttemberg had committed itself by law to treat the inventors from the other countries of the *Zollverein* in the same way as its own subjects.¹⁶ On the level of the German Customs Union, Article 2 of the law of 1842 was a precursor of the principle of national treatment

¹⁵ Ferdinand Steinbeis' (1807-1893) former career as an entrepreneur reached its peak in 1842 when he became managing director of the ironworks *Stumm* in Neunkirchen in the Saar region. As the head of the *Centralstelle fuer Handel und Gewerbe*, Steinbeis is especially credited for founding several trade schools. For a re-assessment of his lifetime achievement, see Kollmer-von-Oheimb-Loup (1998).

¹⁶ See Article 2 of the *Gesetz betreffend die Erfindungs- und Einfuhrungspatente vom 29. Juni 1842* in *Regierungsblatt für das Königreich Württemberg vom 8. Juli 1842*.

established in the Paris Convention of 1883. Whether the Patent authority of Wuerttemberg complied with this principle, we will research in the following sections.

Figure 1 A historical letters patent from the year 1860



Source: Landesarchiv Baden-Württemberg, Abteilung Staatarchiv Ludwigsburg E 170 a Bü 263 Bild 3.

Data and identification strategy

To find out whether patent fees were determined by the expected profitability of an innovation, retaliation, or discrimination, we need information about the individual patents.¹⁷ An unpublished register compiled by Hans Peter Münzenmayer, which is held by the *Wirtschaftsarchiv Baden-Württemberg*, provides details about the 1,141 patents the state of Wuerttemberg granted between 1818 and 1868.¹⁸ These information include a patentee's name and place of residence as well as a patent's assigned and realized life span. Sometimes, a patentee's occupation is also known. Based on its title, we assigned each patent to one of sixteen industries (from agriculture to building industry) (see Appendix Table A3). In addition, we hand-collected data about individual patent fees from the original letters patents that are shelved in the *Staatsarchiv Ludwigsburg*. Information are available for 731 out of 972 patents that were granted between 1844 and 1868. If we compare the geographical distribution of patentees in our restricted sample of 731 patents with the one in the full sample, we find that differences are only small (see Appendix Table A2). The years from 1844 to 1868 cover most of the period in

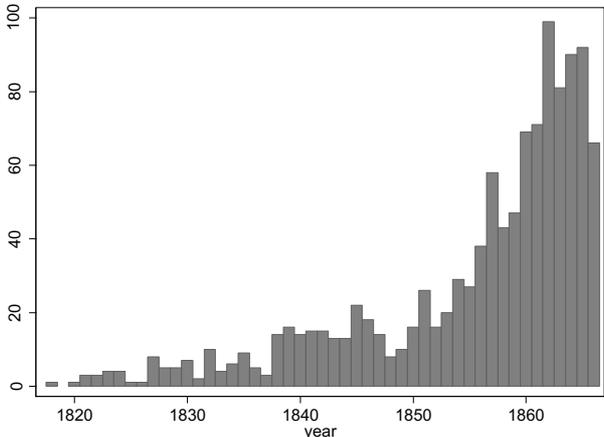
¹⁷ Kollmer-von Oheimb-Loup (2016) gives an overview about patenting activities in Wuerttemberg between 1818 and 1932.

¹⁸ We do not consider the patents granted in Wuerttemberg after 1868 because the introduction of a nationwide patent law in 1877 distorted their assigned and realized life spans.

which Wuerttemberg had promised not to discriminate against inventors from other member states of the German Customs Union. Figure 1 depicts a patent that was granted to the French inventor Jacques Belou from Paris in November 1860, who had invented a caloric machine. Belou had to pay the maximum annual patent fee of twenty South German guilders. The assigned life span of his patent was five years.

