

MARKET DIVISION AND INDUSTRIAL STRUCTURE: STRATEGIES FOR THE COMPETITIVE EDGE OF THE GERMAN STEEL INDUSTRY IN THE NINETEENTH CENTURY

YOUNG GOO PARK*

Prohibitive tariff walls, initiativeness in introducing the Thomas process, or export-market first strategy was obviously important for the competitive edge of the German steel industry in nineteenth-century international markets, as have been usually pointed out until now. But the decisive factor for the competitive edge of the German steel industry was, rather, the German strategy of demand expansion through market division in two aspects, in other words the formation of the Germany-type heavy industry structure which made the adoption of the Thomas process and the mass production of steel, and the cost reduction to the competitive level possible.

This paper shows domestic demand market and market division are important for a late-comer to be able to secure an industrial competitive edge in the international market.

JEL Classification: N6, L6, O1

Keywords: Market Division, Industrial Structure, German Steel Industry

I. INTRODUCTION

Superiority in the steel industry in the nineteenth century was directly related to an industrial competitive edge. Even though Germany was in its stage of the early modernization of the iron industry until the middle of the nineteenth century, it came to possess the highest steel industry competitive power in Europe by the end of the nineteenth century.¹ Accordingly, a study on the development and the strategy of the German steel industry during the second

Received for publication: July 22, 1998. Revision accepted: Jan. 6, 1999.

* Dept. of Economics, Pusan University of Foreign Studies. E-mail: parkyg@taejo.pufs.ac.kr.

¹ It was Germany and the U.S.A. that took the leading powers in the world market. As to the steel industry between Germany and the U.S.A. from the 1860s to the 1930s, see Welskopp(1994).

half of the nineteenth century could present important suggestive points in research of the development strategy of heavy industry in the developing economies as a late-comer.

Existing studies on the nineteenth-century steel industry were concentrated on the U.K.'s steel industry or the U.S.A.'s, or a comparison between the two countries² in many cases. In addition, even studies on the German steel industry have focused on exogenous variables, such as Germany's protective tariff or cartel,³ initiativeness in introducing the Thomas method, entrepreneurship, and social and institutional implicit factors,⁴ or on the result itself of superiority in the steel industry, such as prices(or dumpings) and productions. As a result, most of these studies have relatively ignored the endogenous correlative-variables such as demand and cost in supply side, and pointed out prohibitive tariff walls, the Thomas process itself or the export-market first strategy as one of the decisive factors for the competitiveness edge of nineteenth-century Germany's steel industry.

Based on above points, this paper reveals first the fact that the strategy of the competitive edge of the Germany's steel industry in the nineteenth century was in the cost saving, and then attempts to examine strategies for the competitive edge of the German steel industry in the nineteenth century from different standpoints and their implications.

II. COST FACTOR AND COMPETITIVENESS CONDITION

So far, many researches on nineteenth-century issues have indicated the U.K.'s disadvantages inherent in priority but haven't the German disadvantages of a late-start.⁵ But, the German steel industry, at the beginning of its development, had the disadvantages of cost that can be traced back to a relative late-start.

This can be shown graphically in the cost list for steel production at Krupp in the 1870s.⁶ A cost list for steel production at Krupp in 1873/4 reveals that the proportion of materials cost was 81.04 per cent, wages and interests cost 5.42 per cent, and fuel cost 3.24 per cent, so these three parts took possession of 89.7 per cent of total cost. In 1877, the proportion of materials cost changed to 88.2 per cent, and fuel to 2.86 per cent. These facts show that resources such as iron and coal were the most important cost items in steel manufacture

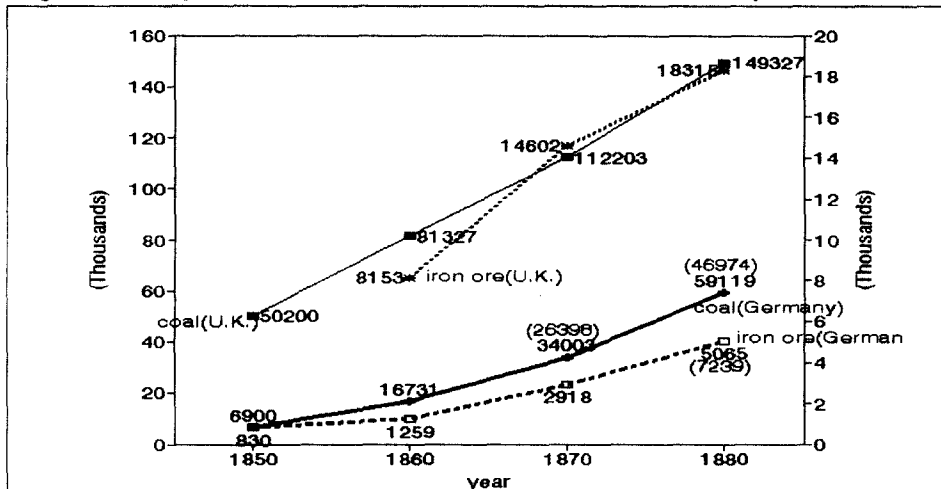
² Carr and Taplin(1962). Temin(1966). McCloskey(1973). Warren(1973). Elbaum and Wilkinson(1979). Elbaum(1986). Yang(1994) includes Germany's but its focus is on the U.K.'s and the U.S.A.'s.

³ Webb(1980).

⁴ As for disputed points and the data about these, refer to Payne(1990); Landes(1991), pp. 334, 337; Park(1996a), pp. 163-8.

⁵ As for British disadvantages of priority, see Jervis(1947); Kindelberger(1961); Yamazaki(1980), p. 78; Landes(1991), pp. 334-7.

⁶ Krupp-Archiv, Villa Hügel, Essen. Bestand Fried. WA IV 976, 1873-82.

[Figure 1] Output of coal and iron ore (thousand tons, Germany and the U.K.)

Source : Mitchell(1981), pp. 381-3, 385, 408-9.

