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Import Dependence and Strategic War Planning – The German Iron and Steel Industry, 1933–1945

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ABSTRACT

In this paper I analyse the import dependence of the German steel industry between 1933 and 1945 and its strategic implications. After the First World War, the steel industry was faced with the loss of iron ore deposits in Lorraine. Steel producers replaced these ores by increasing imports. The industry was also dependent on imported alloying metals such as nickel and chromium. Taken together, this reliance on imports made the industry strategically vulnerable. Army officers drew up plans to expand domestic mining to build up strategic reserves. However, as most German ore deposits were of poor quality, private steel companies did not increase production significantly. The Nazi government forced the expansion of domestic mining to ensure supplies in the event of a blockade. This policy led to the creation of the Reichswerke 'Hermann Göring'. In the early years of the Second World War, domestic iron ore was successfully used when imports temporarily declined. After the occupation of France, the industry was again able to rely on ores from Lorraine, so that iron ore was no longer a limiting factor. Non-ferrous metals remained scarce, but the industry was able to use substitutes so that steel production was not significantly affected.

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1. Introduction

After the Nazi seizure of power, Germany gradually transformed itself into an economy that devoted substantial resources to the development of the armaments industry and to 'autarky' programmes.[1] The latter were originally motivated by the shortage of foreign exchange in the early 1930s, but military strategic considerations became the dominant motive even before the Four-Year Plan of 1936, under which Germany was to be prepared to 'be ready for war in four years'.[2] Germany was heavily dependent on imported resources, making the economy vulnerable. Given the experience of the Allied blockade during the First World War, it was likely that imports would be disrupted in the event of a future war.[3] The government therefore encouraged the development of industrial capacity that would allow imports to be replaced by domestic production. One industry that figured prominently in these plans was iron and steel. Steel was needed not only to equip the army and navy, but also to invest in autarky industries, such as the construction of synthetic fuel plants. However, the steel industry itself was heavily dependent on imports of ore and alloying metals.

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In this paper I discuss German policy measures against the effects of a potential blockade, focusing on the iron and steel industry. Drawing on a variety of sources from company and state archives, I show how the Nazi government responded to this vulnerability by incorporating economic aspects into strategic war planning and by pushing German steel companies to develop domestic ore deposits that could provide a reserve in the event of a wartime blockade. The interruption of Swedish iron ore imports in 1940, during the Battle of Norway, serves as a case study to assess the success of these measures. It shows that domestic iron ore created a strategic reserve that could be used during short-term trade disruptions. I also discuss imports of alloying metals. The lack of domestic deposits made it difficult to increase domestic production of the latter. However, substitution and increased production efficiency had already reduced the demand for these materials before the war, thereby reducing the risk of supply shortages.

The paper relates to the debate about the extent to which Nazi Germany was economically prepared for the Second World War. Alan S. Milward argues that the Nazi government did not prepare for a long war but pursued an economic 'Blitzkrieg' strategy, reflected in low stocks of strategic raw materials and only modest increases in armaments production in the early years of the war.[4] According to this view, the Nazi government refrained from full economic mobilisation to minimise the economic burden on the German population. Recent studies, however, have challenged this view and used newly collected data to provide evidence against the Blitzkrieg hypothesis.[5] For example, large investment in war-related industries and efforts to conserve strategically important resources through substitution suggest that the German economy was preparing for a prolonged war.[6] The results of this paper are consistent with this view.

There is an extensive literature on the development of the German steel industry under the Nazi regime.[7] Previous work has focused on the conflict with the government over the development of domestic iron ore deposits and the increase in iron and steel production that led to the creation of the *Reichswerke AG für Erzbergbau und Eisenhütten „Hermann Göring"* (*Reichswerke*) in 1937.[8] Business historians have studied the German steel companies also from a broader perspective, motivated by the historical reappraisal of crimes committed during the Nazi period, such as the 'arianisation' of Jewish companies, forced labour, and the exploitation of occupied Europe. While this strand of research mainly includes individual case studies of well-known companies such as *Friedrich Krupp AG* or *Vereinigte Stahlwerke AG* (*Vestag*),[9] this paper focuses on the import dependence for the steel industry as a whole.

More recently, Jonas Scherner has systematically analysed the strategic dimension of import dependence, but his focus is on copper and other industrial metals such as nickel or tin.[10] I complement this research by analysing the role of iron ore imports. In quantitative terms, iron ore imports were even more important than copper imports. In doing so, this paper is also related to previous studies on other autarky programmes and to research focusing on specific aspects of the steel industry's import dependence.[11] In a broader sense, the paper contributes to the literature on the effects of the Allied blockade in the Second World War and blockades in general.[12]

The paper is structured as follows. Chapter 2 gives an overview of the situation after 1919, when German steel companies became increasingly dependent on Swedish iron ore imports. Chapter 3 provides a quantitative perspective on the import dependence of the steel industry. Chapter 4 analyses the German iron ore policy, which aimed at reducing import dependence, and the role of the *Reichswerke*, which were established to accelerate the mining of domestic iron ores and to produce iron and steel in areas less exposed to potential war damage or occupation. Chapter 5 evaluates this policy by using the import disruptions of 1940 as a case study. Chapter 6 concludes.

2. Import dependence of the german steel industry after 1919

After the Franco-Prussian War of 1871 and the German annexation of Alsace-Lorraine, German iron and steel companies invested heavily in the exploitation of iron ores from Lorraine (the so-called Minette ores). The Minette ores were partly used to produce iron and steel in local

plants in Lorraine, but were also exported to the Ruhr area, where the core of the German steel industry was located.[13] In 1913, it supplied about 19 per cent of the ore needed by the Ruhr works.[14] In return, coke coal was shipped from Germany to Lorraine to fuel local blast furnaces. The First World War disrupted this bilateral trade relationship. Immediately after the war, the French took over the German-owned steelworks and mines in Lorraine.[15] Under the Treaty of Versailles, the German government had to accept these expropriations. As compensation, the German Empire paid the companies involved 100 million Goldmarks to be used to find and develop new iron ore deposits.[16]

After 1919, Germany could no longer import similar quantities of ore from France because the French steel industry wanted not only to limit the influence of its German counterpart but also to reduce its dependence on German coking coal.[17] The German steel companies therefore had to adapt their business strategies and look for new suppliers. Domestic ores could not immediately replace Minetette ores due to a lack of investment in the development of these deposits. In addition, most of the German deposits could only be mined in small quantities due to their limited size.[18] High-grade ore was particularly scarce. This ore was characterised by a high iron content and a chemical composition that facilitated the production of iron. The only region where it was feasible to mine large quantities was the area west of the Harz mountains (the so-called Salzgitter area). However, these ores were of poor quality and could only be smelted using large quantities of coking coal, which, given the technology available at the time, resulted in high production costs. As a result, the major steel companies explored these deposits but only invested little in their development and exploitation.[19] Instead, they looked abroad for alternatives.

