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UNIVERSITÉ DE MONTRÉAL

ECONOMIC AND POLITICAL UNIFICATION OF GERMANY: 1815-1871

PART 1: THE ZOLLVEREIN AND RAILWAYS

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CONTENTS

	Page
INTRODUCTION.....	1
CHAPTER I: The Zollverein.....	3
A - Historical background.....	3
B - Functioning.....	7
C - The Zollverein and German political unification.....	11
CHAPTER II: Railways.....	21
A - Development.....	21
B - Capital formation.....	26
C - Backward linkage effects.....	32
D - Forward linkage effects.....	36
E - Railways and German political unification.....	38
CONCLUSION.....	43
APPENDIX.....	45
Tables.....	46-51
Footnotes.....	52-57
Bibliography.....	58-60

INTRODUCTION

What was Germany in the early 1830's? Politically: a bunch of rival independent states organized in a loose and largely impotent confederation; economically: a multitude of small inefficient markets isolated one from the others by tariff walls and the lack of an adequate transportation system. The German Confederation was paralyzed by political infighting, especially the Austro-Prussian rivalry. Both Vienna and Berlin tried to dominate the scene by fomenting coalitions and intrigues. While Britain had nearly achieved her industrialization, Germany had barely started hers in the 1830's: by all accounts, it was a backward country. Yet, four decades later, that picture changed dramatically. Germany, under Prussian leadership, became one of the world's great powers. Prussia's military victories over Austria in 1866 and over France in 1870 led to the Reich in 1871, with the Hohenzollern monarch at its head. The economy had expanded tremendously. The Zollverein, the German customs union founded in 1834, and the development of a railway network from 1835 onwards integrated regional markets and stimulated growth. The German economy had taken off.

From the 1830's to the 1860's there was a process of economic unification and growth while Germany's nation-building was under way. According to most economic historians, there was a close connection between either the Zollverein or railroad construction, on the one hand, and the political unification achieved by 1871, on the other hand. This study examines the foundation and subsequent evolution of the customs union and railways, as well as their impact on the German economy. The evidence

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gathered is used to determine whether that impact had a causal relationship with the political unification process.

CHAPTER I: THE ZOLLVEREIN

The formation of the German customs union began in 1819, with the adoption by the small principality of Schwarzburg-Sonderhausen of the Prussian tariff system, and it was completed in 1834, with the inclusion of the City of Bremen in the customs frontier of the Second Empire. The customs union of northern and southern German states which was effective from January 1, 1834, until the foundation of the North German Confederation in 1867, was named Deutscher Zollverein. A so-called Second Zollverein was formed by the North German Confederation and it lasted until the creation of the Reich in 1871. Members of the Zollverein remaining outside the 1867 federation (Bavaria, Wurttemberg, Baden, Hesse-Darmstadt and Luxemburg) were bound to it by treaties.¹ However, in practice, the term Zollverein refers to more than a hundred bilateral and multilateral treaties concluded by the German states and covers the period 1834-1871.

A. Historical background

The Congress of Vienna brought a new political order for Europe in 1815. The major powers were against a united Germany, fearing a potential commercial competitor and because of the political dualism between Austria and Prussia. The resulting German Confederation comprised 39 independent states: 1 empire (Austria), 5 kingdoms (Prussia, Bavaria, Hanover, Wurttemberg and Saxony), 18 grand duchies and duchies, 11 principalities and 4 Free Cities. It could not work either politically or

economically as an entity, as several German states were linked with foreign countries (England with Hanover, Denmark with Holstein and the Netherlands with Luxemburg). Besides, more than half of Austria's territory and nearly a third of Prussia's were outside the Confederation. Finally, the latter was paralyzed by veto powers, by different monetary systems and commercial codes and by huge disparities in regional industrialization. Prussia gained territories: new possessions in the Rhineland in addition to those she previously held, Westphalia and 58.2% of the Kingdom of Saxony.² She became a western and an eastern state, with no connections between the two parts and with several enclaves within her territories.³ Due to this territorial division and increasing industrialization in the west (the Rhur), Prussia's centre of gravity shifted westward while Berlin remained the administrative heart.⁴

Urgent treasury and trade needs incited Prussia to unify her customs system. The customs law of 1818 introduced a uniform tariff for the whole of Prussia to be collected at her external frontiers. This bill also established free trade and a unified tax administration within the kingdom. Hence the necessity for Prussia to conclude agreements with states located within or between her territories. These commercial treaties, starting in 1819, constituted the nucleus of the Zollverein.⁵ The Prussian tariff of 1818 replaced medieval "Accise" taxes placed on all commodities entering legally defined cities, without any special treatment of foreign goods.⁶ When enacted, this tariff was higher than that of the smaller German states but it was the lowest one in Europe, in spite of high effective

duties on coarse yarns and textiles since the duty was levied by weight. Although adjustments were made in tariffs levels, the latter remained low by British standards due to the pressure of Junker grain growers who wanted to import English manufactures in order to export more grain in return.⁷ The Prussian law of 1818 was intended to decrease the fiscal and administrative burden, the public debt having reached 217 million thalers that year. The other purpose was to integrate the diverse parts of an incontinent territory: on the one hand, the economically more advanced and Catholic western provinces of Rhineland and Westphalia; on the other hand, the predominantly agricultural and Protestant East and West Prussia, Posen, Pomerania and the annexed former Saxon territory.

The other German states were hostile to Prussian tariffs, seeing them as opposed to the Confederation common interests and legal tasks. Particularism was stronger than economic necessities. The agrarian North and the Free Cities wanted free trade while the small businesses of the south and south-west asked for protectionism. Austria was particularly protectionist, fearing competition for her industry from the Rhineland and Saxony.⁸ Two customs unions were formed in 1828, the first one between Prussia and the Grand Duchy of Hesse, the second one between Bavaria and Wurttemberg (after a failed attempt to form a customs union between the southern states). They became the two cornerstones of the Zollverein. Central German states wanted to retain the control of north-south trade but failed to form a customs union.⁹ In the 1830's many states were forced to join the Prussian customs union because of financial and political problems.

Existing tariff systems outside Prussia were too small and heterogeneous, necessitating high administrative costs. These costs represented on average 50% of customs revenue, even reaching 91% in Hesse-Darmstadt.¹⁰ Revenues per head of the population were 9.5 silver groschen in the Bavaria-Wurttemberg customs union whereas they amounted to 24 groschen per person in the Prussia-Hesse union.¹¹ Moreover, small economies could not produce positive trade balances. The revolution in 1830 led to constitutional, political and agrarian reforms as all states, especially Austria and Prussia, feared the uprising.¹² Smaller states found stabilization in a union with the larger and stronger Hohenzollern kingdom. Although that union was formally limited to customs, it yielded implicit Prussian political support.

The 1834 treaties were ratified by 18 German states with an area of 162,870 square miles and a population of 23.5 million people, 15 million (64%) of whom were Prussians (the Zollverein treaties were renewed for 12 years in 1842, 1854 and 1866).¹³ Most of the larger members of the German Confederation were part of the Zollverein, with the exception of Austria, Hanover, Baden, Mecklenburg-Schwerin, Oldenburg, Nassau and Brunswick.¹⁴ All of the latter but Austria joined the customs union in the following decades. The Hapsburg monarchy was weaker than Prussia in terms of capital and natural resources. The Austrian Empire wanted to consolidate its internal structure under the leadership of its German provinces in order to create a greater Austria (Grossosterreich), not a greater Germany (Grossdeutschland). That goal required a decline of Prussian power in

Germany. In the late 1840's Austria changed her German policy under the leadership of Schwarzenberg. It concentrated more on economic than on political or military affairs. Austria tried to enter the Zollverein in 1848-49 to close off the enlarged customs union through protective tariffs adapted to Vienna's requirements. It would then become the nucleus of a central European economic block under Hapsburg leadership. Prussia used the customs union policy of free trade-low tariffs to exclude Austria from the Zollverein and retain her influence. Berlin's supremacy over Vienna was definitively established by Prussia's stunning military victory over Austria in 1866.¹⁵