Notes : 1) coal: left Y axis, iron ore: right Y axis. 2) Figures in brackets are from Feldenkirchen (1982), Tab.: 33, Tab.: 37, Tab.: 103. 3) Mitchell's coal figures include brown coal.(Being overestimated). 4) From 1871, Germany includes Alsace-Lorraine.

and their significance was growing with time in the 1870s.

After all, under the cost composition like this, it was the resources cost that pushed German steel cost higher than the U.K.'s until the 1870s. Compared with the U.K., Germany, in addition to less favorable locations and quality of iron ore and coal, had a serious shortage of coal and iron ore, which came from the late-start in both side of industrial demand shortage in demand side and resource underdevelopment in supply side (Figure 1). The fact that the shortage of coal and iron ore came from the late-start is well shown from that in fact the Rhur-basin was one of the greatest single basin in Western Europe and Alsace-Lorraine's resources were not fully utilized even after being included in Germany. Like the U.K., Germany also imported phosphorous-free ore from Spain and prices of iron ore dropped rapidly during the 1870s,⁷ but the shortage of these two resources was a bottleneck in the development of the German steel industry in the 1870s.

German backwardness in terms of resources like this, especially of iron ore, appeared not only in the domestic market but also import markets, another resources supplier. German steel makers had the disadvantage of cost in ore imports also. The U.K. not only had powerful control over international trade networks, but also had geographical advantages in plant sites. What is more important is that the U.K. could significantly save on freight costs by importing ore on her coal-export ships' return journeys. As a result, the costs in the Rhur

⁷ Flinn(1955). Payne(1990).

were higher than the U.K.'s by about 14.9 marks per ton of pig-iron by the differential in transportation costs alone.⁸

The second most important part of cost was factor cost, though the absolute proportion is low. First, German steel makers had to pay higher interest costs than the U.K.'s because of the backwardness of the capital market and higher risk though the international capital market was open by then.⁹ Many researches have pointed out that in the case of the U.K., the close connection between financial institutions and enterprises¹⁰ had not appeared, while the German banking system played an important role in supporting the growth of German heavy industry by mobilizing scarce capital and channelling it to heavy industry.¹¹ To be sure, for Germany, capital for investment was concentrated in heavy industry.¹² Yet Germany had a riskier uncertainty and less capital to work with than the U.K.. As, especially in contrast to the U.K., industrialization in Germany from the mid-1850s did not start in the consumption goods industries, but in the capital-intensive heavy and chemical industries, the demand on the capital market was greater.¹³ So, the cost of capital in the capital markets of Germany was not so cheap as in the U.K.. In reality, there was a continued gap of 1-2 points between the rate of interest in Berlin and those rates prevailing in the other markets of western Europe.

Only labour costs were cheaper in Germany than in the U.K. or in France. But industrial wage, which had stagnated through the first half of the nineteenth century, were increasing sharply because of condensed high industrialisation in the latter part of the nineteenth century. The demand for labour increased rapidly and, from the standpoint of demand and supply of labour, it was Germany rather than the U.K. who found it more and more difficult to meet the labour demand of growing new industries in the late nineteenth century.¹⁴ In reality, the unemployment rate in Germany after 1870 was low. As a result the increase rate of factory workers' real wage was high, especially that in the heavy industry as a new industry like steel industry was rising faster and leading overall industrial wage increase.¹⁵ Both absolute levels and increase rates of wages in the heavy industry were higher than those in the traditional light

⁸ This cost differential was estimated from the fact that for one ton of pig iron, an average 2.5 tons of iron ore was required in the 1870s.

⁹ In fact, some of the German steel industry were directly financed by French and Belgian investors.

¹⁰ Davis(1966), pp.255-72.

¹¹ Jeidels(1905). Gerschenkron(1966), p. 18. Sandberg(1982), pp. 675-98.

¹² The banks' influence on the heavy and electro-technical industries was greater in Germany in the nineteenth century but on other industries was not. Neuburger and Stokes(1974), pp. 710-31. Feldenkirchen(1991), p.135.

¹³ Borchardt(1976), Vol. II, p.239.

¹⁴ Landes(1991), pp.332-3.

¹⁵ The U.K.'s report also shows that there was no difference between German and the British wages in the steel industry. BITA(1896).

industry like cotton textiles, and the gap between two industries was expanded even to 1.8 times in the 1870s.¹⁶ Heavy industry workers were never in low payments in late nineteenth-century Germany¹⁷ and also German wage per unit of products was sometimes higher than the U.K.'s.¹⁸

After all, the German steel industry in its beginning had to have a high cost function as compared with the U.K.'s. So, for international competitiveness, it was an imperative for German makers to reduce costs than anything else. They always made it their first aim to reduce the cost and the growth history of the German steel industry was a very cost reduction history.

III. DEVELOPMENT AND CONSTRAINT

The endeavor for cost reduction began with the replacement of capital facilities in the 1870s.

First, German Bessemer plants replaced the reverberatory furnaces with cupola furnaces. As the cupola furnace could reduce the fuel consumption by 55 per cent from the reverberatory furnace and decrease greatly the need for repairs, German makers could reduce costs. For example, the fuel cost for 1 ton of steel, which estimated with the same annual production at 1873/4 constant prices, was reduced from 7.07 marks to 5.73 marks between 1873/4, the last year before the furnace replacement, and 1877 (Figure 2).

Second, German steel makers optimized the operating time on the production process. Major inventions in the Bessemer method were made in the U.K., but it was Germany and the U.S.A. that made the technical and organizational changes for the productivity increase at the industrial site.¹⁹

By these endeavors, the Krupp's average production rate of 98 tons per man in 1873 had risen to 236 tons per man in 1878, and at the same time the average production rate of the plant had increased from 10 to 25 charges a day. As a result, even after eliminating the influence of economies of scale and the variation of prices, steel makers could reduce the cost of wages and interest for 1 ton of steel from 11.83 marks to 4.59 marks at 1873/4 constant prices between 1873/4 and 1877. Totally, the conversion cost per ton, which subtracts materials cost, could be reduced from 41.42 marks to 23.62 marks and, resultantly, the total cost per ton of steel was changed from 218.35 marks to 200.23 marks at 1873/4 constant prices from 1873/4 to 1877 (Figure 2).

