

# **Patenting and Early Industrialization in Norway, 1860-1914. Was there a Linkage?**

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## Introduction

Patents and industry in the “modern” sense came to Norway at about the same time. The patent system was formally established in 1839. The first textile manufacturers and mechanical engineering firms were established in the 1840s. During the latter part of the nineteenth century and the first decades of the twentieth century Norway was gradually industrialized. There has for long been an issue among Norwegian economic historians whether or when - within this period - there was an industrial breakthrough; from the 1840s, the 1880s or after the turn of the century? So far, patents, patent policy and the role of the patent institution (legislation, administration) have not been explicitly related to this question. This paper will therefore examine and analyse the development in patenting, the institution and the policy. It will compare the development in patenting with other indicators of industrialization, and investigate to what extent the system was developed to stimulate modernization and industrialization.

The paper is organized in the following way: It starts out with general observations on the relationship between patenting and early industrialization. Secondly, it reviews the industrialization in Norway from about the mid nineteenth century with a focus on whether and when an industrial breakthrough took place. Thirdly, the paper describes the institutional development of the Norwegian patent system in the period. Finally, the main part of the paper describes and analyses the Norwegian patent data in the period 1860-1914.

The first twenty years with a patent system in Norway, 1839-1860, was dealt with in a previous paper.<sup>1</sup> That was a period with a very moderate interest in patenting, both among Norwegians and foreigners. This paper expands on that work.

### Patenting and Industrialization

The topic under consideration in this paper relates to a substantial historical literature on the relationship between patents and industrialization, industrial breakthroughs and the Industrial Revolution in particular. It also relates more generally to research on the relationship between patents and inventions, innovation, diffusion, technological change and productivity growth.

It seems to be a never ending debate and an unresolved topic whether patents are something completely in a world of its own, or whether they are part of the “ordinary” economic life and thus related to economic and technological development. Does the existence of a patent system encourage or discourage technological change? Do patents indicate technological change? Reviews of the literature usually conclude in raising the standard warning sign. Joel Mokyr is just one example: “It remains an open question whether a bad approximation such as patent statistics is better than no approximation at all, ...”.<sup>2</sup> The numerous in-depth studies of patents and the patent system during the early industrialization in several countries that have emerged over the last twenty years or so, seem to share this scepticism. Great caution should be shown in interpreting development in patenting. There seems also, on the other hand, to be a consensus that growth in patenting in one way or another is connected to emerging industrialization – maybe more reflecting economic changes than invention in a narrow sense.<sup>3</sup> As long as the main question under investigation is to understand *the patterns of early industrialization*, patent-history has a role to play.

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<sup>1</sup> B.L. Basberg, “Creating a Patent System in the European Periphery: The Case of Norway, 1839-1860”, *Scandinavian Economic History Review*, Vol. XLV, No. 2, 1997.

<sup>2</sup> J. Mokyr, *The Lever of Riches. Technological Creativity and Economic Progress*, Oxford 1990, p. 251.

<sup>3</sup> The British case, with a natural focus on the Industrial Revolution has in particular been studied by H.I. Dutton, *The Patent System and Inventive Activity during the Industrial Revolution 1750-1852*, Manchester 1984 and C. MacLeod, *Inventing the Industrial Revolution. The English Patent System, 1660-1800*, Cambridge 1988. See also R.J. Sullivan, “England’s “Age of Invention”: The Acceleration of Patents and Patentable Invention during the Industrial Revolution”, *Explorations in Economic History*, Vol. 26, 1989. The U.S. case has in particular been explored by K. Sokoloff and associates; see K. Sokoloff, “Inventive Activity in Early Industrial America: Evidence From Patent Records, 1790-1846”, *The Journal of Economic History*, Vol. XLVIII, No. 4, 1988.

## Early Industrialization in Norway

Early nineteenth century Norway was a predominantly agricultural economy. Around fifty percent of the GNP originated in that sector. If fisheries and forestry are included, the GNP share was more than seventy percent.<sup>4</sup> There were obviously industries of various kinds; iron works, mills, distilleries, saw mills, rope-walks, shipyards, tanning yards, tile makers etc. With a few exceptions, they were small establishments with few employees. The organisations resembled craft more than factories. They were proto-industrial enterprises.

The establishment of the textile industry marked a change. It was the first industry of the “modern” kind with a direct link back to the British Industrial Revolution. Two firms had been established in 1813 and 1818, but the real expansion took place in the 1840s when plants were set up in Kristiania (Oslo) and outside Bergen. The textile industry became a growth sector with an increase in employment all the way to 1914.

The 1840s also saw the introduction of another new industry; the mechanical engineering industry. The firms typically started out repairing imported machinery. They gradually increased their own skills and developed into manufacturing of various kinds of machinery for other Norwegian industries and into major shipyards building iron-steam ships.

The 1840s and 50s clearly marked a change in industrial development in Norway. It was a first wave of industrialization. Various explanations of this development have been suggested. Some focus on internal factors, like population growth, decline in the agricultural sector, economic policy and new institutional arrangements that facilitated the establishment of commercial activities. Some emphasize international factors, like growth in the international economy and British commercial policy – especially the more liberal policy of technology transfer.