B. Functioning

The executive body of the Zollverein was the annual general congress, which usually sat in summer in the capital of one of the members who took it in turns. Delegates were bound by instructions from their respective governments, each member state having one vote with the exception of the enclaves and some very small participants. Veto-power was in effect until the foundation of the North German Confederation in 1867: unanimity was necessary for all decisions concerning tariffs and trade policy. None of the treaties involved giving up sovereign rights except for tariff administration. The complicated structure of the Zollverein gave rise to difficulties. Most of the members kept their own excise duties and state monopolies. As a result, a compensatory levy was instituted on commodities liable to different excise duties. And the import of salt and playing cards

into states maintaining a monopoly (e.g. Prussia) was prohibited.¹⁶ Smuggling was therefore endemic. As early as the 1820's the ratio of goods smuggled to those imported legally in the Rhine provinces was 3 to 1 for high tariff items, some smaller states even specializing in that activity.¹⁷ Differences in weights and measures impelled the use of those current in Prussia and Bavaria as standard. At the beginning duties were paid in any gold or silver coins circulating in the member states. But the multiplicity of monies created chaos. A new southern German gulden was created which, with the Prussian thaler, constituted the main currency. Customs duties were to be paid in one or another of these currencies, both being linked to a silver standard. As for commercial treaties with foreign countries, the annual congress usually agreed on the general terms of the negotiation while Prussia acted on behalf of the union. Bavaria and Wurttemberg had the right to sign commercial treaties of their own but they did not really use their privilege. Once the treaty was concluded by the negotiator it had to be ratified by all members. That is, if the foreign country rejected the terms agreed by the congress, the negotiator had to consult all the member states before new terms could be put forward. However, Prussia was preponderant. In 1862, for example, she negotiated a commercial treaty with France which modified the tariff on 161 items and reduced many import duties. The southern states, backed by Austria, refused to ratify it but Prussia imposed her will after three years of pressure.¹⁸

Yet, despite these difficulties, the Zollverein institutions adapted themselves to complex conditions and proved viable. The basis of

the Zollverein was the Prussian customs law of 1818 with its advantages (simplicity and efficiency) and liberal principles (removal of quantitative restrictions and interior barriers). There were only three types of customs duties: import, export and transit duties. Most of the raw materials and many basic foodstuffs were not taxed.¹⁹ The tariff was specific, not ad valorem: that is the duty was based on the weight of the commodity, not its value. Coarse and heavy goods were taxed at a higher rate than finer luxury items, the specific duty nature of the tariff providing an implicit protection. Moreover, price changes did not affect specific duties. Although the tariff on foreign factory and manufactured goods was not to exceed 10% of their value, these imports were in effect taxed at a much higher rate. According to John Bowring, in his 1839 report on the Zollverein to the British Parliament, foreign manufactured goods were taxed from 20 to 80% ad valorem (sometimes higher). The protection inherent in the Zollverein's specific duty affected negatively British exports and positively the German industry. However, his own data showed an increase in British exports to Germany after 1834. The declared value in current prices of British exports to Germany, Holland and Belgium passed from 6,996,057 to 8,550,347 sterling pounds between 1829-33 and 1834-38 (five-year averages), i.e. a 22.2% increase.²⁰ German mercantile tonnage growth accelerated from 6.2% between 1830 and 1835 to 25.3% for the next five years, reflecting an expansion of foreign trade.²¹

Revenues from duties after deduction of expenses were automatically divided among the Zollverein state members on an equal per

capita basis. In the 1840's the shares of Prussia, Bavaria, Saxony and Wurttemberg were 55, 17, 6.36 and 5.5%, respectively. As most goods by sea entered the German states via Prussia, either directly or by way of the Netherlands, the Hohenzollern monarchy lost tariff revenues following the establishment of the Zollverein.²² In 1834 Prussia saw her customs receipts reduced by 25% with respect to the preceding year; the level of 1833 was not reached until 1838.²³ The Prussian government estimated that the total loss to its treasury due to the Zollverein's sharing formula was over 1,200,000 thalers for the year 1840, i.e. more than 10% of its tariff revenues.²⁴ In 1848 that loss amounted to 2 million thalers.²⁵ Prussia tried to renegotiate her share of the revenues when the first period of the Zollverein ended in 1841, but the attempt was rejected by the other participants.²⁶ The latter gained considerable customs revenues from the beginning. For instance, Bavarian tariff receipts nearly doubled between 1833 and 1834, increasing from 2.1 to 3.9 million florins.²⁷ The average net customs revenue of the Zollverein was around 18 million thalers between 1834 and 1845. From 1820 to 1850 the most important source of revenue gain in Baden and Bavaria was from tariffs, with increases of 189.8 and 113.6%, respectively. By the mid-nineteenth century tariff receipts were one of the main income in most German states. They exceeded the amount yielded by direct taxation in ten small states, most of which had no customs system of their own before the Zollverein due to high administrative costs (these governments had to rely on road use and waterway charges). The tariff receipt share of all central government revenue rose markedly after 1834,

reaching an average of 15.4% for the whole of Germany in 1850.²⁸ Table 1 (see Appendix) shows that, before the foundation of the Zollverein, Prussia was far ahead of other German states in terms of revenues yielded by tariffs. That was due to her elaborate customs system. Starting in 1834 tariff receipts rose dramatically for all member states but Prussia, thanks to the Zollverein mechanisms of duties collection and revenue sharing formula but also because of an increase in imports. As shown before, Britain, Germany's main trade partner, exported significantly more goods to the Zollverein after 1834. The total value of the customs union imports increased from 125 to 224 million thalers between 1836 and 1847.²⁹ In 1834-35 taxation of colonial goods and other foodstuffs comprised three quarters of tariff revenues. Taxation of sugar and coffee alone provided the Zollverein with 50% of its customs receipts. Revenues obtained from tariffs on industrial raw materials and on manufactured goods amounted each to about 10% of the total proceeds.³⁰ In 1871 tariffs on popular drinks, foods and tobacco still comprised three quarters of the Zollverein receipts, nearly one third coming from coffee alone.³¹

C. The Zollverein and German political unification

What was the effect of the Zollverein on Germany's nation-building? Opinions and studies are divided with regard to the customs union's impact on the process of political unification. The traditional view has contended that the Zollverein helped, in one way or another, or even led to the formation of the German nation. The political history of

Germany from 1815 to 1871 is still dominated by the nineteenth-century work of Heinrich von Treitschke. The formation of Bismarck's Reich is the central historical event. The German Volk exists as a natural, cultural identity. And it is the destiny of the Prussian state to give this Volk its political expression. Politics is viewed as a zero-sum game, with the Hohenzollern kingdom maximizing its power at the expense of the other German states. Prussian diplomacy produced the Zollverein which led to economic growth. Within that customs union Prussia was the main power, hence her political dominance. The Zollverein was a step toward a political union led by the Hohenzollerns for the benefit of the German people. Treitschke's eulogy of Prussian diplomacy, military accomplishment and kings implies that the state had a positive role as an originator of economic development. The Germans were described by Treitschke as celebrating the opening up of borders on new year's eve of 1833-34: there were joyous festivities and fireworks along these borders as long lines of wagons full of merchandise crossed freely under the cheers of the populace. However, that idealistic view is contradicted by the existence of a strong opposition to the treaty at that time which continued for several years after the customs union formation. The press was so unfavorable to the Zollverein that the Prussian government used censorship and circulated supportive articles and pamphlets.³²

More recently, Helmut Bohme argued that industrial expansion led to larger trading areas and increased the financial requirements of German states. Those commercial and fiscal needs, combined with the

superiority of Prussian diplomacy, forced small and medium states of north and south Germany into economic cooperation with the Hohenzollern kingdom. It was later followed by a political union. Prussian foreign and commercial policies were interwoven in order to win supremacy in Germany and central Europe. The achievement of free trade in the Zollverein established Prussia's dominance over Austria and the other German states: before war broke out between Vienna and Berlin, the commercial and political struggle had already been won by the latter.³³ The Zollverein was Prussia's tool for economic supremacy. However, the argument that the middle German states lost their political independence because of their adherence to the customs union ignores the treaties' two mechanisms that guarded their sovereignty: veto-power and revenue sharing on an equal per capita basis.³⁴ Moreover, industrial expansion started in the 1840's with railway construction and the attendant rise in iron and coal production, about a decade after the foundation of the Zollverein.