German steel companies replaced Minette mainly with imports from Sweden.[20] Because of its high iron content, it was economically feasible–if not superior–to substitute Minette, even though it required investment in the modification of blast furnaces. Strategically, however, these imports increased the vulnerability in the event of a blockade. Most of the ore mined in Kiruna (northern Sweden) was transported by rail to Narvik in Norway, from where it was shipped across the North Sea to Germany.[21] In a plausible war scenario with England and France, these shipments were at risk. Ore from other countries, such as Spain or British Empire territories, was less important but, with a few exceptions, also vulnerable in the event of a blockade.

In the inter-war period, German steel companies tried to secure control of foreign ore deposits by carrying out exploration projects and purchasing shares in foreign mining companies. However, this strategy was not very successful. By 1927, only two per cent of all imported ore came from mines owned by German companies, so almost all ore had to be bought from third parties.[22] Importing ore from third parties increased the price risk, so companies sought long-term contracts. In the case of Swedish imports, about 60 per cent were imported on the basis of such contracts, while ore purchases from other countries were based on short-term contracts.[23]

According to German trade statistics, iron ore accounted for 2.6 per cent of all imports in 1927.[24] Steel companies were also dependent on a range of other metals. For example, manganese was used in the production of high-quality steel, chromium and nickel in the production of stainless steel, and zinc and tin as coating materials used to protect steel from corrosion. Overall, the share of imports of metals important for steel production was 5.6 per cent in 1927.[25] By comparison, copper (ore and refined), which was mainly used in the electrical engineering industry, accounted for 2.6 per cent.

3. Strategic trade policy and ore imports in the 1930s

In the summer of 1931, the rapid withdrawal of deposits by foreign investors triggered the German banking crisis, resulting in a massive loss of the Reichsbank's gold and foreign exchange reserves.[26] To stem the gold outflow, the government restricted the convertibility of the Reichsmark by introducing a state-controlled allocation system for foreign exchange. This policy was combined with export subsidies and tightened under the Nazi regime to prevent a worsening of the

balance of payments crisis.[27] Hjalmar Schacht, President of the Reichsbank, who also became Minister of Economics in 1934, introduced the 'New Plan', which prioritised the allocation of foreign exchange to strategically important resources at the expense of consumer goods.[28] In addition, the German government sought to reach clearing agreements with other countries to limit the use of foreign exchange in international trade. For example, Germany negotiated with Sweden to finance iron ore imports with coal exports.[29] This strategy was often costly because Germany had to accept unfavourable terms of trade. In other words, when Germany exported goods on the basis of such clearing agreements, it had to sell them below the world market price.

Clearing agreements and the allocation of foreign exchange made it possible to increase iron ore imports from 58.8 million RM in 1933 (1.4 per cent of total imports) to 281.5 million RM in 1939 (5.2 per cent) (see Table 1). More importantly, Germany benefited from low world market prices after the Great Depression. The average import price was 18.6 RM per tonne in 1929 and it fell to 12.9 RM per tonne in 1938. Between 1933 and 1937, average prices were even lower.

The fact that iron ore imports in 1936 exceeded the 1929 level underlines the success of Schacht's policy of allocating funds to strategic resources. Germany would have imported even more, given the strong demand that led to a massive increase in iron and steel production. However, the shortage of foreign exchange and difficulties in negotiating clearing agreements[30] forced the producers to rely on domestic ores, which were increasingly used in the late 1930s despite of their low quality, significantly increasing production costs.[31] Although iron ore was strategically important, it competed in the state-controlled allocation of foreign exchange with other resources for which import dependence was even greater and substitution more costly. For example, the electrical engineering industry was dependent on copper imports, which rose from 108.4 million RM (2.5 per cent of total imports) in 1933 to 203.1 million RM (3.7 per cent of total imports) in 1938.[32]

As mentioned above, the steel industry was not only dependent on iron ore imports but also on various other metals which were not or only scarcely available in Germany. Table 2 shows the import values and percentages of total imports for all such metals (except iron ore) in 1933 and 1938. The last column shows the change in import values between 1933 and 1938. I distinguish between metals that were 'partly' and 'mainly' used in the steel industry. The former group includes tin and zinc, which were used as coating materials (e.g. for the production of tinplate) but also by the non-ferrous metal industry,[33] and iron pyrite, which was used by the chemical industry for the production of sulphuric acid.[34] In 1933, tin and zinc accounted for 0.8 and 0.6 per cent respectively, and iron pyrite for 0.4 per cent. Imports of pig iron, including scrap used in the production of Siemens-Martin steel, were of similar magnitude (0.4 per cent). Manganese accounted for only 0.1 per cent and all other ores and metals not specifically mentioned in 1933 accounted for 1.8 per cent. The latter included alloying metals such as nickel, chromium, and ferro-alloys (for which data are available for 1938), but also tungsten, vanadium, molybdenum, or cobalt, which were also important for the production of high-quality steel but were imported in relatively small quantities.[35] In total, all metals mainly used in the production of steel accounted for up to 2.3 per cent of all imports.[36] This figure rises to 4.1 per cent if metals that were partly used in the steel industry are added. This is more than three times the share of iron ore imports in 1933, highlighting the quantitative importance.[37]

Table 1. German iron ore imports, 1929–38.

	1929	1933	1934	1935	1936	1937	1938
Ore imports in million RM	315.6	58.8	88.3	123.4	168.3	221.9	281.5
In % of all imports	2.3	1.4	2.0	3.0	4.0	4.1	5.2
Ore imports in million tonnes	17.0	4.6	8.3	14.1	18.5	20.6	21.9
Average price in RM per tonne	18.6	12.8	10.6	8.8	9.4	10.8	12.9

Notes: All figures are rounded. Ore imports in tonnes based on the crude ore weight (not weighted for iron content). Source: Donges (2014), 135.