From the 1870s and -80s a second wave of industrialization in Norway may be identified. It was connected to a gradually more advanced and sophisticated use of the abundant Norwegian raw material; wood and timber. The saw mills had in terms of number and employment been a major industry all along. In the 1860s the first mechanical pulp

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<sup>4</sup> F. Hodne and O.H. Grytten, *Norsk økonomi i det 19. århundre*, Bergen 2000, p. 90.

manufacturers were established, and the number grew throughout the 1870s and -80s – delivering input to the European paper manufacturers. A second phase in the development was the cellulose industry. The first companies were established in the late 1880s, and the industry expanded rapidly in the -90s. So, in the late 1890s, a domestic paper manufacturing industry was established, thus one step further was taken in the gradual improvement of domestic industrial skills. The cellulose and paper industry had a close link to advancements in the chemical sciences. The development thus signified that Norwegian industrial development was gradually moving from the First to the Second Industrial Revolution Era. This development was even more apparent during the next phase of the industrialization.

A third wave of industrial expansion has usually been connected to various industries established from around the turn of the century to utilize hydro-electric power. One was the electro-chemical industry, with the establishment of Norsk Hydro in 1905 to commercialise the Birkeland-Eyde method for manufacturing artificial fertilizer as the most well known example. The electro-metallurgic industry was another example, where the manufacturing of aluminium gradually became a Norwegian specialty. The electro-technical industry was a third group within this cluster – not based on the use of hydro-electricity, but supplying other industries and households with electricity related products.

It is possible to make some general observations on the Norwegian industrial development of the second half of the nineteenth and early twentieth century. First, although there was obviously an industrialization process going on, Norway was way behind the western European core of early industrialized nations. Looking at per capita industrial production in 1900, Norway was still slightly below the European average.<sup>5</sup> Second, there were clearly phases in the development, with new growth industries that emerged in a sequential order. Textile and mechanical engineering emerged from the 1840s. Wood processing emerged from the 1870s and 80s, and the metallurgic and chemical industries grew from around the turn of the century. Third, the foreign influence on the development was significant. Technology import, especially from Great Britain was especially apparent in the first phase. Foreign capital and ownership became typical especially from the turn of the century. Fourth, industry expansion especially in the second and third wave, was clearly associated with areas that

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<sup>5</sup> I.T. Behrend and G. Ránki, *The European Periphery and Industrialization 1780-1914*, Budapest 1982, p. 144.

Norway had a comparative advantage in domestic resources; timber and sources for hydro-electric power.

The question is then; within this period of gradual industrial development in Norway, is it possible to specify any particular period or phase as representing an “industrial breakthrough”? Hovland and Nordvik have reviewed the literature and research on this topic.<sup>6</sup> They studied various sources and several statistical indicators, and reviewed the research by other Norwegian economic historians over the past twenty years or so. They conclude that Norway indeed had experienced an industrial breakthrough before World War I. When it comes to a more specific timing, they discuss three main positions taken by Norwegian economic historians; (1) The growth of the textile industry and mechanical engineering between the 1840s and the 1870s (Bruland); (2) The growth in wood processing industries in 1880s and 90s (Sejersted and Lange); and (3) The growth in electrochemical and electrometallurgical industries between 1905 and 1920 (Hodne). Hovland and Nordvik reject the first wave of industrialization as any industrial breakthrough. They are more uncertain when it comes to which one of the next waves that signifies a breakthrough, but are inclined to conclude that the Norwegian industrial breakthrough took place during the last two decades of the nineteenth century. They base their conclusions mainly on data on industrial employment. They realize that more research is needed before any conclusions can be drawn with more certainty. They also encourage more effort to be put into the reconstruction of data on nineteenth century Norwegian national accounts. I will leave this to others and instead give a more limited contribution to shed light on this question, in presenting and analysing data on patents.

### The patent institution

A patent legislation was introduced in Norway in 1839 , incorporated in the *Act for the Protection of Trades and Crafts* (Lov om Haandværksdriften). The government responsibility for granting patents was with the Ministry of Finance and the Ministry for the Interior (from 1850). The responsibility for examination was delegated to the independent society *Selskabet*

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<sup>6</sup> E. Hovland and H.W. Nordvik, “Det industrielle gjennombrudd i Norge 1840-1914 med samtidens og ettertidens øyne”, in B.L. Basberg, H.W. Nordvik and G. Stang (eds.), *I det lange løp. Essays i økonomisk historie tilegnet Fritz Hodne*, Bergen 1997, pp. 61-85.

for Norges Vel.<sup>7</sup> Patents were granted for five, seven or ten years. The institutional arrangements did not change much over the first twenty years. Only when the number of applications, as we will see, started to increase dramatically in the 1870s, there became an increased pressure on the organization. It was not able to handle the increased work load efficiently. The fact that Selskabet for Norges Vel was a private – not a public – organization, was also criticized. A commission was set up in 1876 to suggest changes in the legislation. It made slow progress, one reason was that it awaited revisions of the patent laws in several other European countries. A reason was *not*, as had been the case earlier, that there was an opposition against the system as such. Rather to the contrary, the prevailing view was now in favour of a strong patent system. Secrecy, according to the commission, was the worst enemy of industrial progress. Patents, on the other hand, were seen as an important instrument in fostering industrial development.

A telling example of this political attitude of using the patent-system explicitly in generating industrial activity, relates the emerging Norwegian whaling industry.<sup>8</sup> Throughout the 1860s Svend Foyn had invented and developed several devices for whale hunting (a grenade harpoon gun, a whaling steam vessel etc.) that initiated what was to become known as “modern” whaling. The Norwegians gradually took over the hegemony of an industry that for decades had been dominated by the Americans. Both in 1870 and 1872 Mr. Foyn was granted patents for his harpoon. When, however, a German company appeared on the Northern Norway whaling grounds in 1872 in an attempt to study and copy Foyn’s methods, he immediately reacted on what he obviously considered as industrial espionage. He argued that the government should intervene and support him, because he tried to create a new industry for the nation. He then applied for a patent that covered not only his single inventions, but the entire new catching system, including vessel and devices. The application was recommended by Selskabet for Norges Vel as well as the Ministry for the Interior. The patent, for ten years, was finally approved by the government on January 14. 1873. There were concerns about the width and extent of the patent. The government realized that it in reality had granted Mr. Foyn a monopoly, but at the same time, it saw this as an opportunity to create and protect a new

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<sup>7</sup> See Basberg (1997), *op.cit.* The standard account of the historical development of the Norwegian patent institution is Aa. Svinndal et.al. (eds.), *Styret for det industrielle rettsvern – 50 år*, Oslo 1961. A summary in English, p. 313 ff.