Economic historians have long been influenced by the analysis of Friedrich List. He was the leader of a German trade and commercial association which started calling for a customs union in the 1820's. List was one of the first to link domestic economic backwardness with the lack of national unity. After 1816 German manufacturers were flooded with English imports as Napoleon's Continental System was ended and German agriculture was hit by crop failures and a drop in grain exports due to the English corn laws. List argued that Adam Smith's division of labor and free exchange of goods caused prosperity in advanced, not backward

nations. Therefore, England was Germany's natural antagonist because British free trade's objective was to keep Germany underdeveloped.³⁵ Economic nationalism and protection were List's key ideas. He advocated a German national state, with tariffs on foreign goods and free trade inside. The Zollverein was necessary to protect the emerging domestic industry from the competition of cheap English manufactured products.³⁶ However, until the 1870's the German customs system never became highly protective: it was not used to further industrialization. The Prussian tariff of 1818, which laid the foundation of the Zollverein, gave little protection to infant industries.³⁷ The influence of List's ideas on the economic policy of the 1820's and 1830's has been overemphasized. Actually, he started being cited and praised after 1871.³⁸ Bismarck's Reich was sympathetic from the beginning to the nationalistic theme. And the German Empire became a supporter of protectionism in the mid-1870's. The 1873 depression led to the strengthening of the interests opposed to free trade (iron industry) and to the end of the opposition of landed nobility to tariffs (the fall of the price of grain and the threat of grain imports made free trade less appealing). The result was the alliance of bread and iron under Bismarck and the 1879 protectionist tariff.³⁹ Moreover, recent authors have considered British exports to Germany as a positive factor contributing to the latter's development. There were close economic relations between the two countries. Natural resources and labor were immobile at that time and German wages were lower than British ones. Therefore, the ratio of comparative costs favored England where her machines were superior, the difference in productivity overwhelming the wages gap. But when Germany

had comparable machinery, the ratio benefited to the Germans, thanks to their lower labor costs. According to John Bowring, Germany enjoyed industrial advantages in the textile, metal and chemistry sectors in 1840. Besides, the development of German industries was furthered by the availability of cheap British imports as well as English capital and technology. And the Zollverein producers had access to open markets, not only inside their customs union but also farther east and south.⁴⁰

List advocated the expansion of Germany eastward into the Danube region. And, after the foundation of the Zollverein, he called for the inclusion of Holland and Denmark into the customs union to obtain fisheries, maritime commerce, naval power and colonies. But List's expansionism is different from Pan-German imperialism. He viewed the nation as a vehicle through which economic development proceeds. The nation is "self-determined" by need and common interest in the Bismarckian way; it is not "pre-determined" by culture. A unified state is, therefore, necessary to protect industrialization in its early phase.⁴¹

That positive role of the state is also held by the conventional view of the Zollverein based on Henderson's classical work. The customs union eliminated internal trade barriers and increased inner-German economic links. The result was a large unified market which favored greater specialization, trade and economic growth in participating states. The gradual economic unification through the Zollverein was vital to the subsequent German industrialization which started in the 1850's. The

Zollverein by itself did not cause the industrialization of the economy. However, the customs union was one of several factors that brought about Germany's take-off.⁴² There are two hypotheses underlying this reasoning. First, small German states did not have the requisite size for economies of scale in production, therefore were unable to industrialize on their own. Only Prussia, with a large territory and population, could be a potentially economically viable country. That is why she was able to dominate the Zollverein.⁴³ Second, there is a direct link between state policy and economic behavior: developments which favored political integration furthered economic growth. Prussian bureaucracy's maneuvers led to the formation of the Zollverein and its extensions. The customs union became the basis for a "German economy" which was later linked to the North German Confederation, first, and then to the Reich. The Zollverein helped the subsequent political unification through its economic impact. The first hypothesis is contested by authors studying German history from a regional point of view. There was no "German economy" in the 1830's but local, regional and transnational economic relationships.⁴⁴ There were minor degrees of integration of the economy itself, and of the economy with the state. Some of the most important markets of German producers were overseas. The agricultural east exported to England while Saxony and the Rhineland sold industrial products in the Danube area as well as in the northern Rhine and Elbe regions. Commercial legislation began to be standardized in the 1850's, two decades after the foundation of the Zollverein.⁴⁵ The origins of that legislation lay in political issues, not

in economic ones. As the German states failed to enter the Crimean War (1854-56) against the tsar, the Bund was attacked by liberals and nationalists. On the other hand, the rising bourgeoisie demanded greater economic unity. In order to appease public opinion and demonstrate its vitality, the German Confederation decided to codify its chaotic commercial laws, thereby bypassing its rival, the Zollverein. In November 1855 Bavaria announced her intention to introduce commercial legislation into the federal diet. King Max of Bavaria himself had originated the bill. Prussia wanted to veto the legislation in order to block any expansion of federal activity but could not openly stand in the way. She went along, reluctantly, to get favorable terms. The commercial code was finally ratified in 1861, after much bickering.⁴⁶ As to the assumption that the Zollverein accelerated economic growth, it has never been demonstrated.⁴⁷ None of the available statistical indicators shows a decisive shift connected with the establishment of the customs union. Per capita output, the share of industry in the labor force and population continued to rise at a nearly constant rate while the number of persons working in the agricultural sector kept on declining at the same speed.⁴⁸ As a result of their joining the Zollverein, Bavaria, Wurttemberg and Baden added only 1.06% to their total income.⁴⁹ The first significant economic changes started around 1850 with railways, coal and iron as leading sectors. Therefore, there is no causal relation between the creation of the Zollverein and Germany's take-off which occurred about 20 years later.⁵⁰

Recently, it has been argued that the motives behind the formation of the Zollverein were primarily fiscal, not economic. The objective of the member states was to maximize tariff revenue gains from a more efficient customs system while circumventing budgetary restrictions due to constitutions and parliaments.⁵¹ The Prussian Tariff Act of 1818, basis of the Zollverein treaties, had been enacted to achieve administrative reforms and to procure necessary fiscal receipts. The specific nature of the customs duty was due to administrative convenience and was not initially intended to protect domestic producers. It yielded much more revenues than had been expected by the Prussian government.⁵² The negotiators of the Zollverein were preoccupied by the potential effects of the treaties upon treasury and trade.⁵³ The Union would be able to solve the fiscal needs of member states in view of the political and economic constraints upon their public finances. It was intended to capture the potential increase in revenues due to lower administrative costs brought about by economies of scale in customs administration.⁵⁴ Customs receipts rose from 14,815,723 to 22,255,204 thalers between 1834 and 1841, that is more than 50%, while tariff administration costs fell to nearly 10% of the Zollverein revenues.⁵⁵ Rolf Dumke showed that the ratio of the Union's expenditures to its gross customs revenues was 14.7%; the ratios for Prussia, Bavaria (without Rheinkreis), Wurttemberg and Hessen-Darmstadt were 15-20, 25, 43 and about 100%, respectively. The administration of a tariff required expenditures proportional to the length of the customs border and provided revenues proportional to the area enclosed. The ratio of administration costs to receipts rose as the superficy of the customs area declined. Therefore,

there was a fiscal advantage to customs unions which were geographically compact and sufficiently large: the Zollverein procured much more net revenues than competing tariff systems. Intermediate German states on their own had to accept tariff levels much lower than Prussia's in order to earn significant receipts. Otherwise, smuggling and prohibitive administration costs would eat up customs revenues. As for the smaller states, they simply could not afford any tariff system at all.⁵⁶ When it became obvious, in the early 1830's, that a customs union including both Prussia and Austria was impossible because of their rivalry, the former was chosen because her 1818 tariff system had much more to offer. Within the Zollverein, Prussia used her territorial, demographic and economic weight to get her own way. The financial sacrifices she made in favor of her partners were a powerful tool to gain political power: the threat of non-renewal of the expiring treaties was used repeatedly. Finally, Prussia was the only member state in a position to conclude commercial treaties with foreign countries, especially navigation treaties with England and Holland.⁵⁷ Bismarck used trade negotiations as a foreign policy tool. For instance, the 1863 commercial treaty with France was intended to gain her support in the Danish question and to counter any Austrian attempt to join the Zollverein by lowering the customs union's tariff level.⁵⁸

The Zollverein facilitated the German unification under Prussia's leadership. Member states achieved common ends while the Hohenzollern kingdom dominated the customs union. The law and administration followed Prussia's, the tariff system preparing the

administrative machine of the German nation. However, the Zollverein did not lead to political unification. That was demonstrated in 1866 when Hanover, Saxony, Bavaria, Wurttemberg and the Hesse states fought with Austria against Prussia (all the Zollverein member states kept on collecting duties, sending the proceeds to Berlin and sharing the revenues according to the usual formula, while some of the participants had declared war on each other!). Economic unification led to a fall in particularism, not to the German Empire of 1871: other political solutions might have been possible.⁵⁹

CHAPTER II: RAILWAYS⁶⁰

The introduction of railways affected all Europe simultaneously in the mid-nineteenth century. However, each European country was at a different stage of development when this new means of transport was set up. While railways came to England at the end of her industrial revolution and to Russia in advance to hers, the railroad network was established in Germany during her take-off.⁶¹ The introduction of this transport system in Germany coincided with the foundation of the Zollverein.