Figure 2 shows that patenting activities were rather low until the end of the 1830s, stagnated at a slightly higher level in the 1840s and early 1850s, and began to rise substantially since the late 1850s. This development mirrors the economic development of Wuerttemberg whose industrialization gained momentum in the second half of the 19th century.¹⁹

Figure 2 Newly granted patents in Wuerttemberg, 1818-1868

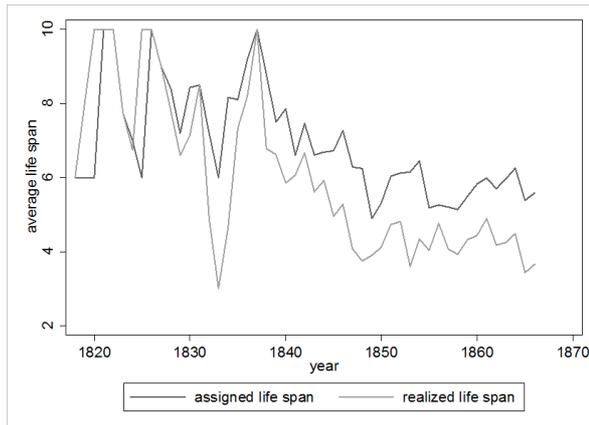


Source: Münzenmayer (no date).

Figure 3 illustrates the development of the patents’ assigned and realized average life span over time. We observe a downward trend of the average assigned life span in the 1840s and 1850s. At the first glance, this finding suggests that the patentees learned to form more realistic expectations with regard to the future economic performance of their inventions. The average realized life span, however, dropped even faster, which means that even shortened patent terms still turned out to be too optimistic.

Figure 3 Assigned and realized life span of the patents granted in Wuerttemberg

¹⁹ See Kollmer-von Oheimb-Loup (2016), pp. 51-56.



Source: Münzenmayer (no date).

The empirical fact that foreigners had to pay higher patent fees than inventors from Wuerttemberg does not automatically imply a case of systematic discrimination. Getting a foreign patent imposes additional costs in the form of expenses for patent lawyers and translators, fees for filing and renewing, and the longer-term costs of international disclosure of the underlying technology (Sáiz/Amengual, 2018). After weighing the costs and benefits of foreign patenting, most inventors therefore decide to file a patent only in their home country. Only their most promising innovations they will also patent abroad. That is why it is widely believed that foreign patents represent an especially valuable part of a country's patent stock (Degner/Streb, 2013; Streb, 2016).²⁰ This argument implies that the patents of Wuerttemberg that foreigners held were on average more valuable than the ones the residents possessed. If this was true, and the patent authority also did as it claimed and adjusted the patent fee to the expected profitability of an invention (see also Klostermann, 1876, p. 260), the higher patent fees foreigners had to remit might just indicate that they only brought their most valuable inventions to the market of Wuerttemberg.

These considerations lead to an identification problem. Since the patent status “held by a foreigner” can indicate either an above-average economic value or a target of discrimination, we cannot use this information to control for the quality of patents when trying to identify the quantitative effect of the patent administration's home bias. Fortunately, in patent systems like that of Wuerttemberg, where patent holders had to renew their patents annually by paying an additional fee, valuable patents can alternatively be identified by their realized life span (Schankerman/Pakes, 1986; Streb/Baten/Yin, 2006). In fact, legislators had deliberately introduced patent renewal fees in the hope that many patent holders who were not able to

²⁰ Today, the so-called triadic patents that are simultaneously filed at the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO) are used to identify a country's best innovations.

profitably exploit their patents would give them up early and make the new knowledge that was documented in the patent file publicly usable long before the assigned patent duration would have elapsed. Figure 3 suggests that this mechanism worked as intended, as many inventors obviously decided to forego their patents before the end of their term. That is why we interpret a long realized life span of a patent as a reliable indicator of its comparatively high private economic value.

Another way to identify the valuable patents of a historical patent population is to distinguish between patents of invention and patents of introduction. Patents of introduction were awarded to persons who introduced an innovation that was already successful abroad for the first time in Wuerttemberg. Originally, the person who applied for a patent of introduction did not need authorization by the original foreign inventor (Dölemeyer, 2015, p. 14).²¹ In 1842, however, this rule changed at least with respect to foreign inventors who lived in the German customs union. Formally accepting the new principle of national treatment, Wuerttemberg agreed on granting patents of introduction only to those persons who had already patented the invention in question in another member state of the German customs union.²² In the following years, the original inventor often teamed up with a resident of Wuerttemberg to apply for a patent of introduction. We assume that the patent authority assigned comparatively high patent fees to patents of introduction that protected inventions that had already proven their usefulness outside of Wuerttemberg.