<sup>8</sup> A.O. Johnsen and Joh. N. Tønnessen, *Den moderne hvalfangsts historie*, vol. I, Oslo 1959, p. 218ff. An explicit account and analysis of patents in this industry, see A.O. Johnsen, *Norwegian Patents Relating to Whaling and the Whaling Industry. A Statistical and Historical Analysis*, Oslo 1947, and B.L. Basberg, “Technological change in the Norwegian whaling industry. A case study in the use of patent statistics as a technology indicator”, *Research Policy*, Vol. 11, No. 1, 1981.

industry and block for a foreign competitor. Selskapet for Norges Vel (Industriklassen) put it this way: The elements in the application taken together constitute one large invention of particular interest to the nation.<sup>9</sup> However, when Foyn proposed that his patent was extended to include also the shore based processing methods (oil rendering etc.), the government rejected.<sup>10</sup>

Svend Foyn's monopoly kept competitors away, thus delaying the diffusion and expansion of the industry for a ten year period. Only one intruder was accepted. When in 1877 a Norwegian whaling company entered business, using - without permission - Foyn's patented technology six years before the patent expired, several courts ruled in his disfavour. An expansion of the industry was welcomed – as long as the participants were Norwegians.

A new patent act was passed in 1885 (in effect from January 1. 1886). In many respects it was modelled after the German legislation.<sup>11</sup> An important institutional change was the foundation of a *Patent Commission*, from now on responsible for examination and the overall management of the system. It was not a large organisational body; a moderate five members from the beginning, increasing to twelve in the later years of our period of investigation. Within this new legislation, patents could be granted for fifteen years.

An increase in applications in the 1890s again demanded organizational changes. A new committee to reform the patent act was set up in 1898, and again the work dragged on due to the need for international co-ordination. This time the issue was a common Scandinavian patent act. This was, however, never materialized, and a new Norwegian Patent Act was passed in 1910. The most significant change was that the Patent Commission was succeeded by the new *Styret for det industrielle rettsvern* (The Council for the Protection of Industrial Rights). Again the maximum length of protection was extended, this time to seventeen years.

There were, as we have seen, three clearly distinct phases with different institutional arrangements and legislation within the period 1860 to 1914. The first was from 1860 to

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<sup>9</sup> “...når det hele system betraktes under ett, hvorved hver av disse i og for seg lite merkelige enkeltheter inntreer som ledd i en eneste stor oppfinnelse, der spesielt for vårt land tør antas å være av ikke liten betydning.” Quoted from Johnsen and Tønnesen, op.cit., p. 221.

<sup>10</sup> Ibid., p. 223.

<sup>11</sup> The main principles of this act have, in fact, never been changed, for example regarding procedures for investigation and examination of the applications

1885. The second was the years of the Patent Commission, 1886-1910. The third was the years of the Patent Council (Patentstyret), 1911-1914.

### Development in Patenting in Norway

There was a very moderate interest in the patent system in Norway for the first twenty years after the establishment in 1839. The total number of applications never reached more than nineteen annually (in 1859). Patents granted to Norwegian citizens never climbed above ten annually (in 1856).<sup>12</sup> However, the creation of the system itself was an example of institution-building which at the time was considered important in order to stimulate industrial development and modernization. The Act for the Protection of Trades and Crafts signified a new era and became the basis for institutional arrangements that played an important role in explaining the first wave of industrialization in the 1840s. However, it took time to get the system working efficiently. That was probably one reason for the moderate interest – in much the same way as other countries had experienced earlier.<sup>13</sup>

The development in patenting in Norway in the period 1860 to 1914 is listed in Appendix A. It lists the most common types of patent data; the total number of applications, the total number of patents granted, applications from Norwegians, patents to Norwegians – and different relations in the development between such data series.

Figure 1 illustrates the trends in the total number of applications, the total patents, and patents granted to Norwegian citizens in the period 1860 to 1914. The moderate interest in the Norwegian patent institution that was observed for the first twenty years of its existence continued, but there was an increase in a somewhat faster rate throughout the 1860, with a record 68 applications in 1868. The 1870s experienced a sharper increase, especially from the mid 1870s, although there were ups and downs in the number of applications throughout the decade. 200 applications annually was passed in 1881, and the annual increase continued at a fairly even rate until 1886. The annual increase was more moderate for some years, and a new sharp increase in applications was experienced from 1894 until 1900. From then on the

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<sup>12</sup> Basberg (1997), *op.cit.*, Table 1.

<sup>13</sup> There is, of course, more to say here: As Dutton (*op.cit.*) showed for the British case, the very imperfect nature of the patent system before around 1830 may have facilitated diffusion and technological change as such, more than a “perfect” system would have done.



applications declined for several years, until a new and uneven growth phase started in 1906. Overall, the total number of patent applications in Norway increased gradually over the period under investigation. It is, however, possible to observe distinct phases within the period. One may be observed in the 1870s and 80s, another in the latter half of the 1890s. The late 1880s and early 1890s, and again the first decade of the twentieth century experienced lower annual growth rates in patent applications.