Third, German steel makers pursued economies of scale.

German makers found that the cost reduction through mass production was important to compete with the U.K.'s in the international market. Favorably German

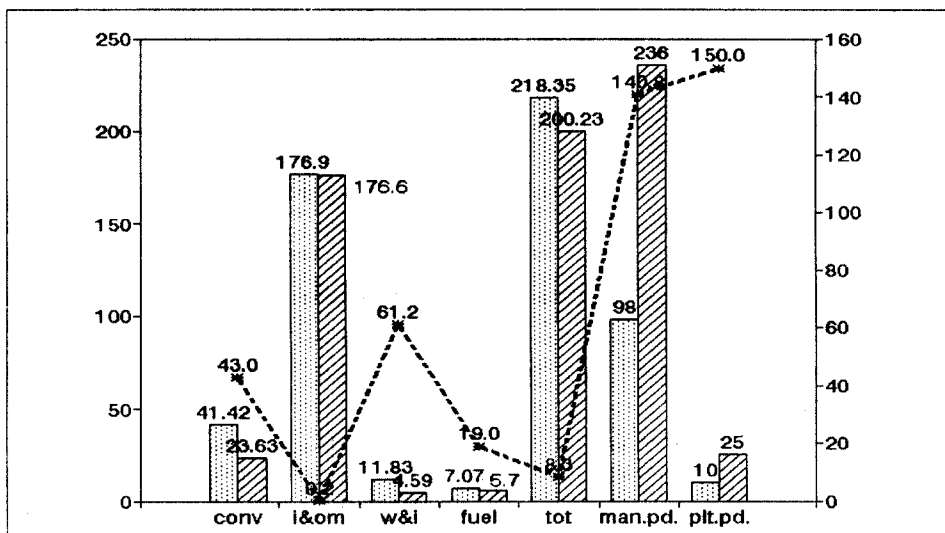
¹⁶ Tilly(1991), p.186.

¹⁷ Kiesewetter(1991) has also pointed out this.

¹⁸ Bell(1884). Brown(1995), p.501.

¹⁹ Park(1996b), pp.244-5.

[Figure 2] Comparison of the productivity and cost at 1873/4 constant prices for 1 ton of Bessemer steel at Krupp's



Sources : Krupp-Archiv, Villa Hügel, Essen. Bestand Fried. WA IV 976, 1873-82. Protokolle über die Vernehmung der Sachverständigen durch die Eisen-Enquete-Kommission Tafelband, Anlage zu I.b.2, II.15, Berlin, 1881.

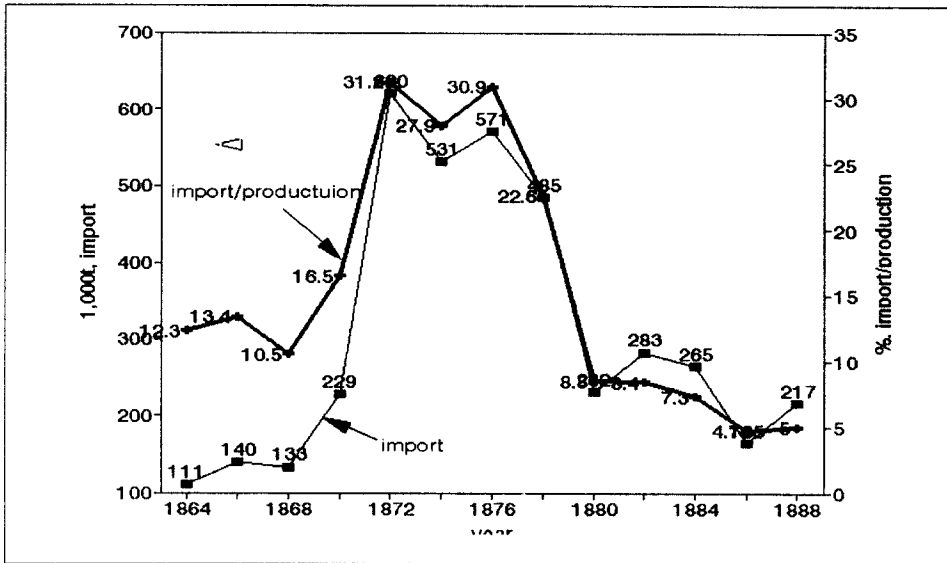
Notes : 1) conv: conversion cost(marks, left Y axis). i&om: material cost(marks, left Y axis). w&i: wages and interest(marks, left Y axis). fuel: fuel cost(marks, left Y axis). tot: total cost(marks, left Y axis). man.pd: production per man a year(tons, left Y axis). plt.pd: charges per plant a day(charges, left Y axis) 2) cost comparison was made at 1873/4 constant prices between the working year 1873/4, the last year before the reorganization, and 1877. 3) productivity comparison was made between 1873 and 1878. 4) cost comparison was made at the same annual production. 5) dotted line represents improvement rate(% , right Y axis).

cupola furnace was good for works to pursue economies of scale because the optimal lot-size of a plant in cupola furnace operation was larger than in the direct process, which was popular in the U.K.. In reality, the Krupp increased production greatly from 77,338 tons of steel in 1876/7 to 89,600 tons in 1877/8 and the conversion cost per ton was reduced by more than 3 marks according to the production increase by changing operations from 1,294 a month to 1,514 in 1878.²⁰

But, in spite of the large reduction in conversion cost, materials cost couldn't be changed from 176.9 marks to 176.6 marks per ton of Bessemer steel in the 1870s as seen from figure 2. As the result the cost of German steel was still higher than the U.K.'s at the end of the 1870s. At that time, even a small percentage difference in ore cost would have been of competitive significance,²¹

²⁰ Wengenroth(1994), pp.81-7.

²¹ Elbaum(1986), p. 73.

[Figure 3] Import and import ratio(import/production) of pig-iron in Germany

Sources: Feldenkirchen(1982), p.170. Vereins Deutscher Eisen-und Stahlindustrieller, 1881-900.

Notes: import: ton, left Y axis. ratio(import/production): %, right Y axis.

because materials cost had an absolute share in steel cost. Nevertheless, the real difference in ore costs between the two countries was great.