A. Development

The first German railway line, which never became part of the national railway network, was about four miles long, linking Nuremberg with Furth.⁶² It was opened on 7 December 1835 despite critics who feared disastrous sanitary effects or the end of commerce on the roads. The first long-distance line connected Leipzig to Dresden in 1839, covering a distance of seventy miles.⁶³ Railway building followed old roads but it also created communications between regions that had been politically or economically separated.⁶⁴ The construction of lines between the major commercial cities started in 1836 and constituted the embryo of the railway system.⁶⁵ By 1840 there were only 462 kilometers of track in operation. That figure rose to 2,152 km by 1845. In the next five years the railroad network almost trebled, reaching 5,875 km in 1850.⁶⁶ It almost doubled in the 1850's and increased by 71% in the 1860's: the length of tracks in operation was

11,088 km in 1860 and 19,000 km in 1870.⁶⁷ Railway construction, in terms of investment spending, reached its first peak in the years 1842-48. It slowed down in the 1850's, then accelerated in the middle of the following decade. The level of 1846 was reached again in 1868.⁶⁸ Between 1850 and 1871 competition among rival regions encouraged the development of the railway system. German states feared a substantial loss of income due to trade diversion if their neighboring states had superior railroad networks. This led to a proliferation of interstate lines. Moreover, public involvement permitted the construction of profitable tracks, thereby boosting the total length of the railroad network. The catching up of the industrializing regions is shown by their rates of railway growth. The rates for Saxony, Prussia, Wurttemberg, Bavaria, the Rhineland and Hesse-Darmstadt were 146, 254, 311, 397, 420 and 508%, respectively.

Between 1850 and 1870 the total of railway passengers rose from 782.7 to 4,446.8 million passengers while the total of kilometer tons (i.e. kilometers driven X tons carried) increased from 302.7 to 5,875.9 tons.⁶⁹ That is the number of persons transported by rail and merchandise haulage were multiplied by 5.7 and 19.4, respectively. From the outset passenger transportation grew very rapidly whereas freight hauling started more slowly. Railway companies had forecasted the opposite. In the late 1830's and early 1840's passenger transportation output was severely underestimated and merchandise haulage was overestimated. Railway companies used data on the urban population along their lines as well as information on traveling habits to forecast the number of persons who would use their

services. They did not expect the increase in traveling habits brought about by the new transportation. On the other hand, customers and suppliers of merchandise haulage services by traditional means (barges and horse-powered wagons) were tied by long-run contracts. The latter were respected until expiration date when rail transportation was usually substituted for antiquated modes when possible.⁷⁰ Moreover, the significant increase in merchandise haulage by rail after 1850 was largely due to the considerable decline in freight rates. The average price per ton-kilometer started at a very high level in 1840 (16.9 pfennigs) and, at 10.1 pfennigs, was still costly by 1850. During the next twenty years freight rates declined by nearly 50%. Merchandise haulage by rail became very competitive: the output grew rapidly (see Table 2 in Appendix). As for passenger transportation, railway tariffs declined slightly. Output prices per passenger-kilometer passed from about 4.4 pfennigs in the early 1840's to around 4 pfennigs in the late 1860's.⁷¹

Railways dominated the expansion of internal transportation from the 1840's onwards. They met most of the additional demand for transport in the second half of the nineteenth century and supplanted roads and waterways.⁷² Roads had undergone an exhaustive change by the *chaussée* building introduced under Napoleon.⁷³ They were greatly expanded between 1815 and 1850 but construction slowed down in the second half of the nineteenth century due to railroad competition. The length of the German road network quadrupled between 1835 and 1870, reaching about 100,000 km in the late 1860's.⁷⁴ The length of Prussian roads in operation was 3,936 km

in 1816 and 16,889 km in 1852. This shows an increase of 12,853 km between 1816 and 1852, corresponding to an average annual growth rate of 6 to 7%.⁷⁵ However, the differential in average costs per ton-kilometer between roads and railroads was very large as early as the 1840's. Freight carried by railways cost much less than that transported by roads. That differential increased over the nineteenth century because productivity gains in rail transport were much faster. Although the road network expansion was considerable, technical progress in that sector was minimal before the advent of the internal combustion engine. Animal and man power were still used for cartage. And the opportunity costs of the inputs employed in road transportation (labor, animals and animal feed) increased with agricultural and industrial growth. Therefore, carrying goods by road became more expensive while the cost of merchandise haulage by rail decreased with the fall in freight rates. However, road transport continued to dominate short hauls, loosing freight to railways over long and medium distances.⁷⁶ Waterway carriage expanded after 1820. There was nearly no construction of canals before that year. Afterwards, 275 km of canals were constructed until 1850, an annual average of 5.5 km. The peak was between 1836 and 1845, coinciding with the building of the Bavarian Donau-Main-Kanal. However, even during those years, canal-building remained modest, with 16 km of canals completed annually. A comprehensive network, connecting the Rhine and Rhur with the Elbe, central Germany and Berlin and the Oder, was debated since the middle of the century but was not started before the 1890's. The Prussian government was torn between advocates of the canals

(the Rhur industry and the cities) and their opponents (the agrarian interests). As for river improvement, the upper Rhine was regulated in the first half of the nineteenth century by France and Baden, the latter investing more than 3 million thalers between 1817 and 1850. German states spent as much money on canals as on river improvements from 1820 to 1850 (20 million thalers). These ameliorations proved to be more important for the modernization of water transport than canals.⁷⁷ Germany benefited from its rich natural network of waterways. Moreover, the introduction of steam power and iron transport vessels increased inland navigation.⁷⁸ The first steamboat was put into service in 1816 on the Rhine, which also saw the introduction of the iron vessel in 1836.⁷⁹ The international régime of navigation, which covered the Rhine and the Elbe, led progressively to the abolition of transit prohibitions, staple rights and toll duties.⁸⁰ The overall waterways network grew 20 km per year between 1816 and 1849, reaching at that later date a total length of 5,823 km.⁸¹ Navigation traffic amounted to 750 million ton kilometers in 1840. It more than doubled by the end of the 1860's, reaching 1,800 million ton kilometers in 1869.⁸² However, from the introduction of railways to the 1870's inland navigation was no match for the railroad system. In 1861 the shares of Prussian steamboats and locomotives of all horsepower were 4.5 and 56.5%, respectively. The middle and southern regions of Germany were mountainous. Therefore, building canals to link the major rivers (Rhine, Danube, Weser, Elbe and Oder) was more expensive than railway construction. It was easier for the particularistic aims of medium-sized and small states to either delay or block a projected canal than to oppose a new railroad. In northern Germany

an east-west link of the main rivers faced minor technical problems but was hindered by the rivalry between Hanover and Prussia. Institutional constraints (the particularism of 39 independent states) hampered the expansion of inland navigation. Moreover, the structure of the demand for transportation favored railways. Small lines between commercial cities within the borders of one state could be profitable. In 1850 passenger transportation provided more than 50% of railway revenues and most of railway freight consisted of goods with high value-weight ratios. Before the 1860's bulky commodities such as coal or grain represented a small percentage of the merchandise carried by trains. Therefore, between the 1830's and the 1850's the volume of the transportation of goods with high weight-value ratios was insufficient to induce canal construction. That volume increased significantly from the 1860's onward. Waterway transportation became an alternative to railway freight but political opposition blocked the construction of a systematic network of canals until the end of the century.⁸³