To conclude, we base our identification strategy on the idea of determining the profitability of a patent by means of its life span and its status as a patent of introduction. For the possibility of retaliation fees, we control by the respective patent fee structure (see Table 2) in the home country of the foreign patent holder. That part of the excessive patent fees of foreigners, which profitability and retaliation *cannot* explain, we interpret as discrimination. Thus, we estimate an OLS regression, in which the variable we aim at explaining are the annual patent fees. In addition to our main explanatory variables retaliation fee, life span and dummies for patents of introduction and for place of origin, we control for sectors fixed effects, year fixed effects, networks of inventors (number of co-inventors), experience of inventors (total number of patents), distance to the patent office and overall number of granted patents per year.²³ The standard errors are clustered by sector.

²¹ Many backward countries that tried to catch up used this instrument. For the Spanish case see Sáiz/Pretel (2014).

²² See Article 3 of the *Gesetz betreffend die Erfindungs- und Einführungspatente vom 29. Juni 1842* in *Regierungsblatt für das Königreich Württemberg vom 8. Juli 1842*.

²³ For descriptive statistics, see Appendix Table A1.

Table 3 Determinants of patent fee at the level of groups of countries

VARIABLES	(1)	(2)	(3)
	Patent fee (OLS)		
Life span (assigned)		0.358*** (0.0431)	
Life span (realised)			0.273*** (0.0485)
Customs Union (<i>Zollverein</i>)	4.453*** (0.522)	4.837*** (0.486)	4.705*** (0.453)
Other German state	8.611*** (1.338)	8.357*** (1.252)	8.847*** (1.228)
Non-German state	5.974*** (0.418)	6.494*** (0.389)	6.300*** (0.396)
Retaliation	-0.00202 (0.00461)	-0.00237 (0.00475)	-0.00245 (0.00469)
Patent of introduction	2.207*** (0.714)	2.565*** (0.655)	2.254*** (0.657)
Distance to Stuttgart	6.45e-06 (0.000120)	3.95e-05 (0.000115)	-8.39e-07 (0.000126)
Number of patents by inventor	0.184 (0.169)	0.158 (0.149)	0.124 (0.160)
Number of fellow inventors (by inventor)	0.182 (0.364)	0.198 (0.330)	0.211 (0.346)
Patents per year	0.00952* (0.00502)	0.0336*** (0.00451)	0.0382*** (0.00684)
Constant	4.440*** (0.523)	0.297 (0.613)	1.361* (0.643)
Year and sector dummies	Y	Y	Y
Observations	712	712	712
R-squared	0.497	0.521	0.513

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Empirical Results

Table 3 shows that signs of discrimination against foreigners persist even if we control for profitability and retaliation. A German patentee, who lived outside the German Customs Union, had to pay a patent fee that was eight guilders higher than the one a resident of Wuerttemberg had to remit. A non-German patentee had to pay six guilders more, and even patentees from within the *Zollverein*, who were allegedly treated the same as locals, faced an excess patent fee of about 4.5 guilders. Regardless of this discriminatory treatment, the patent authority obviously took into account the expected profitability of the invention when calculating patent fees. A patent of introduction was about two guilders per year more expensive than a patent of invention, and the patent fee rose with both the assigned and the realized life

span of a patent. We also tested the idea that an experienced inventor, who had successfully applied for other patents in the past or had a network of co-patentees, produced patents of a higher quality and was therefore charged higher patent fees. The two variables “Number of patents by inventor” and “Number of fellow inventors” turned out to be insignificant, however. Likewise, we did not find any statistical evidence for the claim that the patent authority retaliated against high patent fees abroad. Interestingly enough, the average patent fee was positively correlated with the number of patent application that occurred in the same year. This finding suggests that the patent authority raised patent fees when demand for patent protection was high and lowered them when there was need to raise the attractiveness of the local patent system.