The number of patents granted in Norway developed in much the same way as the applications over the period from 1860 to 1914.<sup>14</sup> Phases and rates of changes were much the same. An exception was a sharp drop in the number of granted patents in 1911. This may be explained in terms of institutional changes (see below).

Applications and patents granted to Norwegian citizens were moderate throughout the entire period. Granted patents were never more than 300 annually (Figure 1 and Figure 2). Patents that were granted to Norwegian citizens, reveal one fairly distinct growth period throughout the 1880s. Before that period, the annual growth was gradual and very modest. From the 1890s and all the way along to 1914, there was an overall growth trend, but with significant annual variations and setbacks. There was a drop after 1910 similar to the one seen in total grants.

We only have data on applications from Norwegians from 1886 (Figure 2). In that year the total number was 145. The increase was moderate, and it is difficult to reveal any clear phases or periods. It was a gradual increase in the annual numbers throughout the entire period, with a few annual setbacks. Applications reached more than 500 per year only in the last years before World War I.

If we take a closer look at the proportion of the patent applications that was granted every year (Figure 3) we find a peculiar development. In the years between 1885 and 1910 the proportion relating total patenting was extremely stable around 85%. Data relating Norwegian citizens were systematically lower, in the 70 and 80 percent range, and the annual fluctuations

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<sup>14</sup> Before 1910 the examination time was on average less than a year. Thus there are no significant lags between aggregate data on applications and patents in most of the years we are studying. Over time, the average examination time increased, and in the period 1911 to 1914 more than fifty percent of the applications had to wait for more than a year before a decision was made. See B.L. Basberg, *Patenter og teknologisk endring I Norge 1840-1980*, Bergen (NHH) 1984, p. 96ff.

were higher. These differences obviously had an institutional explanation. As we have seen, these were the years of the Patent Law of 1885 and the Patent Commission. The extraordinary high proportion related, as we can see from the data, the applications with a foreign origin. Norway had signed the so called Paris Convention in 1885, and accepted the new priority rules. So, applications with a foreign origin obviously had an almost pro forma examination during this period. When a new legislation was adopted in 1910, the proportion dropped and was in the years to come typically in the 50-70% range.

The policy shifts in 1885 and 1910 obviously affected the number of patents granted, especially the ones with a foreign origin. They did not, on the other hand, seem to have affected the number of applications, neither from foreigners nor Norwegian citizens.<sup>15</sup>

The proportion of the total number of patents applied for and granted in Norway that originated among Norwegian citizens, is also of interest when trying to reveal something about trends in genuine Norwegian contribution to the industrialization process. In Figure 4 the percentage of total number of patents in Norway that were granted to Norwegians are plotted. The graph reveals some distinct features. There were very large annual fluctuations in the proportion, between eight and 73%, from 1860 to late 1870s. Such large fluctuations were observed throughout the entire period from 1839 to 1860, too, reflecting the low numbers that are underlying the calculations. From around 1880 the proportion fluctuated within smaller margins. The Norwegian share increased somewhat throughout the 1880s, then decreased for the next decade, and increased again from 1900. From around 1880 to 1914, the Norwegian share was seldom higher than 30%. In the 1839-60 period the share was 65%. This decline in the proportion of patents with a domestic origin reflects an increase in patents with a foreign origin. It does not reflect reduced patenting with domestic origin (see Figure 1). It is a reflection of the development away from an infantile stage of the patent system, when foreigners only had a moderate interest in patenting in peripheral Norway.

Data for the application proportion, available from 1886, show the same overall trends. The grant-proportions were systematically slightly lower than the application-proportions,

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<sup>15</sup> Such relationships between applications and patent policy changes has recently been discussed by J. Lerner, "Patent protection and innovation over 150 years", *National Bureau of Economic Research, Working Paper Series*, No. 8977, June 2002.

reflecting that applications with a foreign origin had a higher probability for a successful examination result.<sup>16</sup>

In an attempt to obtain a more detailed view of the relationship between patents and industrialization, we will now move beyond the aggregate patent numbers and study patents in the various industries and technological areas. Appendix B lists patents in Norway distributed across seventeen industries in five-year intervals between 1861 and 1915. The patents have been re-classified from the patent authorities' own technical classification system into user industries to get a better impression of the linkage between patents and industrialization.

The first sector where we can observe a significant increase in patenting is *fabricated metal products* in the early and especially the late 1870s. From then on this was the leading patent sector through the entire period we are studying. About the same time patents in *machinery* increased significantly. During the 1880s, an increase may be observed in most industries, but no other industries really stand out. In the second half of the 1890s, the aggregate numbers increased sharply. Especially two industries were responsible for this increase; *chemicals* and *transportation*. In this period (1895-1900), *electrical products* also became one of the most important sectors, and that position was manifested after the turn of the century.

The development in patenting in the various industries thus in part reflects important industrial shifts, in particular connected to the emerging chemical and electricity using industries around the turn of the century. The mechanical engineering industry that was one of the two industries that is associated with the first wave of industrialization from the late 1840s, "emerged" in the patent records (*fabricated metal products*, *machinery*), but only after the mid 1870s.