B. Capital formation

The first German railway, linking Nuremberg with Furth, was built by raising money from wealthy citizens. The support of the king of Bavaria was confined to the purchase of two shares of 100 florins each.⁸⁴ Once railway construction grew out of its initial stage, the connection of clustered cities, and started to establish long lines, capital needs became

considerable.⁸⁵ 322 million thalers had been invested in railways by 1850, that is about the double of the total amount put into canals, river improvements and roads during the first half of the century.⁸⁶ Railroad capital formation was intense in the 1840's: construction expenditures averaged around 20 million thalers per year, that is between 1 and 2% of national income. The absolute value of net investment in that sector in 1846 was not exceeded until 1859.⁸⁷ In Prussia, railway net investment in 1913 prices reached 137 million marks (i.e. 45.7 million thalers) in 1846, whereas the 1841 figure was 28 million marks.⁸⁸ The importance of railways was reflected by their weight in the German economy. From 1851 to 1869 the share of railroads in Germany's total net investment fluctuated between 11.8 and 19.7%. In the 1850's railway net investment amounted to 78% of that flowing into Gewerbe (Gewerbe included mining, manufacturing and handicrafts, trade, banking, insurance and transport - with the exclusion of railways and post). That figure declined in 1860-64, then rose considerably in the second half of the decade (see Table 3 in Appendix). From 1851 to 1869 the share of railroads in transportation investment was about 75%. In 1913 prices, railway net investment amounted to 1,330 million marks in 1851-59 and 2,390 million marks in 1860-69.⁸⁹ Due to these considerable spending flows, the railroads' share in the economy's total stock of capital increased from 3% in 1850 to 11% in 1880.⁹⁰ No other modern sector accumulated capital on this scale during that period. Whereas the ratio of railroad capital stock to that of Gewerbe was about 15% in 1850, it exceeded 62% in 1879.⁹¹ The expansion of the railway system was effected at the expense of consumption and did not affect other investments. Germany

consumed relatively less than other European countries in order to devote more resources to net capital formation. The share of total investment in national income increased during the railway age, averaging 10.2% in 1851-75.⁹² This new transportation system influenced the volume of capital formation and fluctuations in rates of investment.⁹³

Railway construction demanded considerable capital over relatively short periods of time. This necessitated the development of financial intermediaries for the mobilization of domestic and foreign savings.⁹⁴ Private bankers constituted the main class of financial institutions between 1815 and the 1860's. Unincorporated private banks organized and financed almost all the non-public railroad companies from the 1830's to the 1850's.⁹⁵ They provided a link between savers and investment opportunities. The average capitalization of Berlin bankers in the late 1850's was around 400,000 thalers, but that figure fell to about 290,000 thalers if other unincorporated institutions were considered. In 1845 the typical private banker in the Rhineland had a capital of between 200,000 and 300,000 thalers. For Prussia as a whole the average was probably closer to the former figure than to the latter.⁹⁶ As the sums required for railroad financing exceeded the resources of individual bankers cooperative syndicates, with as many as a dozen members, were formed. However, these syndicates functioned with great difficulty. To solve these problems, incorporated banks were formed from the late 1840's onward to answer railways' capital demands. The A. Schaafhausen'sche Bankverein was founded in Cologne in 1848; five years later, the Bank of Darmstadt was

established. In the beginning incorporation was slowed down by public bureaucracies in most German states while private bankers were skeptical with regard to this institutional innovation. However, corporate banks with limited liability handled large transactions more efficiently than unincorporated financial intermediaries (the latter were outstripped by the 1870's).⁹⁷ Prussia was opposed to these Kreditbanken and refused most of the time to charter banks as joint-stock companies. As a result, Prussian financiers founded corporate banks in other states. Moreover, they established Kommandit banks inside Prussia, thereby bypassing the governmental ban. The first important Kommandit bank was the Disconto-Gesellschaft of Berlin, founded in 1851. In the year 1856 alone eight financial institutions of that type were established in Prussia, with a total nominal capital of about 70 million thalers. By 1865 the total assets of the Kreditbanken amounted to 10% of those of Prussian private bankers. Railway construction led private bankers as well as corporate and quasi-corporate financial institutions - from the 1850's onward - to finance the accumulation of fixed capital. That was facilitated by the foundation of joint-stock railroad companies. These firms could fund current debt by issuing new securities whereas private partnerships were not able to use such means. For instance, the Rhenish Railway Company had considerable debts in the 1840's, usually amounting to between 300,000 and 400,000 thalers. The company used a bond issue in 1845 to convert this liability into a deposit balance.⁹⁸ Moreover, railroad building led unincorporated and corporate banks into investment banking. Bankers underwrote the issue of railway securities, managed the companies' current accounts and controlled

the management. Mixed banking, the combination of short-term commercial business with investment banking activities, became characteristic of the main banks.⁹⁹ The latter placed the issues of stocks and bonds of companies or took them for their own account. Banks could then redeem the firms' short debt and provide them with additional means. Investment banking also had an entrepreneurial aspect. Sometimes, bankers found new opportunities for investment and offered ways of exploiting them. More often, they helped others' projects by getting governmental approval and support and by creating a market for the new securities. Bankers would then maintain close links with these companies to further their own interests. In the case of railways, banks' participation was considerable from the beginning. The Rhenish Railway Company provides an example of such involvement. For their organizing and financing skills, Rhenish bankers obtained voting rights over large blocks of the company's shares and key positions upon its board of directors. Moreover, financial institutions were particularly interested in promoting and placing railroad securities because the latter were less risky than those issued by manufacturing firms. Railway shares and several options in railroad stocks were traded at the Berlin Stock Exchange from 1842 onward. Some of these options facilitated access to the Stock Exchange for small stockholders by allowing them to buy shares at a later date while postponing payment for them. Moreover, railway securities often bore guaranteed interest and dividends for a number of years, with governments frequently acting as guarantors.¹⁰⁰ Finally, banks shared in the profits of railroad companies. Railways were in general profitable from the start because they already followed existing trade routes, responding to a demand

for transportation services.¹⁰¹ J. C. Bongaerts considered the profits to capital ratios in the 1840's and 1850's for a large sample of railroad companies, of which 27 were privately owned and 29 were public enterprises. Most of these firms were profitable. 13 public enterprises and 19 private companies had a profit to capital ratio of at least 3.5% after 5 years of business; 3 state-owned enterprises and 10 private companies had a ratio of at least 10% after 10 years of existence. However, profits were defined as sales receipts minus business expenses. Since some earnings were not paid out to investors but were retained, the ratios tended to be overestimated. Nevertheless, this sample confirms the profitability of the railway industry in the mid-nineteenth century. Steady or even increasing profits to capital ratios prompted investors to pour capital into railroad companies.¹⁰² As to the public investment in railway construction, it was considerable in some states and less so in others. There were state-owned railway systems in Hanover, Brunswick, Baden and Wurttemberg, whereas private companies built most lines in Prussia and Saxony. In these latter cases, governments influenced private firms by controlling large blocks of shares or by guaranteeing minimum returns on capital.¹⁰³ In 1842 the Prussian government assured investors that the interest on approved railway bonds would be equal to that paid on state securities, which usually was around 4% in the middle of the nineteenth century.¹⁰⁴ Public investment in railroads was financed through the budget as well as by state loans and paper money.¹⁰⁵