So, many German makers thought using British pig-iron would make the steel production cheaper. As the result, even though the domestic demand was still stagnant in the 1870s, the import size and the ratio of import/production of pig-iron, which was 22.6%-31.2%, was extraordinary high in the 1870s (Figure 3).

But this production dependency on the U.K.'s materials continued to bring on higher costs, higher prices than the U.K.'s, and competitive disadvantages for German steel. The German solution for this problem was an obvious one. That was the aquisition of cheap iron-ore and pig-iron to reduce costs to a competitive level. But the required and sufficient conditions for this were still constrained in two aspects.

One was the technological constraint in the supply side. As German makers' production method was basically based on the U.K.'s Bessemer process, they could not use German cheap resources. The other was the constraint in demand side. In Germany, there were still shortages of effective demands to induce revolutionary mass production through the development of cheap ore in the 1870s.

IV. MARKET DIVISION AND TARIFF: FIRST STRATEGY

The Bessemer process was an epoch-making system in terms of productivity. On the other hand, the open-hearth furnace invented by W. von Siemens and P. E. Martin enabled closer quality control, contributing greatly to the upgrading of steel quality. The Thomas process invented in 1878 not only had high productivity but also could remove phosphorus from slag, making it possible to use cheap iron-ore containing large amount of phosphorous.

These three processes have been adopted differently by each country in accordance with the supply and demand conditions of each country. First of all, in view of supply side, the introduction of the Thomas method was a problem of cost directly related to enterprise's profit variation. Only those sites which could reduce cost enough to offset the costs of altering works for the Thomas method by developing its own cheap ore were able to introduce the Thomas process. But in the U.K., there was no site where the Thomas method could have had a clear cost advantage over the old Bessemer process. It was no cheaper to assemble raw materials in the East Midlands, where the U.K. discovered her own large deposits of phosphoric ores, than in the Cleveland district, the largest production region of pig-iron in the U.K..²² In addition to these, in view of demand side also, Thomas steel was not suitable for the U.K.'s existing industrial structure. Of course phosphoric ore also could be used for open-hearth steel which was being greatly demanded in the U.K.'s industry. But the deposits location was not proper for both the supplier and the demander of pig-iron and steel because it was not consistent with the conditions of location of the main product of open-hearth steel such as ship-plate, tinplate, and sheet, and was far away from the relevant product and factor markets.²³

It was in Alsace-Lorraine in Germany that it would pay to introduce the Thomas process. Its ore deposits were the most suitable for the Thomas method in view of both costs and ore ingredients because it had the problem of excessively high transportation costs of ore and the cheap iron-ore produced there contained large amounts of phosphorus.

However, in spite of the possibility of technological innovation and these favorable conditions in supply side the steel makers in Germany were unable to realize this. Because mass production based on this innovation and resultant cost reduction became possible only when there was an expansion of effective demand for products.

The shortage of effective demand had posed a decisive problem for the steel industry of Germany. During the 1860s, Bessemer converters had been introduced in by the non-patent policy of government,²⁴ but still the introductions and

²² McCloskey(1973), pp.57-67.

²³ Elbaum(1986), p.73.

²⁴ Troitzsch(1975), p.224.

applications of large scale Bessemer plant were being delayed and even the already installed Bessemer converters were also lying idle in the early 1870s.

The reason why such epochal new technologies were not normally applied was that there were the constraints of shortage of materials and labour force,²⁵ but most of all, the fundamental reason was the lack of demands for their products. Demand for Bessemer and Siemens-Martin Steel was still low in Germany due to the late-start in industrialization. So, German iron and steel makers should sell their products even at below cost price abroad in order to achieve a minimum satisfactory production size in the 1870s.²⁶

Therefore, the German producers experiencing financial shortage were reluctant to introduce large Bessemer converters or open-hearth which required a large amount of capital and as, unlike in the U.K., in the case of Germany financial costs were high²⁷ because of high risk, also reluctant to expand largely facilities in uncertain sectors for the output of which demand was still low.²⁸ Even though Bessemer or Siemens-Martin converters were installed, most of them were very coarse and inefficient, and the lack of the demand for Flußeisen (Bessemer and Martin steel) still existed as a bottleneck in the 1870s. Demand problem like this became even one of the major reasons for diversification and integration of companies in nineteenth-century Germany.²⁹

As a result, during the 1870s, the production of Bessemer and Siemens-Martin Steel in Germany was relatively stagnant compared with the U.K.. In 1869, it was only 58.5 per cent of that of the U.K. but the ratio fell sharply even to 46.4 per cent in 1879 (Figure 4). Because, while the prices of rails and steel bars were falling and the import of steel products from the U.K. continued, there yet did not appear the demand expansion. So, rather, the advanced steelmakers, who adopted a new process extensively were falling into a trouble in collecting investment funds.

After all, the competitive edge of Germany's steel industry and the required cost reduction for it, were dependent upon demand.

The problem was that Germany was still behind the U.K. in international competitive power in the 1870s. Accordingly, German government and makers focused the competitive strategy in the first place on domestic market. Many existing research pointed out that at those days German strategy was only export-market first, but these opinions have logical problems in two aspects. First is that at that time Germany's absolute competitive power was still behind the U.K., which made it impossible for Germany to adopt export-market first

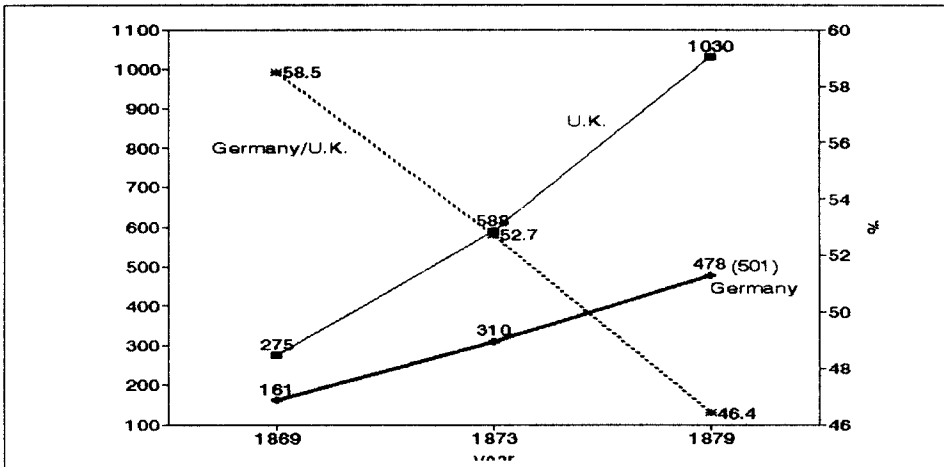
²⁵ Otsuka(1980), p. 116. Of course, the Bessemer process was labour saving. But, as I pointed out before, in late 19th-century Germany labour-demand was rapidly increasing and there existed high friction and transaction costs in labour market.