Table 2. German imports of ores and metals used in the steel industry, 1933–38.

	1933		1938		
	in mio. RM	in %	in mio. RM	in %	1933 = 100
(1) Mainly used in the steel industry					
Manganese ores	4.7	0.1	16.8	0.3	357.5
Pig iron (incl. scrap)	15.9	0.4	73.4	1.3	461.6
Other ores and metals	75.2	1.8	136.2	2.5	181.1
thereof:					
- Chrome ores			9.9	0.2	
- Nickel (ores, refined and scrap)			16.7	0.3	
- Ferro-alloys			10.2	0.2	
Sum	95.8	2.3	226.4	4.1	236.3
(2) Partly used in the steel industry					
Zinc (ores, refined, and scrap)	27.0	0.6	27.2	0.5	100.7
Tin (refined and scrap)	34.8	0.8	19.7	0.4	56.6
Iron pyrite	15.4	0.4	23.6	0.4	153.3
Sum	77.2	1.8	70.5	1.3	91.3
Sum (1) + (2)	173.0	4.1	296.9	5.4	171.6
Total imports	4,203.6		5,449.3		126.6

Notes: This table shows the imports of ores and metals used in the steel industry (in millions of RM and as % of total imports) for 1933 and 1938. The last column shows the 1938 imports (in RM) in relation to 1933. Other ores and metals are not further specified in the 1933 trade statistics. Source: Deutsches Reich, *Statistisches Jahrbuch 1935*, 204; Deutsches Reich, *Statistisches Jahrbuch 1939/40* (Berlin, 1940), 272.

By 1938, imports of ores and metals used in the iron and steel industry increased not only in absolute terms to 296.9 million RM but also in relative terms to 5.4 per cent of all imports. However, there were differences in the composition. Imports of tin decreased in RM, while imports of zinc remained almost constant in RM. In the case of tin, for which imports also fell in tonnes,[38] scholars document the substitution by other materials,[39] and additional zinc demand was met by increased domestic production.[40] On the other hand, imports of manganese, which was used in the production of high-quality steel that was particularly important for armaments production (e.g. armour plating for tanks), were more than 3.5 times higher in 1938 than in 1933. This increase was not due to higher prices but to higher volumes.[41] There was also a massive increase in pig iron imports, which can be explained by the rising demand for scrap iron, which was added in the production of Siemens-Martin steel.[42] By 1938, there was already a shortage of scrap so that increasing amounts of scrap had to be imported. Because of the shortage of foreign exchange, the economic authorities planned to restrict scrap imports and reduce the production of Siemens-Martin steel in favour of Thomas steel, which did not require scrap.[43] However, the steel companies successfully lobbied against this plan and scrap imports actually increased, facilitated by lower world market prices.[44] Finally, Table 2 also shows the share of imports of chrome, nickel, and ferro-alloys in 1938.[45] These metals were used to make high-quality products such as stainless steel, which was also heavily used in the armaments industry.[46]

The German steel industry was particularly vulnerable because of the geographical origin of its imports. Table 3 shows the countries of origin of iron ore in 1913, 1929, 1933, and 1938. The first group includes countries that were neutral in World War I. Sweden accounted for the largest share. Its share increased significantly from 1913 and remained high throughout the 1930s. The relative decline in Swedish imports from 54.5 per cent in 1933 to 51.5 per cent in 1938 does not reflect a strategic shift but the fact that Germany could not increase its imports as much as it would have liked, as trade negotiations proved to be lengthy and difficult.[47] Imports from Norway accounted for seven per cent in 1933 and fell to 5.7 per cent in 1938. Again, this decline is not evidence of a systematic shift, but reflects the limited size of Norwegian ore deposits. Spain (including its colonies) provided 10.7 per cent of Germany's iron ore imports in 1938, and there were plans to increase imports from Spain even further.[48] The fact that the Nazi government

Table 3. Share of German iron ore imports by country of origin, 1933–38 (in %).

Country of origin	1913	1929	1933	1938
Neutral in WWI				
Sweden	38.2	50.5	54.5	51.5
Norway	3.3	4.6	7.0	5.7
Spain (incl. African colonies)	32.0	19.0	3.8	10.7
Sum	73.5	74.1	65.3	67.9
Enemy countries in WWI				
France	10.9	10.6	15.8	12.8
Algeria (French)	4.4	4.7	4.0	3.9
Newfoundland (British)	0.9	4.5	5.1	5.2
Sum	16.2	19.8	24.9	21.9
Not specified				
Other countries	10.3	6.1	9.9	10.2
Sum	100.0	100.0	100.0	100.0

Notes: This table shows the share of German iron ore imports by country of origin in 1913, 1929, 1933, and 1938 (in % of total iron ore imports, based on the value in RM). In 1938, other countries include Belgium, Brazil, Greece, Luxembourg, Morocco (French), Switzerland, Tunisia (French) West Africa (British). Source: Deutsches Reich, *Statistisches Jahrbuch 1914* (Berlin, 1915), 201; Deutsches Reich, *Statistisches Jahrbuch 1930* (Berlin, 1931), 214; Deutsches Reich, *Statistisches Jahrbuch 1935*, 217; Deutsches Reich, *Statistisches Jahrbuch 1939/40*, 282.

regarded Franco's Spain as a friendly country may have encouraged the strengthening of trade relations between the two countries. It is worth noting, however, that Spain had played a more important role in the past. In 1913, it accounted for 32 per cent of all iron ore imports, but its share of imports declined over time. This was due to the depletion of ore deposits, increased domestic demand in Spain and more intense international competition.[49] Overall, countries that were likely to remain neutral in the event of a major conflict, based on their experience of the First World War, accounted for around 68 per cent of all iron ore imports in 1938. The second group includes the territories controlled by France and the United Kingdom, which accounted for about 25 per cent of all imports in 1933 and 22 per cent in 1938. These figures are only lower bounds, as the 1933 trade statistics do not specify the group of other countries. In 1938, the latter included Belgium, Luxembourg, and other French and British territories. Their combined share was 7.7 per cent, so that in 1938 about 30 per cent of all iron ore imports came from countries that had been enemies of the German Empire in the First World War. From the perspective of the late 1930s, the loss of these imports was likely in the event of a blockade. Most other imports were also at risk, as imports from Scandinavia and Spain were also transported by ship.