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<sup>16</sup> In analysing inventive and innovative capabilities in a country, national's patenting abroad has been considered a useful indicator. One has assumed that such patents on average has a higher quality than domestic patents. Only patents with a special commercial and technological potential will be taken abroad to a leading country, like Britain or the U.S. We do not have available data for Norwegian citizens patenting in Britain in our period. U.S. data, on the other hand, have been assembled from 1883. The aggregate data should be interpreted with great care, and obviously reflect both general international business cycles as well as institutional characteristics with the U.S. patent system. The numbers were also very low, making interpretations of the annual fluctuations dubious. Between 1883 and 1900 Norwegian patents granted in the U.S. to Norwegian citizens were annually around ten or lower. From 1900 there was an upward trend, culminating in 1914 with 38 patents. I will not here go further into a discussion about how these data should be interpreted. See instead B.L. Basberg, "Foreign Patenting in the U.S. as a Technology Indicator. The Case of Norway", *Research Policy*, vol. 12, No. 4 1983.

A striking feature is that two of the industries strongly connected to the Norwegian nineteenth century industrialization were no significant patent sectors. The textile industry that was the first “modern” industry in Norway in the 1840s, had almost no patents at all before in the late 1880s. There was a continuous increase, but the numbers were low.<sup>17</sup> The wood processing and paper industries, constituting important emerging industrial sectors in the last two decades of the nineteenth century, also had a moderate patent activity with slow increase.

The industry patent data presented so far refer to total patenting in Norway. We have not compiled annual data for patents with a domestic origin, and have so far only a sample year; 1890. In this year, fabricated metal products and machinery were the most active patent sectors for Norwegian citizens as well as for foreigners, and taken together, there seem to be a high correlation between Norwegian’s and foreigners’ patenting in the country.<sup>18</sup> One notable difference is that wood processing ranks as the third most important industry sector of patenting from domestic citizens, while chemicals has the same position regarding foreigners patents.

It is possible also to move one step further and look at patent classes where Norwegian citizens were most active (Table 1).

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<sup>17</sup> The almost complete absence of patents all the way from 1839 was discussed in Basberg (1997). A more detailed analysis of the early development of this industry, including references to patenting is K. Bruland, *British Technology and European Industrialization. The Norwegian Textile Industry in the Mid Nineteenth Century*, Cambridge 1989.

<sup>18</sup> Different correlation-calculations of the ranking of patents in industry-sectors in 1890 for foreigners and Norwegian citizens give results between 0.8 and 0.9.

Table 1: Patent classes with the highest number of patents to Norwegian citizens, 1890.

<i>Rank</i>	<i>Patent class</i>	<i>Description</i>	<i>Number of patents</i>
1	34	Household goods	20
2	38	Wood processing	7
3	42	Instruments for (...) measuring	6
4	65	Ship building	6
5	68	Lock making	6
6	54	Paper products	5
7	55	Paper making	5
8	45	Forestry	5
9	47	Machine components	5
10	37	House building	4
11	21	Electrical apparatuses	4
12	23	Fat industry	4

*Source: Register over norske patenter utfærdigede i 1886-1895, Kr.a. 1901.*

These data give a somewhat different impression than the industry-sector data. Especially the leading patent class, *household goods*, does not signify any emerging new industries. Rather to the contrary, it reflects the typical inventive area of the amateur inventor and a patent class where there is more domestic than foreign interest.<sup>19</sup> The patents were simple consumer product inventions rather than process inventions connected to new industries. This is, of course, reflecting an early stage in industrialization that more advanced Western-European countries had gone through long before Norway.<sup>20</sup> On the other hand, although the amateur inventors for many years were easily visible in the Norwegian patent records, the more professional inventors and companies took an interest in the system from its beginning. In the late 1880s, less than ten per cent of Norwegian patentees were firms. In 1920 this had increased to 27%. Studying the individual patentees, leaves a strong impression that many

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<sup>19</sup> 80% of the patents in this class originated from Norwegian citizens.

<sup>20</sup> Norway was in this respect a century behind Britain, the first industrial nation. The importance of commodities and product innovations in this early stage of Britain's industrialization has recently been analysed by M. Berg, "From imitation to invention: Creating commodities in eighteenth-century Britain", *Economic History Review*, Vol. LV, No. 1 2002.

leading industrialists in the late nineteenth and early twentieth century used the patent system.<sup>21</sup>

### Conclusions

Observing the increase in patenting in Britain in the third quarter of the eighteenth century, MacLeod comments: “The temptation to seize on the patent statistics as an indicator of inventive activity remains largely because the graph does exactly what our historical ‘common sense’ tells us it should”.<sup>22</sup> The temptation remains when observing the increase in Norwegian patenting about one hundred years later. The increase indeed coincided with the industrialization of Norway.

There also seems to be a linkage between patenting and industrialization on the institutional level. In the period we are considering, there was an interest in the patent system, its functioning and organization, that clearly was motivated in a strong belief that it could be of importance in stimulating the industrialization process.

What about our main question; the timing of an industrial breakthrough in Norway? Can the patent data shed light on this issue? Over the period 1860 to 1914 there were indeed distinct phases in the development in patenting. First of all, there were no significant patenting activity in Norway before around 1870. The Norwegians themselves did not use the system much before around 1880. The textile industry – the first “modern” industry in Norway – never really appeared in the patent records. So, the patent data do not at all help us in singling out a possible industrial breakthrough from the 1840s.

The period from around 1880 to 1914 reveals an increase in Norwegian patenting. Total patenting and patenting with a Norwegian origin developed in the same way in the 1880s (increase) and early 1890s (slowdown). In the late 1890s, however, foreigners’ patenting in Norway increased dramatically compared with Norwegian citizens. After the turn of the century, the opposite was the case. The industrial breakthrough in Norway, as well as the

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<sup>21</sup> Examples are J.S. Jarman, J. Jensen, A. Jensen, K. Dahl, C.C. Steenstrup, H.C.F. Størmer, Kr. Birkeland, Fr. Hiort, A. Krefting, D. Westad, E. Morterud, A. Hiorth, W. Fougner, G. Sundby and E. Collett. For a more detailed analysis of the patentees, see B.L. Basberg (1984), *op.cit.*, p. 272ff.