C. Backward linkage effects¹⁰⁶

Railway construction made direct demands for the products of several industries which supplied railroad companies. Those backward linkage effects caused the growth of the firms providing railways with the required inputs. When these inputs were initially supplied by foreign producers the derived demand for them led to the eventual development of domestic production. The iron and engineering industries benefited from the delivery of a large proportion of their output to railways.¹⁰⁷ These two industries suffered from technological backwardness and the lack of capacity in the early nineteenth century. Thus, when railroad construction began around 1835, domestic engineering and iron companies were hardly capable of producing rails and locomotives. Foreign suppliers (mainly British) dominated the market for several years. However, a gradual process of import substitution was started in the 1840's. First, foreign locomotives were replaced by domestic ones. A German locomotive appeared on the Prussian railroad network in 1840. By 1845 more than half of all locomotives purchased by Prussia that year were supplied by German producers. From 1851 onward that proportion rose to nearly 100%. The stock of engines in Germany increased from 681 to 5,701 between 1851 and 1871, whereas the percentage of foreign engines fell from 37.1 to 3.8%.¹⁰⁸ Locomotives represented an increasing share of all steam engines in Prussia. In 1840 only 2.8% of the total horsepower was provided by locomotives. That share increased to 35.7% six years later. In 1855-61 locomotives supplied more than half of Prussia's total horsepower, thereby dominating the

engineering sector. Second, domestic rails (puddled and rolled iron) using imported coke pig iron replaced foreign rails. The latter dominated the German railroad network until the mid-1840's. Domestic iron processing plants increased their production and new facilities using British technology were established. However, the production of rails still depended on imported coke pig iron in the 1840's. The replacement of foreign rail suppliers initially resulted in an increase in imports. Railroads required the cheaper pig iron produced by coke-using blast furnaces whereas domestic output mainly consisted of charcoal pig iron. As the technology of coke-using blast furnaces was initially too difficult and expensive to adapt in Germany, pig iron was imported mainly from Britain. In 1850 three quarters of Prussian pig iron and more than one third of the kingdom's bar iron output was still produced with charcoal fuel (see Table 4 in Appendix). By the 1850's most rails were domestically produced. In Prussia imported rails amounted to 90% of the overall stock in 1843. That share declined dramatically in the following twenty years, reaching 14% in 1863. The German iron processing industry developed so much that not only did it supply the domestic market, it also exported rails. In 1860-65 the Zollverein imported 10,200 tons of rails and sold 23,600 tons abroad. In 1866-71 rail imports more than doubled to 23,600 tons whereas exports increased sevenfold to 149,900 tons. The third and last step of the import substitution process was the replacement of foreign through domestically produced coke pig iron. Whereas in the 1830's most of the pig iron and bar iron was still produced with charcoal fuel, almost all the blast furnace and bar iron output used mineral fuel in the late 1860's. German coke-using

blast furnaces were located in Prussia. Pig iron production in the Hohenzollern kingdom rose from 135,000 to 771,900 tons between 1850 and 1865. This considerable increase was entirely due to the growth of coke pig iron production. During that same period bar iron output produced with mineral fuel more than trebled, reaching 403,900 tons in 1865 (see Table 4 in Appendix). The total German production of pig iron increased from 211,639 tons in 1850 to 1,391,124 tons in 1870, while per capita consumption rose from 5.2 to 26.4 kg.¹⁰⁹

However, British pig iron remained competitive in Germany, despite suffering a temporary setback after 1844. The British share in German pig iron imports declined when the Zollverein introduced a new tariff on that product in 1844. Pig iron purchased from Britain was taxed twice as much as that imported from Belgium. The latter's share in the Zollverein's overall pig iron import increased from 18% in 1843 to 69% in 1850. Britain remained a major player in the German market. Her pig iron exports to Germany and Holland trebled between the early 1850's and the late 1860's, reaching an average of 174,059 tons per year in 1865-69 (Holland is included into these statistics because iron imports of the Rhineland from Britain, which were sent up the Rhine, were classified in the British data as exports to the Netherlands). On the other hand, Germany purchased less bar and railroad iron from Britain after 1849, except for a brief resumption in 1855-59. Britain saw her ratio of bar iron (including rails) to pig iron exports decline considerably from 1850 onward (see Table 5 in Appendix). Germany initially caught up with Britain in the process of puddling and the

rolling of bar iron, whereas the British held their dominant position in coke-smelting longer. Catching up meant a transfer of foreign technology. German manufacturers traveled abroad to learn new techniques and employed foreign engineers and skilled workers. Moreover, the Rhur and Rhine area benefited from the foundation of French plants.

Pig iron production and consumption was affected by railroad construction. The annual average demand for pig iron for rails and initial rail fastenings (disregarding locomotives, wagons, buildings and bridges) amounted to 22% of the domestic production and to 16% of the German consumption of pig iron in the early 1840's. By 1855-59 those figures rose to 31% and 23%, respectively (see Table 6 in Appendix). The considerable impact of railways on the German iron industries was reflected by the process of substituting domestic products for foreign ones. The sequence and rapidity of import substitution was affected by the Zollverein trade policy. The tariff structure incited domestic suppliers to satisfy the existing direct demand while allowing the importation of cheap intermediate goods which were worked up to finished products. Coke pig iron was treated as a raw material and could be imported free of duty. A heavy specific tariff (60 marks per ton) protected bar iron, including rails. The domestic iron processing industry used cheap imported coke pig iron to improve its technology and increase its output to meet railroad demand for rails. The new tariff in 1844 followed the same principles. A duty was levied on pig iron but it was structured so as to protect domestic blast furnaces using coke, not those employing charcoal. The Zollverein trade policy adapted

to railway construction to induce the development of the German iron industry through import substitution. The process of substituting domestic iron products for foreign ones went smoothly. The reallocation of demand towards German suppliers did not create bottlenecks, delays and high costs for the establishment of the railroad network.¹¹⁰

D. Forward linkage effects

Railways raised the efficiency of the transport system. Speed and continuity of delivery increased. Producers were provided with a mean of transportation which was faster, safer and more stable than roads or waterways. As a result, firms held lower inventories of raw materials and finished goods. Producers were able to convert circulating into fixed investment. Moreover, railways enabled industrialists and farmers to buy their inputs from further afield and to sell a growing proportion of their output on markets more and more remote. Regional specialization and trade increased. On the other hand, railway building led to a fall in the cost of transportation. Consequently, the cost of inputs used by farmers and manufacturers and the prices of their products were lowered. That was especially relevant for commodities heavy or bulky in relation to value such as metal goods, grain, building materials and coal.¹¹¹ Railroads lowered considerably their fares for coal transportation in the 1850's while modern coke-using blast furnaces were founded in the Rhur. The result was the expansion of coal mining in the Rhur area from 1851 onwards.¹¹² That region emerged as a major industrial center with its iron industries. Within the

Rhur sales of pit coal were confined to the local producers of coke pig iron. Outside mining areas the selling of pit coal was determined by transportation costs, for coal produced domestically had to compete with that imported from Britain. Until the early 1850's the level of railway freight rates was so high that it prevented any significant long-distance haulage of coal. Around 1840 the average rate per ton-kilometer for coal transported by rail was between 11 and 14 pfennigs. The price of the mineral was doubled after a journey of 38 to 50 km. Thus, outside mining areas, British coal dominated in northern and central Germany due to cheap transportation by ship. Considerable improvements in railway productivity as well as economies of scale increased railroad companies' profits. Moreover, the price elasticity of demand for coal and its transportation was high (well over 1) and competition was intense in the railway industry. Therefore, freight rates declined dramatically from the mid-1850's onwards. Long-distance haulage of coal increased, the mineral reaching places which had been excluded from supplies, thereby creating new markets. Einpfennigtarif, a special low rate for coal transportation, was introduced by the Upper Silesian Railway Company in 1849. It was originally designed to make Upper Silesian pit coal competitive on the Berlin market. That special tariff served as a model for other mining areas, such as the Rhur. The rate per ton-kilometer for the transportation of pit coal on Prussian railways declined from 8.2 to 2.2 pfennigs between 1853 and 1863. The share of pit coal haulage in overall ton-kilometers was 1% in 1850, 14% in 1860 and 27% in 1870. Domestic coal matched the price of the British mineral, thereby starting a process of import substitution. The share of British pit

coal on the Berlin market declined from 100% in 1846 to 20.6% in 1865. During that same period the share of Upper Silesian pit coal increased from none to 54%. However, British coal exports to Germany remained considerable, increasing in absolute terms throughout the second half of the nineteenth century. They maintained a strong position in coastal cities like Hamburg, even though their share of the German market fell from the 1860's onwards. Between the 1840's and the early 1880's Germany was Britain's second largest outlet, buying about 15% of British coal exports.¹¹³ German hard coal production increased from 5.2 to 12.3 million tons between 1850 and 1860. It more than doubled during the next decade, reaching 26.4 million tons in 1870. Most of that increase was due to the Rhur's production. The availability of coke led to the establishment of ironworks and engineering plants while new mines were opened. The output of coal in the Rhur rose to 11.8 million tons in 1870, amounting to 44.7% of overall German production. By that year the Rhur was producing twice as much coal as Upper Silesia, whereas twenty years earlier it was the opposite.¹¹⁴