The supply of other ores and metals was even more fragile. The geographical concentration of deposits meant that imports were concentrated in a small number of countries. A large proportion came from parts of the British Empire (including the Dominions).[50] In 1938, for example, 60 per cent of all manganese imports came from the Union of South Africa and British India.[51] The dependency on the Empire was even greater for nickel ore, with Canada and Burma accounting for 93.1 per cent of all imports.[52] In the case of chromium, Germany bought a large proportion from producers in the Union of South Africa (30.3 per cent).[53]

In summary, from the perspective of the German steel industry, it was not only the supply of iron ore that was at risk in the event of a blockade, but also the supply of other strategically important metals. Nevertheless, until the outbreak of the Second World War, the government allocated sufficient funds to buy enough of these ores and metals. Records from company archives show no evidence of any systematic shortages that disrupted production. In August 1938, for example, the minutes of the *Vestag* board of directors stated that the supply of manganese ore was secured for more than a year into the future.[54] Faced with a shortage of foreign exchange, the steel industry was able to reduce the demand for alloying metals through increased production efficiency and substitution. For example, some of the nickel used in stainless steel was replaced by chromium and molybdenum.[55] Estimates for the German economy as a whole

suggest that the substitution of nickel reduced its consumption by 22 per cent compared to a counterfactual scenario without substitution.[56]

Strategic stockpiling could also limit import dependency, but this strategy was not sufficient to prepare for a major conflict. In 1936/37, for example, the iron ore stocks of the *Vestag* works, which accounted for more than 40 per cent of Germany's pig iron and crude steel production, were only sufficient to provide supply for about one to two months' requirements.[57] The government therefore sought to increase the mining of domestic ores, which should be used to replace imports.

4. Development of domestic ore mining

During the years of the Weimar Republic, private initiative in the development and exploitation of domestic iron ore deposits was limited to small-scale projects and focused mainly on exploration, as it was more cost-effective to import high-quality iron ore from Sweden and other countries.[58] Strategically, however, the growing dependence on imported ore increased the risk of a blockade in the event of tensions with the Western Allies. As early as 1928, military officials at the *Heereswaffenamt*, the army's armaments development and economic war planning agency, proposed measures to reduce the dependence on imports, including not only the substitution of scarce materials but also investment in the development of domestic iron ore deposits.[59] They built up on plans developed by the *Kriegsrohstoffabteilung*[60] in 1916 but were not implemented because private companies were unwilling to invest in such risky projects.[61]

Even after 1933, the position of most private companies on this issue remained unchanged. Despite of political pressure, private investment in domestic mining was low. After the Great Depression, the steel companies had only limited funds and investment in other areas such as modernising steelworks or building armaments production facilities, was more promising.[62] Domestic ores could only be mined and processed at high cost. With little financial support from the government, the expected profits associated with large-scale investment in the development of domestic ore mining were too low. As a result, there were conflicting interests: on the one hand, the war planners, who were concerned about the strategic vulnerability of the German economy in the event of a blockade, and, on the other, the financial interests of the private steel companies, which sought high profitability.

After the Nazis came to power, political pressure to expand domestic ore mining increased, not only because of the balance of payments crisis, but also for strategic reasons. The iron ore deposits in the Salzgitter area were seen as the most suitable for creating a strategic reserve in Germany, but the 'Dogger' ores in southern Germany were also to be exploited. From the perspective of the war planners, domestic mining was seen as crucial to prepare for future conflicts. However, simply increasing iron ore extraction was not enough to maintain production in the event of a blockade, as the existing blast furnaces at the Ruhr were designed to melt high-grade ore. It was technically possible to add small quantities of low-grade ore but not to replace all or a significant proportion of the imported ore without massive investment.[63] For this reason, the German government extended its plans to include the construction of additional iron and steel works near the Salzgitter iron ore deposits to act as back-up plants.

Strategically, the Salzgitter area not only offered access to iron ore deposits, but was also less exposed than the Ruhr, which was close to the French border and therefore vulnerable in the event of war.[64] Internal German government documents highlight the military motives behind the construction of additional steelworks and show that the geographical distance from the German borders did indeed play a role in the decision to choose the Salzgitter area.[65] For example, a memo from the German Ministry of Finance, which was involved in the planning, states that 'for the war economy, the construction of a large steelwork is of great importance' and that 'in the war case, it would be less exposed than the Ruhr industry'.[66] The loss of the Ruhr area–the

heart of the German iron and steel industry–or at least massive disruption to production (e.g. from air raids) was likely, given the war scenarios being practised by the German General Staff in 1937.[67] The construction of steelworks in the Salzgitter area was therefore seen as crucial to creating reserve capacity for possible future conflicts.

In 1937, the clash of interests between the Nazi government and the private companies culminated in the creation of the *Reichswerke*.[68] The *Reichswerke* were established and owned by the German state to accelerate the exploitation of domestic iron ore deposits, including those in the Salzgitter area. In addition, as proposed by the war planners, the *Reichswerke* were to build integrated iron and steel works to melt and process these ores locally. This plan was controversial because leading steel managers, including Albert Vögler and Ernst Poensgen (both *Vestag*), feared that additional steelworks would increase competition and threaten their own position. Other industrialists were less sceptical. Hermann Röchling, for example, the owner of a steel company in the Saar region, was an ardent supporter of this policy.[69] The lack of a unified position within the German steel industry helps to explain why opposition to the *Reichswerke* was unsuccessful.

To speed up the extraction of ore, the state forced the *Vestag* and other private companies to sell most of their iron ore deposits in the Salzgitter area to the *Reichswerke*.[70] While much of this ore was to be smelted locally in the *Reichswerke*'s blast furnaces, the Ruhr companies retained access to it through bilateral supply agreements. The forced increase in domestic ore mining was successful, judging by the increase in the quantities mined. Table 4 shows that iron ore extraction rose from 4.8 million tonnes in 1929 to 12.3 million tonnes in 1938, an increase of 156 per cent. However, the average ore quality in 1938 was lower than in 1929 due to a lower iron content. The deterioration in quality can be seen by comparing the supply of ore (imported and domestic) with the production of pig iron. This ratio deteriorated from 1.7 in 1929 to 1.9 in 1938, meaning that almost two tonnes of ore were needed to produce one tonne of iron.[71] While the deterioration in ore quality increased the costs of producing iron, the expansion of domestic mining was strategically rational, as it would facilitate the use of these ores in the event of a blockade.