²⁶ Hupfeld(1875).

²⁷ Davis(1966), pp. 255-72. McCloskey(1970), p. 446.

²⁸ For the number of converters, see Jersch-Wenzel & Kregel(1984), T. II.2.2.

²⁹ Kocka and Siegrist(1979), p. 92.

[Figure 4] Production of Bessemer and Siemens-Martin steel (thousand tons, %)

Source: Beck(1901).

Notes: production(straight line): left Y axis. ratio(dotted line, Germany/U.K.): right Y axis.

strategy. Second is that, in reality, the first policy of Germany was very the rise of tariffs which would bring out big decrease of export. German geographical market division by stage³⁰ which was focused first on domestic market like this was not only an irresistible choice of Germany, but also became the first decisive factor for the German steel industry to get on a successful path in the aspect of long-term stability.

The first strategy for the demand expansion in the domestic market by the German makers and the government, was the rise of tariffs from 1879. This was intended to seek stabilization and expansion of demand for domestic iron and steel products by import substitution though there could be a great decrease of export.

However, this was only a limited strategy to protect the domestic market exogenously and required a decrease in social welfare and an increase in opportunity costs. Above all, as the demand policy based on customs duties targeted only the already existing domestic market, Germany, which was still an industrially developing country, had to have limits positively in terms of market size. So the effect of policy could not be great. In reality, although pig-iron import decreased after 1880 as seen in figure 3, the total production of German iron and steel products increased only by 3.25% in 1880 and soon showed limits that the increase rate stayed negative by -9.8% in 1883, 3.03% in 1884, and -2.36% in 1885.³¹ In spite of the tariff rise in 1879, the Thomas process had not yet been introduced in Germany in 1880.

³⁰ About geographical market division, existing studies have focused on only protective tariff walls. See Holtfrerich(1973), Fremdling(1986).

³¹ Feldenkirchen(1982), Tab.: 54.

V. DEMAND AND INDUSTRIAL STRUCTURE: SECOND STRATEGY

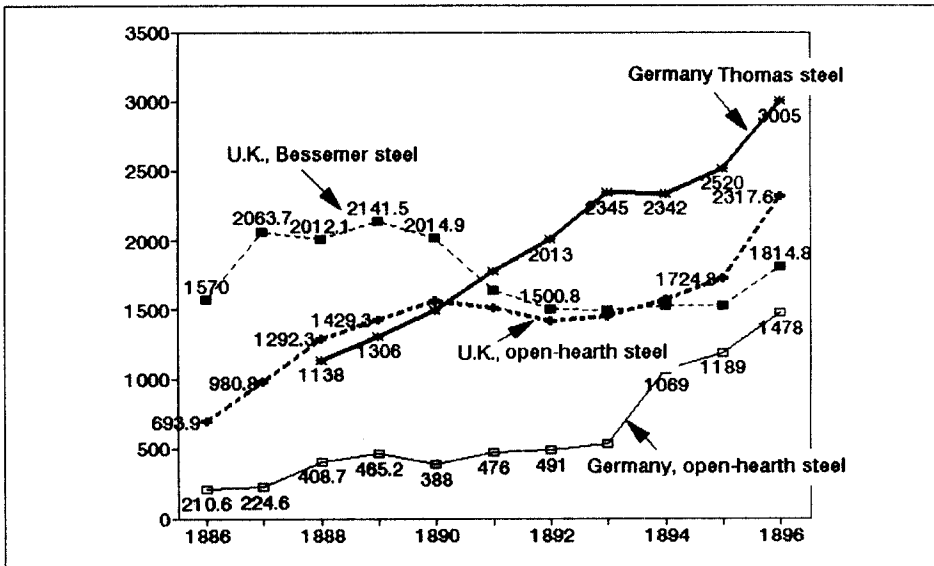
From 1881, the Thomas method was introduced in Germany, but it was still proceeded very slowly. Even some of steel makers like Dortmunder Union which had acquired the Thomas patents introduced partly the Thomas process and continued to use the existing Bessemer converter, and some like the Krupp, which had the stable supply of secure and cheap materials, did not introduce the Thomas process. Although GHH had acquired the patents in 1881 but delayed putting the Thomas process in use. This is because as there didn't yet exist large demand to bring forth large cost reduction, the break-even points of firms could not yet be attained.³²

After all, through the execution process of the competitive strategies until the beginning of the 1880s, German enterprises and government found that three essential conditions should be fulfilled for more stabilized and effective demand expansion in domestic markets. First, the demand had to be large-scale and continuously increasing enough for German makers to get sufficient economies of scale and production stability. Second, in addition to this, the demand must be one for iron and steel manufactured with domestic resources, not with imported materials. Because if it was not, German steel makers could not succeed in reducing costs to a international competitive level even though the prices of imported materials were low, as seen in the 1870s. Third, in order to expand demand in overseas markets in the long run, the demand had to be ones for the products which should not overlap with products of the existing iron and steel markets which the U.K. carried a competitive edge. This meant a market division in terms of products, which is different from the above mentioned geographical market division. This market division in terms of products became the second decisive factor for the German iron and steel industry to get on a successful path in international competition later. In other words, market divisions in terms of geography and products were two decisive factors for the German steel industry to get a competitive edge in the nineteenth century.