To investigate the suspicion that the patent authority of Wuerttemberg discriminated against inventors from selected countries we explicitly consider patentees’ countries of origin in Table 4. Obviously, the inventors from the most industrialized states of their time such as France and Great Britain, the Kingdom of Saxony, Bavaria including Palatinate (with an evolving innovative chemical industry (Streb/Baten/Yin, 2006)) and Prussia had to pay higher patent fees than patentees from backward states. The reason for this differentiation might have been similar to the one the American patent authority had before 1862 when charging especially high patent fees from British inventors: Local firms could profit the most from imitating unprotected innovations of the technologically most advanced countries. Surprisingly, the patent authority of Wuerttemberg gave American inventors the advantage of a comparatively low patent fee. We found no historical explanation for this preferential treatment and can therefore only speculate that Wuerttemberg was especially interested in attracting the American inventors to its own market.

When controlling for individual countries of origin, we also identify a significant correlation between the patent fees in an inventor’s home country and the patent fees he had to remit in Wuerttemberg. This suggests that, after all, retaliation played a role when the patent office of Wuerttemberg determined patent fees for foreign inventors. In contrast to Table 3, Table 4 also provides some evidence that well-connected inventors produced inventions of higher quality whereas the number of patent application that occurred in the same year lost their significant impact on the patent fees.

Table 4 Determinants of patent fee at the level of individual countries

VARIABLES	(1)	(2)	(3)
		Patent fee (OLS)	

(mean) lenght_applied		0.359*** (0.0468)	
(mean) lenght_actual			0.260*** (0.0453)
Baden	0.509 (0.672)	0.821 (0.625)	0.895 (0.663)
Bavaria incl. Palatine	4.849*** (1.279)	5.204*** (1.130)	5.109*** (1.226)
Prussia	3.891*** (0.577)	4.160*** (0.475)	4.034*** (0.530)
Hesse Darmstadt	2.897 (2.106)	3.440 (2.109)	3.395 (2.150)
Kgd. Saxony	4.392*** (1.070)	4.974*** (0.990)	4.600*** (0.978)
Other german states ^a	5.817*** (1.802)	5.797*** (1.848)	5.835*** (1.760)
England	3.384** (1.221)	3.251** (1.182)	3.212** (1.162)
France	4.802*** (0.688)	5.173*** (0.596)	5.024*** (0.645)
Russia	-1.729 (2.037)	-2.073 (1.893)	-2.165 (1.924)
Switzerland	4.383*** (1.243)	4.658*** (1.221)	4.446*** (1.243)
USA	-18.88** (7.163)	-19.30*** (6.355)	-19.39** (6.820)
Austria	0.368 (1.469)	0.687 (1.496)	0.183 (1.486)
Other non German states ^b	1.874 (1.099)	2.432** (1.052)	2.057* (1.048)
retaliation	0.00757 (0.00860)	0.00908 (0.00854)	0.00924 (0.00835)
Retaliation	2.103*** (0.693)	2.394*** (0.662)	2.126*** (0.646)
Patent of introduction	2.406*** (0.707)	2.533*** (0.626)	2.480*** (0.675)
Distance to Stuttgart	0.263** (0.101)	0.190** (0.0823)	0.176* (0.0981)
Number of patents by inventor	-0.0880 (0.331)	-0.0847 (0.308)	-0.0748 (0.321)
Number of fellow inventors (by inventor)	0.0112 (0.00695)	0.0372*** (0.00639)	0.0398*** (0.00845)
Patents per year	3.861*** (0.554)	-0.300 (0.542)	0.919 (0.638)
Sector and year fixed effects	Y	Y	Y
Observations	712	712	712
R-squared	0.532	0.556	0.546

Robust standard errors in parentheses, clustered by sector

*** p<0.01, ** p<0.05, * p<0.1

^a Here, we cover the German states for which we observe less than six patents. Frankfurt/Main, Hamburg, Hanover, Hesse Nassau, Kur Hesse (Hesse-Kassel), and Schleswig are concerned.

^b Here we cover non-German states for which we observe less than six patents. Belgium, Netherlands incl. Luxembourg, Italy, Spain, and Sweden are concerned.

To find out whether comparatively high patent fees pushed foreign inventors out of the market of Wuerttemberg, we research the determinants of early patent termination. This is done by applying a logit regression, in which the dependent variable is equal to one, if the assigned life span is longer than the realized life span and zero otherwise.