There have also been efforts to increase the domestic mining and processing of other metal ores used in the steel industry.[72] Quantitatively, in terms of the size of deposits or the amount of investment, these projects were less significant and consequently less discussed in the literature. Indeed, Germany was a country with few resources and for some metals (e.g. chromium) there were no domestic deposits at all.[73] However, other metals, such as zinc, manganese, and nickel, could be mined from smaller deposits, which made sense to reduce dependence on imports in the event of a blockade, even though the exploitation of these deposits was costly. In the case of zinc, additional mining investment, subsidised by the government, allowed a significant increase in production.[74] Manganese was extracted from ores in the Siegerland region, although mining was very costly due to unfavourable geological conditions.[75] The manganese content was low compared to imports, but this source reduced the need for foreign exchange. This strategy was rational in the short term, but since the depletion of the deposits was foreseeable, it would not have been sufficient to replace imports in the event of war.[76] In the absence of other significant deposits, steel companies tried to create a 'manganese reserve' by reducing the demand through technological innovation and substitution.[77] Nickel is another example. In

Table 4. Pig iron production and iron ore supply, 1933–38.

	1929	1933	1934	1935	1936	1937	1938
(1) Pig iron production (million tonnes)	13.2	5.2	8.7	12.8	15.3	16.0	18.0
(2) Iron ore import (million tonnes)	17.0	4.6	8.3	14.1	18.5	20.6	21.9
(3) Iron ore mining (million tonnes)	4.8	2.6	3.7	5.3	6.7	7.8	12.3
(4) = [(2) + (3)] / (1)	1.7	1.4	1.4	1.5	1.6	1.8	1.9

Notes: All figures are rounded; including Saar (since 1935). Iron ore imports in tonnes based on the crude ore weight (not weighted for iron content). Source: Donges, *Stahlwerke*, 137.

the 1920s, domestic nickel production was insignificant. In the 1930s, however, additional reserves were discovered in Lower Silesia.[78] Due to geological conditions, extracting these ores was very costly, so it made sense to rely on imports for as long as possible. However, in the event of a blockade, these reserves–hidden from the public for strategic reasons–could be used to overcome trade disruptions.

5. War-related disruption in the steel industry

In the early months of the Second World War, the German steel companies suffered severe disruption, partly caused by the interruption of Swedish ore imports from Narvik.[79] Securing access to these ores was one of the reasons for Hitler's decision to invade Denmark and Norway in 1940.[80] While the Germans were able to quickly occupy major Norwegian cities, Norwegian forces, supported by the Allied Expeditionary Corps, temporarily pushed back the German troops at Narvik. During the battle, ore shipments from Narvik were halted. An alternative route *via* Luleå (northern Sweden) was also impossible due to the icing of the Baltic Sea.[81] In addition, imports from other areas under the control of the Western Allies (e.g. Newfoundland) were disrupted or had already been disrupted in the months prior to the outbreak of the war. Combined with the loss of imports from Sweden, these trade disruptions posed a challenge to the German steel companies, which had to maintain production at high levels.

The steel companies responded by using more domestic iron ore, which could partly replace imports. Figure 1 shows the development of iron ore deliveries from the Salzgitter area to the Ruhr steelworks. The grey line shows the monthly amount of ore (in tonnes of crude weight) that could have been delivered on the basis of the contracts signed with the *Reichswerke*, and the black lines show the amount that was *actually* delivered and the average delivery during the observation period (October 1937 to July 1941). Prior to the Battle of Norway, the quantity delivered was well below the contractually agreed quantity. This pattern supports the argument that private companies had little interest in smelting these ores under normal conditions due to the

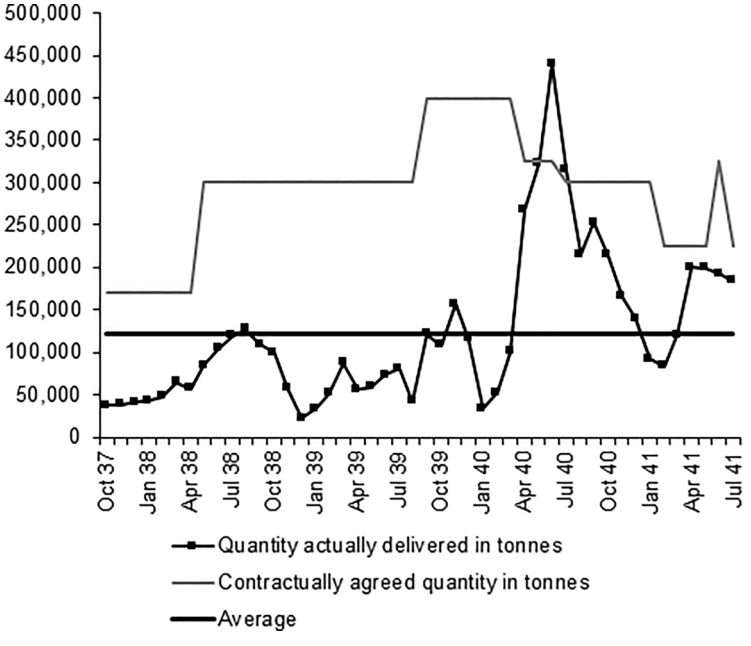

Figure 1. Monthly iron ore deliveries from the Reichswerke (Salzgitter Area) to the Ruhr Works, 1937–41.
Notes: Data extracted from: Übersicht über die Entwicklung des Erzversandes an die Rhein-/Ruhr-Werke durch die Erzbergbau Salzgitter GmbH, Ringelheim, 12 August 1941, in: Niedersächsisches Wirtschaftsarchiv (NWA) 2 Nr. 11527.

Table 5. Iron ore supply of the Ruhr area by country of origin in 1938 and 1943.