<sup>22</sup> MacLeod, *op.cit.*, p. 5.

industrialization process in general, was obviously pushed forward by a combination of domestic and foreign technological stimuli. According to the patent records, the Norwegians themselves took an active role only after 1900.

Patents and the patent system are supposed to encourage invention and innovation. On the other hand, the way the system works obviously also delays diffusion. Thus, the way the patent system affects the industrialization process at large may be dubious. The example we referred from the whaling industry illustrated the phenomenon. The inventor and patentee created an industry, but the diffusion was delayed for a decade.

How foreign patents in Norway affected industrialization is not clear. Did they become important inputs in the technological infrastructure? Did they represent so-called general purpose technology important for the industrialization process at large? How important were licenses? How were they used? Did foreigners patent in Norway to protect their inventions from competition or because they wanted to generate new industries based on their licences? Many questions remain, and the results presented so far represent a partial and first analysis of the Norwegian patent data in the period 1860 - 1914. The analysis can be taken further and deeper, especially when it comes to explicit and formal comparisons with data on the industrial development. Hence, the last word has not yet been said about the extent to which patents may shed light on the question of the timing of the industrial breakthrough in Norway. And, for that matter, the last word has not been said about the main issue itself; when and if a breakthrough occurred. Certainly, that will continue to stay on the agenda the way it has in the past.