Table 5 Determinants of patent cancellation

VARIABLES	(1) cancelled	(2) cancelled	(3) cancelled	(6) cancelled
				Only if life span realized >2
Patent fee			-0.0272 (0.0250)	-0.0512 (0.0322)
Life span (assigned)		0.151*** (0.0243)	0.171*** (0.0237)	0.275*** (0.0381)
Customs union (<i>Zollverein</i>)	0.408 (0.307)	0.581* (0.331)	0.701* (0.396)	0.454 (0.475)
Other German state	0.473 (0.609)	0.347 (0.558)	0.536 (0.604)	-0.382 (1.319)
Non-German state	0.250 (0.277)	0.450* (0.272)	0.640* (0.379)	1.160 (0.741)
Retaliation	-0.000538 (0.00230)	-0.000715 (0.00237)	-0.000237 (0.00254)	-0.00302 (0.00505)
Patent of introduction	-1.211*** (0.438)	-1.093** (0.450)	-0.936** (0.441)	-0.568 (0.542)
Distance to Stuttgart	-0.000104 (8.57e-05)	-8.74e-05 (8.82e-05)	-9.55e-05 (9.10e-05)	-6.51e-05 (0.000113)
Number of patents by inventor	-0.254 (0.157)	-0.294* (0.164)	-0.316** (0.158)	-0.316 (0.212)
Number of fellow inventors (by inventor)	0.147 (0.168)	0.161 (0.171)	0.140 (0.159)	-0.0778 (0.180)
Patents per year	-0.00637 (0.0123)	-0.00557 (0.0122)	-0.00859 (0.0140)	-0.0371 (0.0336)
Constant	0.667 (0.830)	-0.416 (0.789)	-0.00420 (1.008)	-0.230 (2.840)
Year and sector dummies	y	y	y	y
Observations	747	747	706	481

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Standard error clustered by sector

Table 5 provide slight evidence that inventors from the *Zollverein* and non-German states faced a higher probability to cancel their patents prematurely than those living in Wuerttemberg, but patent fees did not drive this result. However, the intention might have existed even if the desired effect of discrimination did not occur. The low cancellation rates of patents of introduction confirms our assumption that they presented more useful innovations

than patents of invention. That the probability of cancellation is correlated positively with the assigned life span is a rather mechanical relationship: The longer the assigned life span, the more opportunities a patentee had to cancel his patent before the assigned term elapsed.

Table 6 Determinants of assigned life span

VARIABLES	(1)	(2)	(3)	(4)
	Life span assigned (OLS)			
	Patent fee=20 fl	Patent fee=15 fl	Patent fee=10 fl	Patent fee=5 fl
Customs union (<i>Zollverein</i>)	-2.255*** (0.664)	-3.881*** (0.855)	-1.859*** (0.314)	-1.507*** (0.445)
Other German state	-2.691 (1.629)	-6.355** (2.735)	-0.325 (1.516)	
Non-German state	-3.314** (1.209)	-3.655* (1.745)	-2.662*** (0.438)	-0.954** (0.435)
Retaliation	0.00553 (0.00523)	-0.00136 (0.0180)	0.00259 (0.00423)	-0.00900 (0.00808)
Patent of introduction	-1.081* (0.590)	1.027 (0.782)	-1.964*** (0.330)	-0.398 (0.763)
Distance to Stuttgart	5.96e-05 (0.000361)	-8.79e-05 (0.000714)	-0.000230** (8.95e-05)	5.66e-05 (4.72e-05)
Number of patents by inventor	-0.0869 (0.188)	-0.767* (0.399)	0.0243 (0.196)	0.121 (0.169)
Number of fellow inventors (by inventor)	0.624 (0.359)	2.290 (3.086)	-0.284 (0.242)	0.112 (0.275)
Patents per year	0.0780** (0.0308)	-0.0531 (0.0497)	-0.0543*** (0.0126)	-0.0929*** (0.0117)
Constant	4.409*** (0.454)	16.20*** (3.513)	12.17*** (0.555)	12.25*** (0.200)
Year and sector dummies	Y	Y	Y	Y
Observations	94	54	272	289
R-squared	0.596	0.798	0.420	0.237

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Standard error clustered by sector

To support our main argument, we conclude with a (counterfactual) thought experiment assuming that the assigned patent fees correctly reflected the value of the individual patents. If that were true, the patent authority could have only discriminated against foreigners by granting them a comparatively short patent term. To explore the determinants of the assigned life span, we divided the historical patent population into four sub groups according to their patent fees. The first sub group, for example, only contains patents with an assigned annual patent fee of 20 guilders. Again, the coefficients are estimated with OLS and standard errors are clustered by

sector. Table 6 reveals that, given a fixed patent fee, inventors who resided within the *Zollverein* or in a non-German state got a shorter assigned patent term than patentees from Wuerttemberg did, meaning that their patent protection was weaker.