	1938		1943	
Source country / region	in 1,000 t	in %	in 1,000 t	in %
Scandinavia	9,091	58.0	8,558	56.3
Minette (Lorraine)	1,111	7.1	4,672	30.7
Normandy / Bretagne (France)	543	3.5	789	5.2
Spain	776	5.0	368	2.4
Switzerland	115	0.7	159	1.0
Austria	410	2.6	124	0.8
Russia	54	0.3	439	2.9
Slovakia	.	.	90	0.6
Africa	2,358	15.1	4	0.1
America	1,191	7.6	.	.
India	12	0.1	.	.
Imported ores total	15,661	100.0	15,203	100.0
Domestic ores (German borders of 1937)	5,833		5,641	
Imported and domestic ores total	21,494		20,844	

Notes: This table shows the supply of ores of the Ruhr works ('northwest works') in 1,000 tonnes by origin. The percentages indicate the proportion of all imported ores. The figures show the weight of the ore (not weighted for iron content).
Source: Erzbezüge der Nordwestwerke (Anlage 7), in: Zusammenhänge und Lage der nordwestlichen Eisenindustrie, 17 August 1945, in: Bundesarchiv (BArch) R 3101/32249.

higher processing costs, particularly the cost of additional coking coal.[82] From January 1940, however, the Ruhr companies began to demand more ore from Salzgitter. In the summer of 1940 the quantities shipped to the Ruhr actually exceeded the contractually agreed quantities, but then deliveries fell sharply after June 1940.

There were two reasons for the decline. Firstly, the Allied withdrawal from Norway allowed Sweden to continue shipping ore to Germany from Narvik, and during the summer months the Baltic route was increasingly used so that imports from Sweden rose steadily after the interruption in 1940.[83] As a result of a German-Swedish trade agreement, German companies were even able to increase their purchases of iron ore from Sweden in 1941 compared with 1939, but the available shipping capacity limited the delivery of this ore.[84] Second, the occupation of France secured access to the iron ore deposits in Lorraine and northern France. The control of these ores changed the strategic situation.[85] In the years that followed, the supply of iron ore was no longer a bottleneck factor. As a result, the exploitation of low-grade iron ore deposits was slowed down. In 1940, domestic production peaked at 16.2 million tonnes of iron ore, but by 1943 it had fallen to just 10.7 million tonnes.[86] One reason for this was the high labour intensity of the mining industry. As labour was scarce, even taking into account the large number of forced labourers employed in the mines, it made economic sense to import as much ore as possible and to concentrate the workforce on the mines with the highest quality ore.

Table 5 shows the supply of ores to the Ruhr works in 1943 compared with 1938 by region of origin. In 1943, Scandinavia still accounted for the largest share (56.3 per cent). The French ores (Minette and ores from the Normandy and Brittany) accounted for 35.9 per cent, compared with 10.6 per cent in 1938, showing that the German war economy benefited greatly from the annexations in the west. These ores compensated for the loss of imports from British and (formerly) French-controlled areas such as New Foundland or the African colonies, which had accounted for a large share before 1939. In 1941, Germany also gained control of significant ore deposits in Ukraine, notably at Krivoi-Rog, which were of similar quality to Swedish ores. Overall, ores from occupied parts of the Soviet Union accounted for three per cent of the Ruhr works' imports. In summary, the economic exploitation of Europe ensured wide access to iron ore. Compared with 1938, the Ruhr works' supply of imported ore was only three per cent lower in 1943.

Territorial expansion also increased the supply of other metals used in the steel industry, reducing the risk of disruption to the armaments production. For example, German companies gained

access to the Petsamo nickel mine in northern Finland and the control of nickel refineries in Norway, which had already accounted for a large proportion of refined nickel imports before the war.[87] Another example is the manganese ore deposit at Nikopol in Ukraine, which came under German control in 1941.

The supply of high-quality ore enabled German steelworks to maintain high levels of production. Wartime disruptions and shortages caused crude steel production to fall in 1939/40, but it then recovered to 20.8 million tonnes in 1941, compared with 22.7 million tonnes in 1938.[88] It remained at this relatively high level until 1943. Taking into account all areas under German control, including Poland and Alsace-Lorraine, crude steel production even reached 34.6 million tonnes in 1943.

A comparison with the First World War is useful. After August 1914, steel production fell massively and recovered only slightly without reaching pre-war levels, despite of full economic mobilisation under the 'Hindenburg Programme'.[89] However, as Germany continued to mine iron ore in Lorraine during the First World War and also imported it from Sweden, the decline in steel production was due to a shortage of coking coal and transport capacity rather than a shortage of ore.[90] The situation was not much different during the Second World War. In quantitative terms, coal production was crucial because there was a massive shortage of labour, which prevented an increase in production that would have made it possible to produce more iron and other coal-based products (e.g. synthetic fuels).[91] There was also a lack of production capacity at various levels of the supply chain. For example, the German steel industry often pointed to the lack of coke oven capacity, which limited the production of coking coal.[92] Therefore, the supply of iron ore and other industrial metals does not seem to have been a bottleneck factor compared to other inputs.

6. Conclusion

In the 1930s, German war planners were concerned about the strategic vulnerability of the steel industry, which was heavily dependent on imported iron ore and other metals used to refine and alloy steel. Under these conditions, and based on the experience of the First World War, a decline in steel production was a likely scenario in the event of a blockade. Consequently, the German government and military command sought to reduce this vulnerability by increasing domestic mining, building up of reserve capacity, and substituting scarce (non-ferrous) metals. Indeed, in the first year of the war, German iron ore deposits were crucial in preventing an even greater decline in production caused by the interruption of Swedish iron ore supplies. History did not, however, test the long-term success of Germany's autarky policy. The rapid victories that led to the occupation of large parts of Europe opened up access to large iron ore deposits in France and secured supplies of other strategic metals such as nickel from Norway. In summary, the German steel industry was dependent on ore and metal imports during the Second World War, but these resources were not scarce compared to other factors, especially labour and coking coal.