As best to satisfy these three conditions, Germany selected and expanded heavy industrial structure in which mild Thomas steel were largely used. By this choice, German heavy industry in the 1880s was specialized in commercial iron products, wire, tubes, and some intermediate products, etc. which put Thomas iron and steel to best use, and these products' demand markets became the biggest in German steel industry.³³ Especially, as such heavy industrial structure had already been preferred by existing German steel makers due to competitive inferiority versus the U.K.'s, Germany was able to realize it without incurring a significant amount of adjustment costs with respect to even existing production organization. As the result, demands for Thomas steel had increased sharply.

³² There was also the short-term rails boom.

³³ Kaiserliches Statistisches Amt(1907).

[Figure 5] Production of Steel by Process in Germany and the U.K. (thousand tons)

Source: Carr and Taplin(1962), p. 126.

Figure 5 shows that by the formation of stable industrial demand structure, in Germany the production of Thomas steel dominated in the second half of the 1880s, while in the U.K. open-hearth steel in the 1890s in accordance with the U.K.'s industrial demand structure. In the case of Germany, of the total steel production, the percentage of Thomas steel for 1890 became 66.9%, while in the case of the U.K., the percentage of Thomas steel production was 11.2 per cent and 13.5 per cent, and that of open-hearth steel, 43.7 per cent and 52.9 per cent respectively for 1890 and 1895.

With the demand expansion for and the resultant mass production of Thomas steel, German makers could pursue the reduction of related costs also.

First, German makers had increased the use of domestic phosphoric ore and converted their ore import market from the U.K. and Spain to Sweden.³⁴ Swedish phosphoric ore always cost less than British or Spanish for Germany's Westphalian makers. By 1900 Germany's chief steel makers in the Ruhr came to rely mostly on its ore imports from Sweden and no further from the U.K.'s ports,³⁵ and after the turn of the century they increasingly imported French ores too. These conversion reduced distribution costs, and contributed to the cost reduction of the German steel industry.

Second, with the mass production of Thomas steel, German makers increased production and productivity in the steel materials industry by increasing facility

³⁴ Elbaum(1986), p. 73.

³⁵ Pounds(1968), p. 112.

[Table 1] Production prices of German iron ore and pig iron (average price per ton at mines and plants, marks)

	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880
iron ore	7.05	7.19	8.15	5.57	5.66	5.01	5.55	4.82	4.55	4.76
pig iron	87.17 84.14 ^a	111.71	111.99	84.92	72.19	62.27	58.13	53.35	50.46	60.06
	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890
iron ore	4.78	4.75	4.49	4.17	3.70	3.49	3.64	3.74	4.22	4.19
pig iron	56.33	57.85 57.83a	53.31	47.98	43.65	40.32	41.36	44.11	48.04	56.31
	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
iron ore	3.70	3.58	3.47	3.40	3.33	3.63	3.89	3.83	3.90	4.09
pig iron	49.99	46.42	43.39	43.04	43.36	47.03	50.85	51.76	55.94	64.65

Sources: Kregel(1983), pp.75, 78. ^a Jersch-Wenzel, Kregel(1984), Tab. 1.2.1.

investments.³⁶ As a result, both the pig-iron and iron-ore productivity increased by mutual inducement effect³⁷ and their absolute production increased rapidly in the 1890s. Such productivity and production increases brought forth the drop of production prices of German iron-ore at mines and pig-iron at plants (Table 1) and it reduced additionally and greatly the German steel cost.

After all, as continuous and great expansion of demand for Thomas iron and steel became internally possible in the aspect of industrial structure, German steel makers were for the first time able to reduce the production costs to a level at which they could compete with the U.K.'s.

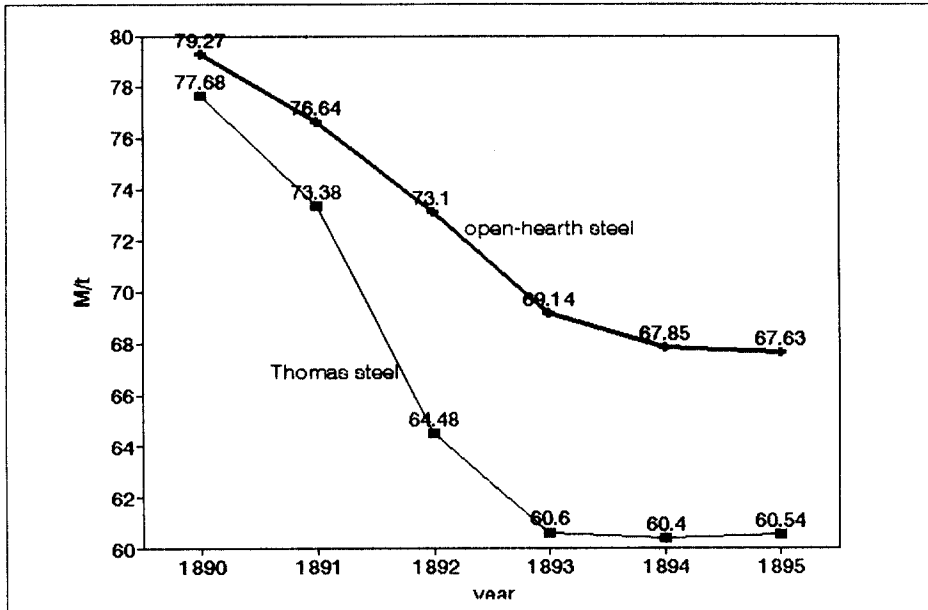
By 1890, the costs of commercial iron, intermediate products, and wire etc. which were made by the Thomas process became rather lower than those of products made of wrought iron. Also, GHH's reports show that the cost per ton of Thomas steel fell from 84.62 marks in 1882 to 60.4-60.60 marks level in 1893-5 and the cost difference between Thomas and open-hearth steel sharply extended from about 2 marks per ton in the 1880s to 7-9 marks in the 1890s (Figure 6).