Conclusions

In the second half of the 19th century, Wuerttemberg was catching up to the more industrialized countries and became one of the most innovative regions throughout Europe. At the beginning of this development stands the reform of the state's patent law that gave residents of the other member states of the German customs union the same formal rights as the local inventors already had. Scholars who like to stress the importance of institutions for economic growth might argue that the introduction of this particular set of inclusive institutions was an important precondition for the subsequent blossoming of innovative economic sectors such as machine building or car manufacturing in Wuerttemberg. Formal rules can be misleading, however. What often matters more is the hidden agenda of the public administration that is responsible for enforcing these rules. We have shown in this article that the patent authority of Wuerttemberg, whose majority were local business men, discriminated against foreign inventors from industrialized countries by charging comparatively high patent fees or assigning relatively short patent terms.

If these discriminatory measures enabled local firms to imitate foreign technology faster than under fair conditions, the extractive use of formally inclusive institutions might have fostered economic development in Wuerttemberg. This tentative conclusion is in line with the argument by Boldrin and Levine (2008) who assume that the strict compliance to the international rules of law with respect to intellectual property rights will decelerate the speed of technological and economic progress in developing countries' domestic industry. It stands in sharp contrast, however, to a recent claim by Donges and Selgert (2018) who suppose that the fair treatment of foreign inventors in Wuerttemberg's neighboring state Baden increased the inflow of new knowledge into the state's economy and therefore growth in the 19th century.

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Appendix:

Table A1: Descriptive statistics

Variables	Mean	Standard deviation
Life span assigned	6.080631	2.479138
Life span realized	4.624014	2.668152
Patent fees	9.756131	5.048921
Retaliation	19.98529	35.49695
Patent of introduction	0.1428571	0.3501546
Distance to Stuttgart	320.9121	915.9034
Number of patents by inventor	1.370727	0.9119972
Number of fellow inventors	1.134093	0.3956826
Patents per year	54.39001	31.74904
Cancelled	0.4189308	0.4936004

Source: see text

Table A2: Country of residence: full sample and sub sample, 1844-1868

Patentees' country of residence	Sample for which we have information on fees		Full sample of patents after 1844	
	Total	In percent	Total	In percent
Wuerttemberg	381	52.7	537	55.25
German Customs Union	196	27.11	254	26.13
German states outside the Customs Union	10	1.38	12	1.23
Non-German states	136	18.81	169	17.39
Total	723	100	972	100

Source: see text

Table A3: Assigned life span and annual patent fees by sector

Sector	Assigned life span (1818-1868)			Annual patent fee (1844-1868)		
	mean	sd	N	mean	sd	N
Agriculture	6.7	2.8	44	9.0	5.2	30
Mining	10.0		1			0
Food and beverages	6.1	2.4	110	9.2	5.1	69
Textiles, clothes and shoes	6.1	2.5	197	10.8	5.6	132
Paper	6.1	2.4	69	9.9	5.4	40
Coke and oil	5.8	2.4	41	10.2	5.2	28
Chemicals	6.4	2.5	94	12.1	4.4	55
Stones	7.0	2.9	40	9.5	3.2	26
Metal working	6.3	2.7	33	9.8	5.7	20
Metal products	6.0	2.5	108	10.4	4.9	72
Electricity	6.0	2.3	13	6.1	2.2	9
Instruments and scientific apparatus	5.9	2.6	54	7.8	3.3	32
Machines	5.6	2.0	150	9.2	4.7	111
Cars	5.6	2.7	27	13.8	5.6	16
Music, jewellery, medical instruments	6.2	2.4	143	7.1	3.7	82
Construction	6.1	2.9	17	12.9	5.8	12
Total	6.1	2.5	1141	9.8	5.0	734

Source: see text