Notes

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8. See, e.g., Gerhard Th. Mollin, *Montankonzerne und „Drittes Reich". Der Gegensatz zwischen Montanindustrie und Befehlswirtschaft in der deutschen Rüstung und Expansion 1936-1944* (Göttingen: Vandenhoeck & Ruprecht, 1988); Richard J. Overy, *Goering. The „Iron Man"* (London, 1984); Rainer Haus, *Lothringen und Salzgitter in der Eisenerzpolitik der deutschen Schwerindustrie von 1871 – 1940* (Salzgitter: Archiv der Stadt Salzgitter, 1991).
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15. Ibid., 373–377.
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17. Denkschrift zur Frage der Eisenerzversorgung Deutschlands insbesondere Rheinland-Westfalens, Hermann Wenzel, 7 October 1927, p. 52, in: Bundesarchiv (BArch), R 13-I/320.
18. Detailed information on the feasibility of domestic ore mining is from an expert report written in 1927; Denkschrift zur Frage der Eisenerzversorgung Deutschlands insbesondere Rheinland-Westfalens, Hermann Wenzel, 7 October 1927, in: BArch, R 13-I/320.
19. Cf. Donges, *Stahlwerke*, 127–132.
20. Cf. Plücker, *Eisenerzbergbau*; Karlbom, *Exports*; Note that Swedish ores had been already used before 1919, but the share of Swedish ores relative to all ores melted was much smaller; Alfred Stellwaag, *Die deutsche Eisenwirtschaft während des Krieges*, ed. by Marcel Boldorf and Rainer Haus (Berlin: De Gruyter Oldenbourg, 2016), 295.
21. Narvik is geographically closer to Kiruna than the nearest major port on the Baltic Sea (Luleå), so that it was cheaper to ship the ore via Narvik. More importantly, unlike Luleå, Narvik's harbour was ice-free during the winter months; for the role of Narvik, see Plücker, *Eisenerzbergbau*.
22. Denkschrift zur Frage der Eisenerzversorgung Deutschlands insbesondere Rheinland-Westfalens, Hermann Wenzel, 7 October 1927, p. 38, in: BArch, R 13-I/320.
23. Ibid., p. 44; Harm Schröter, 'Risk and Control in Multinational Enterprise: German Businesses in Scandinavia, 1918-1939', *Business History Review* 62, 1988, 420–443, here: 427–430.
24. Data for 1927 imports: Deutsches Reich, *Statistisches Jahrbuch für das Deutsche Reich. 1928* (Berlin, 1928), 196–197.
25. This figure includes iron ores, manganese, other ores (not specified), pig iron (including scrap), tin, zinc, and other non-precious metals (not specified). Since some metals were also used in other industries (e.g., tin, zinc, and iron pyrite), the share of 5.6 percent is only an upper bound for imports related to the steel industry. Ores and metals mainly used in other industries (e.g., electrical engineering) include copper (ores), lead, and aluminum (in sum 3.3 percent of all imports in 1927).
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27. Michael Ebi, *Export um jeden Preis. Die Deutsche Exportförderung von 1932-1938* (Stuttgart: Steiner, 2004).
28. Tooze, *Destruction*, 86–98.

29. Niederschrift über die Aufsichtsratssitzung der *Vestag*, 5 August 1938, in: Stiftung zur Industriegeschichte Thyssen (SIT) VSt/4104.
30. Ibid.
31. Donges, *Stahlwerke*, 186–190.
32. Including copper ore and refined copper (including scrap); for 1933: Deutsches Reich, *Statistisches Jahrbuch für das Deutsche Reich. 1935* (Berlin, 1935), 204; for 1938: Deutsches Reich, *Statistisches Jahrbuch für das Deutsche Reich. 1939/40* (Berlin, 1940), 272.
33. Copper works, for example, needed tin to produce brass. Brass was also important for the production of armaments goods (e.g., to produce shell cartridges).
34. The byproduct, iron oxide, was then used to produce steel.
35. This list is based on a memorandum by a working group of steel companies that discusses the possibilities to substitute alloying metals; Niederschrift über die Sitzung des Arbeitskreises der Eisen schafffenden Industrie für den Vierjahresplan, 21 January 1938, in: SIT FWH/1615.
36. This figure is an only upper bound, since some metals were also used in other industries.
37. 1933 could be special due to the Great Depression. The small share of iron ore imports could be explained by stockpiles, which may have been first used in 1933. Table 1 shows that imports increased with a lag. For other materials, similar stockpiles may have not existed.
38. The trade statistics show that tin imports decreased from 14,872 tonnes (1933) to 12,090 tonnes (1938).
39. Estimates indicate a 26 percent decrease of domestic consumption in 1936/37 compared to a counterfactual scenario without substitution; Scherner, *Blockade*, 485.
40. Jonas Scherner, *Die Logik der Industriepolitik im Dritten Reich. Die Investitionen in die Autarkie- und Rüstungsindustrie und ihre staatliche Förderung* (Stuttgart: Steiner, 2008), 231.
41. The trade statistics show that manganese imports rose from 131,926 tonnes (1933) to 425,780 tonnes (1938). This increase may have been due not only to increased production of steel but also to the building up of strategic reserves, see the discussion about a 'manganese reserve' in: Niederschrift über die Sitzung des Arbeitskreises der Eisen schafffenden Industrie für den Vierjahresplan, 21 January 1938, p. 6–8, in: SIT FWH/1615.
42. Donges, *Stahlwerke*, 186–187.
43. Niederschrift über die Aufsichtsratssitzung der *Vestag*, 5 August 1938, in: SIT VSt/4104.
44. To reduce the shortage, the authorities also increased the allocation of scrap from domestic producers; ibid.
45. Ferro-alloys are alloys consisting of iron and other metals (e.g., manganese, chrome, or nickel).
46. Donges, *Stahlwerke*, 202–204.
47. Niederschrift über die Aufsichtsratssitzung der *Vestag*, 5 August 1938, in: SIT VSt/4104
48. Ibid.
49. Wilhelm Pothmann 'Zur Frage des deutschen Eisenerzbezuges aus Spanien', *Weltwirtschaftliches Archiv* 14, 1919, 242–259.
50. Data in import shares is from Deutsches Reich, *Statistisches Jahrbuch für das Deutsche Reich. 1939/40* (Berlin, 1940), 282–284.
51. Other important countries of origin were the Soviet Union (17.3 percent) and Brazil (9.5 percent).
52. In addition, Germany imported refined nickel, which was mainly from the United Kingdom (36 percent) and Norway (32 percent).
53. For chrome, Turkey was the second largest supplier (29.3 percent).
54. Niederschrift über die Aufsichtsratssitzung der *Vestag*, 5 August 1938, in: SIT VSt/4104.
55. Die Verarbeitung deutscher Erze durch die deutsche Eisenindustrie im Rahmen des Vierjahresplans, June 1937, in: BArch, R 3101/32249.
56. Scherner, *Blockade*, 485.
57. Ulrich Hensler, *Die Stahlkontingentierung im Dritten Reich* (Stuttgart: Steiner, 2008), 37.
58. As an example, see the business strategy of the *Vestag*; Donges, *Stahlwerke*, 127–137.
59. Heereswaffenamt, memorandum concerning economic preparations, 22 November 1928, printed in: Georg R. Thomas, *Geschichte der deutschen Wehr- und Rüstungswirtschaft (1918-1943/45)* (Boppard am Rhein: Boldt Verlag, 1966), S. 488–497, here: 494–495.
60. In World War I, the *Kriegsrohstoffabteilung* was founded to direct the allocation of resources.
61. Stellwaag, *Eisenwirtschaft*, 83.
62. See, e.g., the investment policy of the *Vestag*: Donges, *Stahlwerke* 119–224.
63. The technical difficulties are described in: Niederschrift über die Sitzung des Arbeitskreises der Eisen schafffenden Industrie für den Vierjahresplan, 21 January 1938, in: SIT FWH/1615.
64. For the strategic perspective, see the discussion in Donges, *Stahlwerke*, 228–243.
65. Report about the importance of the *Reichswerke* for the German war economy, in: Errichtung neuer deutscher Eisenhüttenwerke, 9 July 1937 (copy), in: Niedersächsisches Wirtschaftsarchiv (NWA) 2 Nr. 1103.
66. Original quote: 'Wehrwirtschaftlich ist die Errichtung eines großen Hüttenwerks im Salzgittergebiet von besonderer Bedeutung. Im A.-Falle würde es weniger gefährdet sein als die Ruhrindustrie'; Vermerk des Reichsfinanzministeriums betreffend Reichswerke, 14 July 1937, p. 5, in: BArch, R 2/15098b.
67. Wilhelm Deist, Die Aufrüstung der Wehrmacht in Militärgeschichtliches Forschungsamt (ed.): *Das Deutsche Reich und der Zweite Weltkrieg. Bd.1. Ursachen und Voraussetzungen der deutschen Kriegspolitik* (Stuttgart: Deutsche Verlags Anstalt, 1979), 369–532, here: 520–521.
68. For general information on the *Reichswerke* conflict: Overy, *War*, 93–118; Tooze, *Wages*, 234–239.
69. Wolfgang von Hippel, *Hermann Röchling 1872–1955. Ein deutscher Großindustrieller zwischen Wirtschaft und Politik. Facetten eines Lebens in bewegter Zeit* (Göttingen: Vandenhoeck & Ruprecht, 2018), 476–487.