Figure 1: Patenting in Norway, 1860-1914

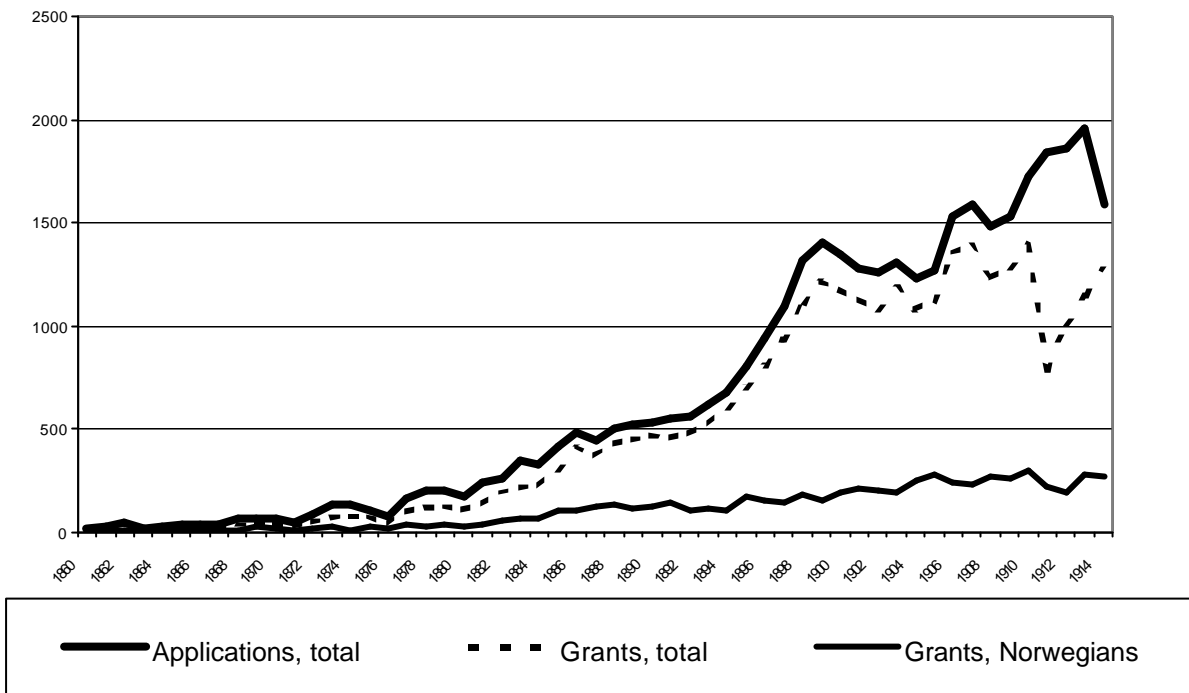


Figure 2: Patents and applications with Norwegian origin, 1860-1914

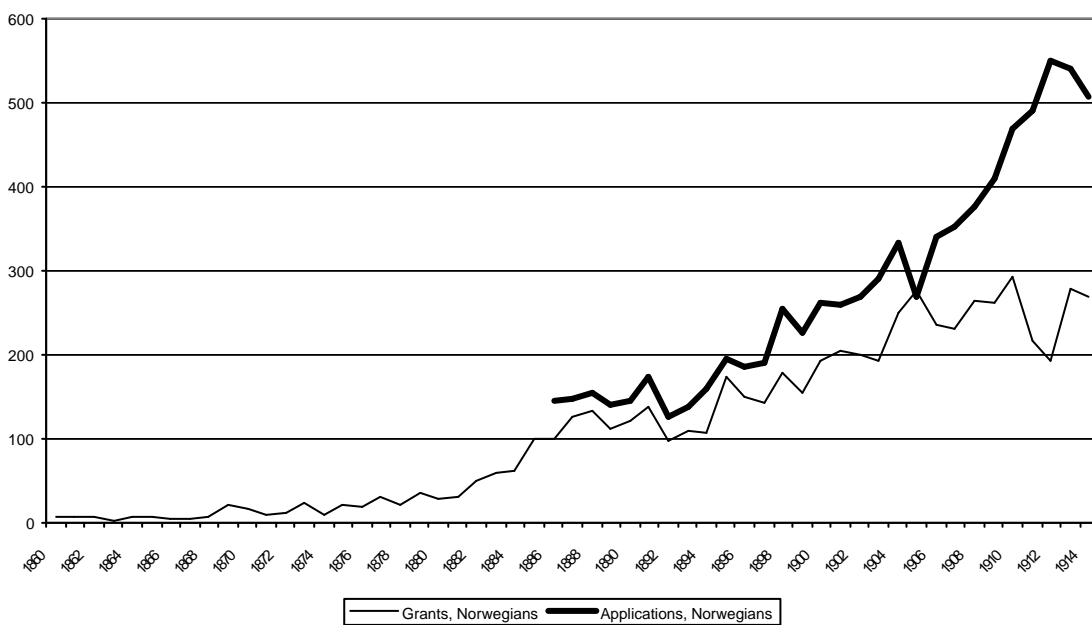




Figure 3: Patents as a proportion of applications, 1860-1910

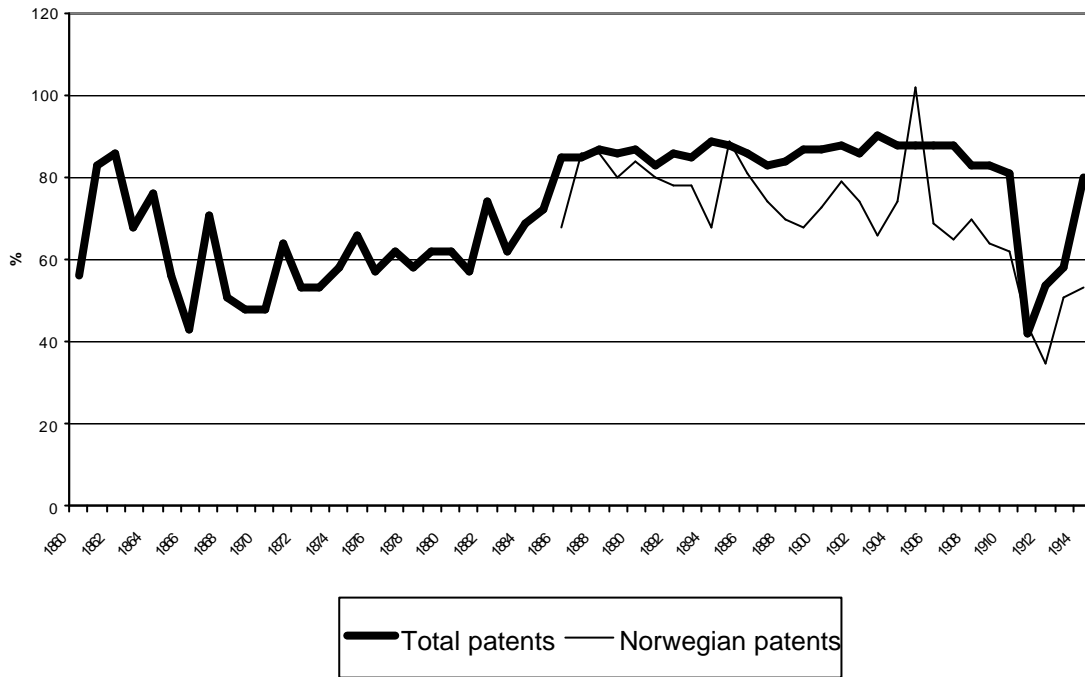
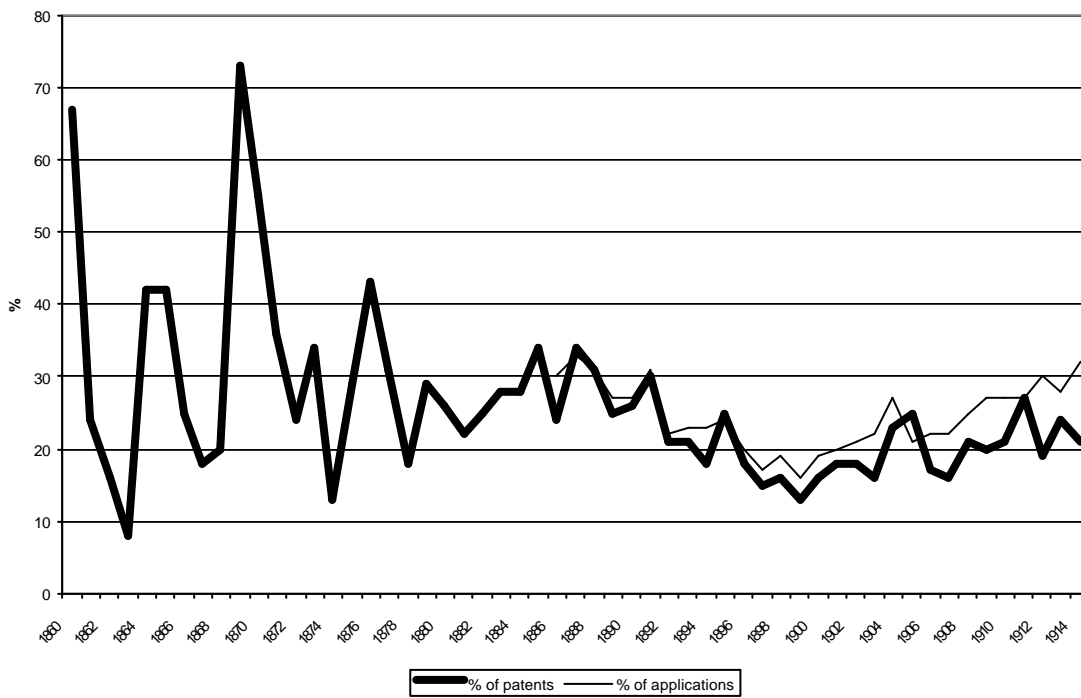