E. Railways and German political unification

According to Rainer Fremdling, the interplay between the railways and the iron (backward linkages) and coal sectors (forward linkages) formed a leading sector complex between the railroad and heavy industries. That process took place from the 1840's to the late 1860's. In the early 1840's the proportion of the railways' output that went to the transportation of coal was nil. Ten years later that share was 1%, whereas

in the early 1860's it reached 25%. Five per cent of coal output was used by the iron-processing industry and the blast furnace production in the early 1840's. Ten years later that proportion more than doubled to 12%. In the early 1860's 30% of the production of coal went to the iron industry. The latter's output was used by railways and agriculture. About one third of the production of the iron-processing industry from the 1840's to the 1860's went to railways. Agriculture used a significant but declining proportion of the iron-processing production (20% in the early 1860's). The growth of the iron and coal industries depended heavily on the linkage effects of railways. As the development of railroads was largely exogeneous, it was this new means of transport that led the expansion of the heavy industrial complex in the early phase of Germany's industrialization.¹¹⁵ The rail system was vital as resource-user and service-provider.¹¹⁶ It was the most influential innovation during the nineteenth century with regard to its effects on economic growth: German industrialization was a process of unbalanced growth with the railroad as the leading sector.¹¹⁷

Patrick O'Brien's analysis coincides to a certain extent with Fremdling's. The share of transportation to gross domestic product more than doubled during the nineteenth century for two reasons. First, demand for travel was income and price elastic. In the early phase of railway construction personal travel increased more rapidly than merchandise haulage as rising incomes generated demand for travel. Railroads provided a safe, comfortable and speedy service that surpassed road and water

transportation. Moreover, as their income rose, consumers asked for more varied goods, thereby stimulating international and interregional trade. On the other hand, improved economic efficiency depressed the prices paid by consumers and the costs of inputs incurred by producers. As a result, markets widened. Another kind of price effect was brought about by increasing regional specialization. Gaps in productivity and price differentials between regions widened. The second reason explaining the rise in the share of transportation to gross domestic product is the increase in factor productivity brought about by railroads. The diffusion of railways and steam locomotives led to a significant fall in the real costs of transport, thereby widening markets and stimulating demand for passenger and freight services. The relative price of transport declined considerably in nineteenth-century Germany. Therefore, the increase in total factor productivity in the railway sector had a twofold impact: it met rising demands for its services at constant real prices and it made a positive and autonomous contribution to economic growth. The railroad network was the leading sector in the process of widening markets and altering the structure of relative prices for commodity outputs and inputs.¹¹⁸

Walther G. Hoffmann found a close connection between economic growth and the development of the transport system. Railway construction was a qualitative and quantitative incentive for the early German industrialization. As more lines were built the railroad network had an additional effect on economic growth. Hence the close connection

between railway development and the cyclical movements of the coal, iron and steel industries. The latter were leading industries with a rate of growth higher than average in the take-off period.¹¹⁹ Richard Tilly was more precise by dating the phases of German industrialization. The definitive turning point was railroad building in the 1840's which stimulated investment directly and indirectly. The coal, iron and machine industries were provided with an expanding market while transportation-using sectors had access to better facilities. However, the boom of the 1840's did not affect consumer goods (e.g. textiles) and it was interrupted by the harvest failures of 1846-47 as well as by the revolutions of 1848-49. The take-off occurred between 1850 and 1873. Growth was strongest in heavy industries (coal, iron and railways) but consumption goods also expanded at high rates. From 1850 to 1874 the average annual increase in net product was 2.5% (1.7% for net product per capita). The index of industrial growth shows a growth of more than 400% for metals, coal and transport in 1850-70 whereas total industry and production rose by only 98 and 50%, respectively.¹²⁰

In his 1987 article, Hubert Kiesewetter summarized the impact of the German railway system on economic growth as well as railroads' forward and backward linkages to industries. He then went on to state that "... the economic interdependencies resulting out of this development were more effective in promoting political unity than any other economic or fiscal measure." The establishment of the railway system in the 1850's and 1860's furthered Germany's unity and independence of political pressure

from outside. However, the process of nation-building that led to the Reich was not a historical inevitability, either on political or on economic grounds. Finally, the author mentioned an "internal logic" that supposedly compelled the other German states, with the exception of Austria, to accept the Prussian solution to the national question.¹²¹ But what is this "internal logic"? Kieseletter does not define it. What is actually missing is the link between the economic effects of the railroad system and the political unification process. The German railways supposedly had a great potential for both political and economic integration.¹²² And yet, the causal relation between the foundation of the German railroad network and Germany's nation-building has not been established.

CONCLUSION

The Zollverein created in 1834 a large unified market within the new customs union. Internal tariffs were eliminated from the beginning. Other objectives were reached later as the Zollverein was often paralyzed by the Austro-Prussian rivalry cutting across economic interest. The standardization of commercial legislation was started in the 1850's and was not completed before 1861. Currencies exchanged completely freely only after 1857. Nevertheless, the unified market increased the mobility of factors of production and the efficiency of competition. The customs union led to greater economies of scale and specialization. However, these benefits would not have occurred without a modern transportation system. The railway network was started and developed during the Zollverein period. Therefore, the effects of the customs union and railroads were somewhat mixed. The suppression of tariffs increased internal trade but the new transportation greatly facilitated the flow of goods. Conversely, railways stimulated the growth of domestic trade by giving access to German areas that had been isolated. Even though the Zollverein did not immediately and completely unify the internal market, the railroad network created a cobweb of inter-German commercial relations from the 1850's onwards.¹²³ Both the customs union and railways led to the economic integration of Germany and furthered industrialization. They contributed significantly to economic growth from the 1840's to the 1860's.¹²⁴ Most studies consider either the foundation of the Zollverein or railway construction as the economic pre-conditions to political unification.¹²⁵ Some authors think that the combined

effects of both processes led to Germany's nation-building.¹²⁶ However, most of the time the transition from the economic sphere to the political one is not explicit. Economic historians have often implicitly assumed that, in one way or another, the unification of the economy led to the Bismarckian empire. Robert M. Berdahl tried to clarify that link. He stated that nationalism is generated among a people by the growing awareness of its economic backwardness and by the desire for a modern economy. And once development starts, it reinforces nationalism: economic modernization breaks down traditional society, thereby providing the means and the psychological need for the creation of the nation. However, Berdahl failed to demonstrate the validity of his two generalizations with regard to the German political unification.¹²⁷ There still is a no-man's land between the integration and the growth of the German economy from the 1830's to the 1860's, on the one hand, and the process of political unification that led to the Reich in 1871, on the other hand.

APPENDIX

TABLE 1

Tariff revenue shares in "net" central government budgets, 1825-50 (in %)

Baden	1830 8.4	1840 16.1	1850 19.6
Bavaria	1825 7.1	1837 10.3	1849 15.8
Prussia	1829 14.0	1841 17.8	1850 17.3
Wurttemberg	1830/31 7.4	1839/42 14.6	

Source: Dumke, 1974, p. 44

TABLE 2Railway freight transportation and freight rates, 1840-70

	Output ^a	Rates ^b
1840	3	16.9
1845	51	13.6
1850	303	10.1
1855	1,095	8.2
1860	1,675	7.9
1865	3,672	6.0
1870	5,876	5.6

^a Millions of ton-kilometers^b Pfennigs per ton-kilometer

Source: Fremdling, 1980, p. 26

TABLE 3

Net investment flows in railways (R), Gewerbe (G) and the German economy(E)
(annual averages), 1851-69

	R ^a	G ^a	E ^a	RG ^b	RE ^c
1851-54	88	113	738	78.3	11.9
1855-59	134	170	678	78.6	19.7
1860-64	142	246	1,204	57.6	11.8
1865-69	201	178	1,148	113.0	17.5

^a Million marks in current prices (1 thaler = 3 marks)

^b % of G

^c % of E

Source: Fremdling, 1977, p. 585

TABLE 4

Iron production in Prussia, 1837-65

	Blast furnace output		Bar iron output	
	Metric tons (000 s)	From charcoal (%)	Metric tons (000 s)	From mineral fuel (%)
1837	99.5	90.4	58.7	31.8
1842	101.0	82.0	79.3	39.5
1850	135.0	75.1	130.4	63.6
1855	301.4	44.4	247.5	80.9
1860	394.7	24.1	265.7	89.7
1865	771.9	7.8	403.9	>95