70. This 'expropriation' is often cited as an example for the violation of property rights by the Nazi regime. For a general discussion, see Christoph Buchheim and Jonas Scherner, 'The Role of Private Property in the Nazi Economy: The Case of Industry', *Journal of Economic History* 66(2), 390–416.
71. The assumption is, that there is no significant difference in stocks over time. When comparing 1929 with 1938, this assumption is reasonable, while the low ratio in 1933/34 might be driven by the reduction of existing stocks that had been accumulated during the Great Depression.
72. For the development of non-ferrous metal mining, see Jonas Scherner, 'Nichteisenmetalle: Bergbau und Verhüttung' in: *Handbuch Wirtschaft im Nationalsozialismus* (edited by Marcel Boldorf and Jonas Scherner) (Berlin: De Gruyter Oldenbourg, 2023), 221–244.
73. Overview of alloying-metal demand, in: Niederschrift über die Sitzung des Arbeitskreises der Eisen schaffenden Industrie für den Vierjahresplan, 21 January 1937, table 2, in: SIT FWH/1615.
74. German ores that contained zinc typically also contained lead, which was mainly used in other industries (e.g., electrical enginerering); Scherner, *Industriepolitik*, 224–231.
75. Denkschrift zur Frage der Eisenerzversorgung Deutschlands insbesondere Rheinland-Westfalens, Hermann Wenzel, 7 October 1927, in: BArch, R 13-I/320.
76. A memorandom of a working group of German steel companies states that 'the task remains unresolved, at least in the case of emergency, to replace the foreign manganese by increasing the domestic supply' [original quote: 'Ungelöst bleibt dabei aber die Aufgabe, zum mindesten im Ernstfalle das Auslandsmangan durch Heranziehung des Inlandsaufkommens zu ersetzen.']; Niederschrift über die Sitzung des Arbeitskreises der Eisen schafffenden Industrie für den Vierjahresplan, 21 January 1938, p. 6, in: SIT FWH/1615.
77. Ibid, 7–8.
78. Scherner, *Blockade*, 491.
79. Other factors were, for example, the mobilization of parts of the workforce and interruptions caused by a lack in railway transport-capacity due to the demand of the German army; cf. Donges, *Stahlwerke*, 326–334.
80. Karlblom, *Exports*, 73.
81. Plücker, *Eisenerzbergbau*, 338–345.
82. Donges, *Stahlwerke*, 187–190.
83. Plücker *Eisenerzbergbau*, 345.
84. Niederschrift über die Aufsichtsratssitzung der *Vestag*, 25 February 1941, in: SIT VSt/4104.
85. Apart from ores, Germany got control over a large number of iron steel works, which were mainly located in Lorraine and Luxemburg; cf. Donges, *Stahlwerke*, 380–392.
86. Donges, *Montanindustrie*, table 4.
87. Pål Thonstad Sandvik and Jonas Scherner, 'Why Did Germany Not Fully Exploit the Norwegian Nickel Industry, 1940-45' in Hans Otto Frøland, Mats Ingulstad, and Jonas Scherner (eds.), *Industrial Collaboration in Nazi-Occupied Europe. Norway in Context* (London: Palgrave, 2016), 273–298; Scherner, *Blockade*, 505.
88. For the development of steel production in Germany (and occupied territories), see figure 2, in Donges, *Montanindustrie*. Data source: Übersicht über die Rohstahlerzeugung in Deutschland, 25 June 1947, in: Historisches Archiv Krupp WA 40 B 1326.
89. In 1916, iron and steel production was 39 percent lower than in 1913, and, in 1917, it was 17 percent lower than in 1913; Ritschl, *Economy*, 49.
90. See for an analysis of the steel industry in World War I: Alfred Stellwaag, *Die deutsche Eisenwirtschaft während des Krieges*, ed. by Marcel Boldorf and Rainer Haus (Berlin: De Gruyter Oldenbourg, 2016).
91. See, e.g., the discussion in Donges, *Stahlwerke*, 332–336.
92. Ibid., 351–352.

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