On the lower cost gained by the strategic cost reduction, German steel makers found it profitable even if they undercut British prices.³⁸ The average price per ton of Thomas iron in 1888-1890 became cheaper by 11.0-32.5% than other

³⁶ Even during, so called, "the Great Depression(1873-96)", the UK took the course of static supply-adjustment, while Germany made an active creation of effective demand and an expansion of industrial supply capacity through the increase and adjustment of capital formation. See Park(1997).

³⁷ Kregel(1991), pp. 187-8, 191.

³⁸ Report of the Tariff Commission(1904), Vol. 1.

[Figure 6] Cost difference between Thomas steel and Open-hearth steel (GHH)

Source: GHH-Archiv 310 009/2; 300 1320/0.

pig-iron such as Gießereiroheisen, Spiegeleisen. The price of Thomasknüppel(bar) was changed from 122.50 marks per ton in 1890 to 86.50, 80.25, 74.19, 74.88 marks after 1891, even to 74.00 marks in 1895.³⁹ Bars and ingots made of Thomas steel became the cheapest steel products.⁴⁰ As a result, the German wire, commercial iron, intermediate products, cruder forms of finished rolled products such as girders, joists and beams were already priced cheaper than the U.K.'s by 1890, and the German billets and even thick sheets also by 1900 in the international market.⁴¹

After all, as seen before, the decisive factor for the competitiveness edge of Germany's steel industry in international markets was not merely prohibitive tariff walls, the Thomas process itself, or export-market first strategy, as have been usually pointed out until now. Rather it could be said that what was more decisive was the German strategy of demand expansion through market division in two aspects, in other words the formation of the Germany-type heavy industry structure which made the adoption of the Thomas process and the mass production of steel, and the cost reduction to the competitive level possible.

³⁹ Feldenkirchen(1982), Tab.: 53.

⁴⁰ Kaiserliches Statistisches Amt(1907).

⁴¹ Kaiserliches Statistisches Amt(1907). Burnham and Hoskins(1943), pp. 165-6.

VI. CONCLUDING REMARKS: INTERNATIONAL MARKET AND COMPETITIVENESS

Having succeeded in reducing cost, the German steel makers were able to pursue the expansion of demand for German steel in international markets. In reality, the German steel makers' entrance into the international market took place through price competition based on cost reduction. The lower prices and the competitive edge of German steel products in international markets were not resulted simply from the 'German dumpings', which were already indicated in the U.K. at that time, but basically from cost reduction by strategic success, as were seen above.

The cost reduction process and the competitive strategies of the German steel industry shows the strategies of industrial development and long-term industrial structure adjustment in developing countries with market limits as late-comers in the aspects of the adoption of domestic-resource using technology, the demand policy for economies of scale and production stability, the first stabilization of domestic demand market and then time-differential approach to the international market, and market division and differentiation from developed countries, etc.. Also they show demand side is very important for a late-comer to be able to secure an industrial competitiveness edge.

REFERENCES

- Beck, L. (1901), *Die Geschichte des Eisens in Technischer und Kulturgeschichtlicher Beziehung*, V, Braunschweig, Reprinted, Tokyo: Yushodo, 1972.
- Bell, I.L. (1884), *Principles on the Manufacture of Iron and Steel*, London: George Routledge & Sons.
- Borchardt, K. (1976), "Wirtschaftliches Wachstum und Wechsellagen 1800-1914," in *Handbuch der Deutschen Wirtschafts- und Sozialgeschichte*, eds. by H. Aubin und W. Zorn, Bd. 2, Stuttgart: Union Verlag, 198-275.
- BITA(The British Iron Trade Association) (1896), *The Iron and Steel Industries of Belgium and Germany*, Westminster: King & Son.
- Brown, J.C. (1995), "Imperfect Competition and Anglo-German Trade Rivalry: Markets for Cotton Textiles before 1914," *Journal of Economic History*, 55(3), 494-527.
- Burnham, T.H., and G.O. Hoskins (1943), *Iron and Steel in Britain, 1870-1930*, London: George Allen & Unwin.
- Carr, J.C., and W. Taplin (1962), *History of the British Steel Industry*, Mass: Harvard University Press.
- Cohen, Y., and K. Manfrass, ed. (1990), *Frankreich und Deutschland: Forschung, Technologie und Industrielle Entwicklung im 19. und 20. Jahrhundert*, Munich: C.H. Beck'schen Verlagsbuchhandlung.
- Davis, L. (1966), "The Capital Markets and Industrial Concentration: the U.S. and U.K., a Comparative Study," *Economic History Review*, 2nd Ser., XIX, 255-72.
- Elbaum, B. (1986), "The Steel Industry before World War I," in *The Decline of the British Economy*, eds. by B. Elbaum and W. Lazonick, N.Y.: Oxford Univ., 51-81.
- Elbaum, B., and F. Wilkinson (1979), "Industrial Relations and Uneven Development," *Cambridge Journal of Economics*, 3(3), 275-303.
- Feldenkirchen, W. (1982), *Die Eisen- und Stahlindustrie des Ruhrgebiets, 1879-1914*, Wiesbaden: Franz Steiner Verlag GmbH.
- ____ (1991), "Banking and Economic Growth," in *German Industry and German Industrialisation*, ed. by W.R. Lee, London: Routledge, 116-47.
- Flinn, M.W. (1955), "British Steel and Spanish Ore, 1871-1914," *Economic History Review*, 2nd Ser., VIII, 84-90.
- Fremdling, R. (1986), *Technologischer Wandel und Internationaler Handel im 18. und 19. Jahrhundert. Die Eisenindustrien in Großbritannien, Belgien, Frankreich und Deutschland*, Berlin: Duncker & Humblot.
- Gerschenkron, A. (1966), *Economic Backwardness in Historical Perspective*, Mass.: Harvard University Press.
- Holtferich, C.L. (1973), *Quantitative Wirtschaftsgeschichte des Ruhrkohlenbergbaus im 19. Jahrhundert: eine Führungssektoranalyse*, Dortmund: Gesell-