Source: Fremdling, 1983, p. 125

TABLE 5

British iron exports to Germany and Holland, 1840-69 (annual averages in metric tons)

	Pig iron (PI)	Bar iron (BI) (including rails)	BI/PI ^a
1840-44	46,964	44,113	1.17
1845-49	38,971	44,663	1.43
1850-54	58,722	35,961	0.83
1855-59	137,109	76,690	0.69
1860-64	134,533	42,758	0.40
1865-69	174,059	43,788	0.31

^a The ratios were calculated after converting the figures for bar iron by a multiplier of 1.25 to become comparable to those of pig iron

Source: Fremdling, 1983, p. 131

TABLE 6Railroad-derived demand for iron (in pig iron equivalents), 1840-59

	As % of total domestic production	As % of total domestic consumption
1840-44	22.1	15.9
1845-49	32.1	24.3
1850-54	36.5	26.2
1855-59	31.5	22.9

Source: Fremdling, 1983, p. 127

FOOTNOTES

1. Fischer, 1960, pp. 66, 70
2. Kiese Wetter, 1987, pp. 84-5, 93
3. Fischer, 1960, pp. 67-8
4. Bohme, 1966, p. 114
5. Fischer, 1960, p. 68
6. Dumke, 1974, p. 77
7. Fischer, 1960, p. 76; Kindleberger, 1975, pp. 41-2
8. Kiese Wetter, 1987, pp. 93-4
9. Fischer, 1960, p. 69
10. Kiese Wetter, 1987, pp. 94-5
11. Fischer, 1960, p. 77
12. Kiese Wetter, 1987, p. 95
13. Fischer, 1960, p. 69
14. Kiese Wetter, 1987, p. 96
15. Bohme, 1966, pp. 115-6
16. Fischer, 1960, pp. 75-8
17. Dumke, 1974, p. 85
18. Fischer, 1960, pp. 74, 79, 83
19. Fischer, 1960, p. 76
20. Since British exports to Germany to some degree went via Holland and Belgium, the latter are included into the statistics.
21. Dumke, 1974, pp. 14-5, 42; Hoffmann, 1963, pp. 104-5
22. Kindleberger, 1975, p. 42

23. Fischer, 1960, p. 80
24. Dumke, 1974, p. 65
25. Kindleberger, 1975, p. 42
26. Dumke, 1974, p. 4
27. Fischer, 1960, p. 80
28. Dumke, 1974, pp. 24, 27, 30, 87
29. Piétri, 1982, p. 27
30. Dumke, 1974, pp. 13-4, 40
31. Fischer, 1960, p. 76
32. Dumke, 1974, pp. 2, 63-4; Sheehan, 1981, p. 2
33. Bohme, 1966, p. 118
34. Dumke, 1974, pp. 3-4
35. Berdahl, 1972, p. 72
36. Dumke, 1974, p. 8; Fischer, 1960, p. 68
37. Brinkmann, 1933, pp. 137-8; Fischer, 1963 , pp. 88-9; Tipton, 1974, p. 199
38. Dumke, 1974, p. 9
39. Brinkmann, 1933, p. 141; Kindleberger, 1975, pp. 45-6
40. Brinkmann, 1933, pp. 136-7; Pollard, 1973, p. 643
41. Berdahl, 1972, p. 73
42. Dumke, 1974, pp. 5,70; Henderson, 1939, pp. 337-8; Lee, 1988, p. 351; Tipton, 1974, p. 200
43. Dumke, 1974, p. 5
44. Sheehan, 1981, pp. 11-2

45. Tipton, 1974, pp. 200-1
46. Kraehe, 1953, pp. 13-4
47. Dumke, 1974, p. 5
48. Tipton, 1974, pp. 202-3
49. Kiesewetter, 1987, p. 96
50. Dumke, 1974, pp. 6-7, 72
51. Lee, 1988, p. 350
52. Dumke, 1974, pp. 16-7; Tipton, 1974, pp. 199-200
53. Fischer, 1960 p. 75
54. Dumke, 1974, pp. 12-3, 29
55. Kiesewetter, 1987, p. 96
56. Dumke, 1974, pp. 25-8
57. Fischer, 1960, pp. 76-7, 80-1
58. Kindleberger, 1975, p. 45
59. Fischer, 1960, pp. 70, 84-5; Kiesewetter, 1987, pp. 98-9
60. This chapter does not distinguish between private and public railways.
That distinction will be made in the second part of this study.
61. Pollard, 1973, p. 646
62. Fremdling, 1983, p. 121
63. Kiesewetter, 1987, pp. 99-100
64. Brinkmann, 1933, p. 139
65. Fremdling, 1983, p. 121
66. Piétri, 1982, p. 201
67. Tilly, 1967, p. 153

68. Hoffmann, 1963, p. 105
69. Kiese Wetter, 1987, p. 101-2
70. Bongaerts, 1985, pp. 337-8
71. Fremd ling, 1980, pp. 26-7
72. O'Brien, 1983, p. 7
73. Brinkmann, 1933, p. 139
74. Piétri, 1982, pp. 54-5
75. Fischer, 1977, p. 438; Tilly, 1978, p. 411
76. O'Brien, 1983, pp. 12-4
77. Fischer, 1977, pp. 432, 437-8
78. Brinkmann, 1933, p. 138
79. Piétri, 1982, p. 63
80. Brinkmann, 1933, pp. 138-9
81. Tilly, 1978, p. 414
82. Mitchell, 1980, p. 662
83. Fremd ling, 1977, pp. 584, 588; Fremd ling, 1983, pp. 139-40, 146
84. Henderson, 1975, p. 46
85. Brinkmann, 1933, p. 139
86. Fischer, 1977, pp. 437-8
87. Fremd ling, 1977, p. 586; Tilly, 1967, p. 152
88. Tilly, 1978, p. 416; one thaler is worth three marks
89. Tilly, 1978, p. 418
90. Hoffmann, 1961, p. 126
91. Fremd ling, 1977, p. 586

92. Hoffmann, 1961, pp. 132-3, 135
93. O'Brien, 1983, p. 18
94. O'Brien, 1983, p. 2
95. Tilly, 1967, p. 159; Tilly, 1986, pp. 118-9
96. Tilly, 1967, pp. 159, 161-2
97. Tilly, 1986, pp. 118-20, 127-8
98. Tilly, 1967, pp. 162-3, 177-8
99. Tilly, 1986, pp. 119, 127
100. Bongaerts, 1985, p. 335; Tilly, 1967, pp. 178-80
101. Fremdling, 1983, p. 122
102. Bongaerts, 1985, pp. 333, 335-6
103. Fremdling, 1983, p. 122
104. Bongaerts, 1985, p. 336; Tipton, 1974, p. 205
105. Fischer, 1977, p. 438
106. This section is based on Fremdling, 1977, pp. 587-92 and Fremdling, 1983, pp. 123-31, 143-4 , unless otherwise specified
107. Fremdling, 1977, pp. 584-5; O'Brien, 1983, pp. 2, 15
108. Kiesewetter, 1987, p. 102
109. Tilly, 1967, p. 153
110. O'Brien, 1983, p. 17
111. O'Brien, 1983, pp. 1-2, 13, 21
112. Fremdling, 1977, p. 592
113. Fremdling, 1983, pp. 132-6, 145
114. Henderson, 1975, pp. 133-4; Tilly, 1967, p. 153

115. Fremdling, 1983, pp. 136-8
116. Tilly, 1978, p. 414
117. Fremdling, 1977, pp. 584, 601
118. O'Brien, 1983, pp. 3-6
119. Hoffmann, 1963, pp. 104-6, 111
120. Tilly, 1978, pp. 385-7, 422
121. Kiese Wetter, 1987, pp. 102-3
122. Brinkmann, 1933, p. 139
123. Tipton, 1974, pp. 200-1
124. Hoffmann, 1963, pp. 95-6, 117
125. Kiese Wetter, 1987, p. 85
126. Henderson, 1975, p. 52
127. Berdahl, 1972, pp. 71-2, 74

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