Figure 4: Share of applications and patents to Norwegian citizens, 1860-1914



## Appendix A: Patenting in Norway, 1860-1914

Year	I	II	III	IV	V	VI	VII	VIII
1860	16	9	6	67	56			
1861	30	25	6	24	83			
1862	43	37	6	16	86			
1863	19	13	1	8	68			
1864	25	19	8	42	76			
1865	34	19	8	42	56			
1866	37	16	4	25	43			
1867	38	27	5	18	71			
1868	67	34	7	20	51			
1869	63	30	22	73	48			
1870	60	29	16	55	48			
1871	44	28	10	36	64			
1872	86	46	11	24	53			
1873	127	68	23	34	53			
1874	129	75	10	13	58			
1875	108	71	21	29	66			
1876	73	42	18	43	57			
1877	159	99	31	31	62			
1878	198	115	21	18	58			
1879	196	122	35	29	62			
1880	173	107	28	26	62			
1881	240	138	31	22	57			
1882	258	192	49	25	74			
1883	344	213	60	28	62			
1884	325	226	63	28	69			
1885	412	297	100	34	72			
1886	484	412	99	24	85	145	30	68
1887	439	372	126	34	85	147	33	86
1888	497	431	133	31	87	154	31	86
1889	518	446	113	25	86	141	27	80
1890	532	465	121	26	87	144	27	84
1891	551	457	138	30	83	173	31	80
1892	556	479	98	21	86	125	22	78
1893	616	527	109	21	85	139	23	78
1894	677	604	108	18	89	159	23	68
1895	798	699	174	25	88	196	24	89
1896	939	808	150	18	86	186	20	81
1897	1098	929	142	15	83	191	17	74
1898	1317	1112	178	16	84	254	19	70
1899	1405	1218	154	13	87	227	16	68
1900	1351	1175	192	16	87	262	19	73
1901	1276	1125	205	18	88	259	20	79
1902	1258	1078	199	18	86	269	21	74
1903	1312	1184	193	16	90	290	22	66
1904	1229	1079	249	23	88	334	27	74
1905	1266	1119	276	25	88	270	21	102
1906	1530	1354	237	17	88	341	22	69
1907	1587	1391	230	16	88	353	22	65
1908	1483	1236	265	21	83	377	25	70
1909	1535	1281	263	20	83	409	27	64

1910	1728	1394	293	21	81	469	27	62
1911	1837	787	216	27	42	491	27	44
1912	1861	1008	194	19	54	551	30	35
1913	1962	1148	280	24	58	542	28	51
1914	1590	1274	270	21	80	507	32	53

*Explanations:*

- I: Applications, total.
- II: Patents, total
- III: Patents granted to Norwegian citizens
- IV: Patents to Norwegians as % of total patents
- V: Patents as % of applications
- VI: Applications from Norwegian citizens
- VII: Applications from Norwegian citizens as % total applications
- VIII: Patents granted to Norwegian citizens as % of applications from Norwegians

*Sources:*

*Register over norske patenter utferdigede indtil 1ste Januar 1886, Patentkommisjonen, Kr.a. 1896*

*Fortegnelse over patenter utfærdigede efter 1.januar 1868, Patentkommissionen, Kr.a. (no dat.)*

*Statistiske opplysninger vedkommende patentvæsenet i Norge 1886-1933, Patentkommissionen / Styret for det industrielle rettsvern, Kr.a./Oslo 1904-1935.*

*Aa. Svinndal, Styret for det industrielle rettsvern – 50 år, Oslo 1961.*

## Appendix B:

Patents in Norway distributed across industries, 1861-1915 (5 year annual averages)

<i>Year</i>	1861-65	1866-70	1871-75	1876-80	1881-85	1886-90	1891-95	1896-00	1901-05	1906-10	1911-15
Food and beverages	1	1	4	6	13	22	22	49	48	47	56
Textiles	0	0	1	2	1	8	7	8	22	29	32
Apparel	0	0	3	4	6	20	22	32	38	37	65
Woodworking and furniture	1	1	4	3	10	16	17	26	23	30	25
Wood proc., paper	0	0	4	2	8	15	17	30	34	40	63
Printing	0	0	1	2	3	9	11	25	33	29	26
Leather and rubber	0	0	0	0	1	3	3	7	6	6	10
Chemicals	2	2	4	5	16	24	38	115	111	125	197
Stone, clay and glass	1	1	1	2	4	6	8	27	42	28	34
Primary metals	3	2	2	6	11	21	21	55	54	78	117
Fabr. metal products	3	3	7	15	28	68	80	144	167	165	213
Machinery	3	2	3	12	21	35	41	70	94	111	164
Electrical products	0	0	1	3	16	16	24	67	123	115	189
Transportation	1	2	4	11	16	27	36	116	124	132	185
Mining	1	0	1	1	1	4	3	6	11	15	22
Power supply	1	0	0	1	3	6	6	16	19	23	31
Agric., forestry, fishery	3	2	6	9	26	26	27	35	47	55	66
Misc.	3	3	6	14	31	57	69	112	145	170	225
Total	23	19	52	98	215	383	452	940	1141	1235	1720

*Sources:* Based on the author's reclassification from patent classes to user industries. Patent data: See Appendix A.

*Note:* The data for 1861-1910 are patents granted. 1911-1915 are applications.