- schaft für Westfälische Wirtschaftsgeschichte.
- Hupfeld, W. (1875), *Eisen und Stahl im Jahre 1874*, *Zeitschrift des Berg- und Hüttenmännischen Vereins für Steiermark und Kärnten*, 7.
- Jeidels, O. (1905), *Das Verhältnis der Deutschen Großbanken zur Industrie mit Besonderer Berücksichtigung der Eisenindustrie*, Leipzig: Duncker & Humblot, Reprinted, Bad Feilnbach: Schmidt Periodicals, 1990.
- Jersch-Wenzel, S., and J. Krengel, eds. (1984), *Die Produktion der Deutschen Hüttenindustrie 1850-1914*, Berlin: Colloquium Verlag.
- Jervis, F.R.J. (1947), "The Handicap of Britain's Early Start," *The Manchester School of Economic and Social Studies*, XV(1), 112-22.
- Kaiserliches Statistisches Amt (1907), *Statistisches Jahrbuch für das Deutsche Reich*, Berlin.
- Kiesewetter, H. (1991), "Competition for Wealth and Power," *Journal of European Economic History*, 20(2), 271-97.
- Kindelberger, C.P. (1961), "Obsolescence and Technical Change," *Bulletine Oxford University Institute of Statistics*, XXXIII, 281-97.
- Kocka, J., und H. Siegrist (1979), "Die Hundert Größten Deutschen Industrieunternehmen im Späten 19. Jahrhundert und Frühen 20. Jahrhundert," in *Recht und Entwicklung der Großunternehmen im 19. und Frühen 20. Jahrhundert*, eds. by N. Horn und J. Kocka, Göttingen: Vandenhoeck und Ruprecht, 88-101.
- Krengel, J. (1983), *Die Deutsche Roheisenindustrie 1871-1913*, Berlin: Duncker & Humblot.
- _____ (1991), "Sectoral Performance and Economic Development," *German Industry and German Industrialisation*, London and N.Y.: Routledge, 185-99.
- Landes, D.S. (1991), *The Unbound Prometheus*, Cambridge: Cambridge Univ. Press.
- McCloskey, D.N. (1970), "Did Victorian Britain Fail?" *Economic History Review*, 2nd Ser., XXIII(3), 446-59.
- _____ (1973), *Economic Maturity and Entrepreneurial Decline: British Iron and Steel, 1870-1913*, Mass.: Harvard University Press.
- Mitchell, B.R. (1981), *European Historical Statistics 1750-1970*, London: Macmillan.
- Neuburger, H., and H. Stokes (1974), "German Banks and German Growth," *Journal of Economic History*, 34, 710-31.
- Otsuka, T. (1980), "Doichini okeru Kinyushihon no Keizai to Kakritsu," in *Koja Seiyokeizaishi* 3, ed. by S. Irie, Tokyo: Tobunkan, 104-31.
- Park, Y.G. (1996a), "The Commodity and Market Structure of Manufactured Exports: the United Kingdom and Germany during the Great Depression (1873-1896)," *Kug Je Kyung Je Yon Gu*, 2(2), 161-85.
- _____ (1996b), "The Features and the Development Strategies of German Industrial Technology from the 19th Century to the Beginning of the 20th Century," *The Korean Economic Review*, 12(2), 243-60.
- _____ (1997), "Depression and Capital Formation: United Kingdom and Germany, 1873-1896," *Journal of European Economic History*, 26(3), 511-34.

- Payne, P.L. (1990), "Entrepreneurship and British Economic Decline," in *British Culture and Economic Decline*, eds. by B. Collins, and K. Robbins, London: Weidenfeld and Nicolson, 25-58.
- Pounds, N.G. (1968), *The Rhur*, New York: Greenwood.
- Protokolle über die Vernehmung der Sachverständigen durch die Eisen-Enquete-Kommission* (1881), Berlin.
- Report of the Tariff Commission*, V. 1. *The Iron and Steel Trades* (1904), London.
- Reuter, H.G. (1907), "Schutzzollpolitik und Zolltarife für Getreide 1880-1900," *Zeitschrift für Agrargeschichte und Agrasoziologie*, 25, 202-227.
- Sandberg, L.G. (1982), "Ignorance, Poverty and Economic Backwardness in the Early Stages of European Industrialisation," *Journal of European Economic History*, 11, 675-98.
- Stillich, O. (1904), *Eisen-und Stahl-Industrie*, Berlin: Siemenroth.
- Temin, P. (1966), "The Relative Decline of the British Steel Industry, 1880-1913," in *Industrialization in Two Systems*, ed. by H. Rosovsky, N.Y.: John Wiley & Sons, 140-55.
- Tilly, R. (1991), "Germany," in *Patterns of European Industrialization*, eds. by Richard Sylla and Gianni Toniolo, N.Y.: Routledge, 175-96.
- Troitzsch, U. (1975), "Die Einführung des Bessemer-Verfahrens in Preussen ein Innovationsprozess aus der 60er Jahren des 19. Jahrhunderts," in *Innovationsforschung als Multidisziplinäre Aufgabe*, Vandenhoeck und Ruprecht, Göttingen: Vandenhoeck und Ruprecht, 209-40.
- Vereins Deutscher Eisen-und Stahlindustrieller(Nordwestlichen Gruppe) (1881-1900), *Stahl und Eisen*, Jg, 1-10.
- Warren, K. (1973), *The American Steel Industry 1850-1870: A Geographical Interpretation*, Oxford: Clarendon Press.
- Webb, S.B. (1980), "Tariffs, Cartels, Technology, and Growth in the German Steel Industry, 1879 to 1914," *Journal of Economic History*, 40, 309-30.
- Welskopp, T. (1994), *Arbeit und Macht im Huttenwerk*, Bonn: J.H.W. Dietz.
- Wengenroth, U. (1994), *Enterprise and Technology: The German and British Steel Industries, 1865-1895*, Cambridge University Press.
- Yamazaki, Y. (1980), "England," in *Koja Seiyokeizaishi* 3, ed. by S. Irie, Tokyo: Tobunkan, Japanese, 76-102.
- Yang, D.H. (1994), "Steel Industry in the End of Nineteenth Century," *Miguk Gyungjesa Tamgu*, Seoul: Seoul National Univ. Press, Korean, 143-62.