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Rhine, Ruhr and Rotterdam.

Continuity and change in a transnational economic core region, 1870-2010.[1]

Introduction

In the last decades, a number of economists came to the conclusion that *'…large-scale regions are more significant economic units than nation-states.'*[2] In other words, there is no reason to believe that the economic geography is just a mirror of political structures and that political and economic borders are falling together. In the USA, where such ideas developed, these theories are reason to ask where clusters of economic activity concentrate or where regions can be traced that could be defined as core-regions.[3] In Europe, where political units are relatively small compared to the American continental-wide scale, the question should be asked whether the economic activities within a state shape a national economy or are part of a larger, transnational economic region. Especially in periods of free trade and monetary stability there are little reasons to believe that an economic region will remain within national borders. To the contrary: national borders and differences in regulation will result in price differences and can stimulate cross-border economic activity and economic integration. From the late 19th century, the most important industrial centre of Germany, the Ruhr-Rhine-area, was dependent for its supply with foodstuffs and iron-ore, later also of oil and oil-products and for the transport to its overseas markets of coal on the Dutch port of Rotterdam. At the same time the port, Rhine shipping, transport and trading services, just as all kinds of linked industries, and with that a substantial part of the Dutch economy, became dependent on its close connection with the German hinterland. In the Dutch case, this results in the question whether the economy was and is not so open and so intertwined with those of the neighbouring country that it hardly makes sense to analyse it independently. Was there a Dutch national economy, or was the economic activity within the Netherlands at least in certain periods, part of a larger, transnational economic region? In Germany it is found that until 1914, the economic contacts between diverse German regions among each other were not closer than such relations with neighbouring foreign regions.[4] In other words, at least in periods of liberal economic relations and monetary stability there neither was a Dutch, nor a German national economy. From an economic perspective regions were more important than nationion states.

The ideas behind these questions are not new. Already in the 1980s Sidney Pollard wrote about one of the most prominent topics in economic history, the industrialisation, as a process that did not happen in Britain or Germany, but in regions like Lancashire or the Ruhr Area.[5] Although many agreed, just as many nowadays do with new initiators of debates on regional economic development like Michael Porter or Paul Krugman, the problem of these theories is that the organisational structures in nation states not only create the context for government and administration, but also for analyses. Archives on political or economic development and policy are organised on a national level, statistical offices create national macro-economic data, academics or politicians discuss national economic politics, and the national press discusses this policy and criticise the outcome. On a local level there is some infrastructure for analyses, but it is much less developed. Regional economic developments within nation states, especially of backward regions, therefore are discussed, but only on levels with little influence. Statistical data are scarce and most of the time academic analyses are lacking, while the local press is read only locally. Transnational regional developments are even less observed. It is typical that until recently the last major publications on the relations between the Dutch port of Rotterdam and its German hinterland or the history of these relations are from the late 1960s and early 1970s.[6] Nonetheless, Rotterdam was Germany's most important seaport (more important than any German port), and for the Rotterdam, Germany, and within Germany primarily the Rhine-Ruhr region, was much more important than any other part of its hinterland, including the Netherlands itself. Most of the time transnational economic developments are not so much ignored, but simply not observed because there are no statistics, no governmental memos, no questions in parliament, or articles in the press on these transnational regions.

Since the late nineteenth century Rotterdam was the most important port of the German industrial centres along the Rhine and its tributaries, like the Ruhr or Main. At first glans it is amazing that it was not already earlier, from the 1850s for instance when the Ruhr started to develop into the industrial heart of Germany and Europe. From a political point of view most amazing is that it remained of vital importance during the period that Germany was becoming ever more protectionist, even when it tried to become autarkic during the Nazi period. From an economic point of view it seems most remarkable, however, that this intense connection survived the transition from coal, the main product of the Ruhr area, to oil. Rotterdam became the most important port for German in the late nineteenth century, and still is. At first glans this suggests an amazing continuity. In fact, some spectacular changes took place, but until recently every time Rotterdam came out as a winner. Only now it is losing its position. This article tries to give an overview of what happened and why a from a German perspective a foreign port, could become and remain vital for its most important economic centres for over a century. The role of governments, supranational organizations, and companies will be analysed.

Industrialization of the Ruhr, the Rhine and Rotterdam

From the 1850s in the Prussian territories along the Rhine and it tributaries (a territory comparable with present day North Rhine-Westphalia and the northern part of Rhineland Pfalz) industrialization made progress. Coal mining grew rapidly and after introduction of the production of cokes iron in 1849, the iron and steel production also speeded up. In 1877 the mine owners of the region agreed that export was needed to keep German price levels profitable and founded the *Westfälischer Kohlenausfuhrverein* (Westphalian Coal Export Union). A year later this organization decided that Antwerp would become their port. The reason that Rotterdam was hardly mentioned in their discussions was that it did not have a good rail connection with its hinterland.[7] In the nineteenth century, steam power and railways caused a transport revolution. Not only did investments in railways push industrialization forward as the demand for coal, iron, and steel sky-rocketed with their development, but also because railways connected industrial centres with markets, raw material producing areas, and seaports.[8] Inland transport became possible on a previously unknown scale.[9] Indeed, in the period 1840–70, the train became a dominantmeans of transport. Inland navigation lost its leading position.[10] A rapidly growing rail network was able to solve most transport problems of the developing industry, including that in the Ruhr area. This region built one of the densest rail networks in Europe, with numerous national and international connections. By 1870, most transport in the Rhine basin took place by rail and as the most important railways from the Ruhr area went to Antwerp or the German ports, the Dutch ports connected with the region by the Rhine lost its dominant position to these competitors.[11]

Since Roman times, in Rhine shipping current, wind or muscle power were used for traction. As in major parts of the river the wind was not strong enough for upstream traffic, the size of barges was limited by the strength of horses. In the mid-1800s, there were circa

3,000 towing-horses exploited along the Rhine.[12] A strong horse on a well-kept path could tow a ship of 50 metric tons, cargo included. Compared with road transport, this was gigantic; a horse on a well-paved road could draw 1.5 ton.[13] Nonetheless, barges were small, and could not increase before the link between their size and the strength of a team of up to five horses was cut. Before that happened barges with a capacity of over 300 ton were rare. Introducing steam power, and thus cutting the link between the strength of a team of horses and the size of the ship, was not enough to introduce a larger scale, however. For that the river had to be adapted to larger, deeper barges. That this was done in the Rhine region was unique. Almost everywhere else, railways became dominant with enormous consequences.

As companies who owned railways did not allow others to use them, railway companies created monopolistic transport markets. Waterways, on the other hand, were state-owned, for general use and thus stimulated competition, at least within the nation state. A problem is that the Rhine was no national, but an international waterway. Traditionally this resulted in protectionism. The competitiveness of Rhine shipping was undermined by regulation, taxation, and discrimination against foreign ships. It gave road transport a chance.[14] Therefore already in this period, the riparian states – Mainz, Trier, Cologne, the Palatine (Pfalz), and the Dutch Republic – met in Frankfurt, to discuss the liberalisation of the river. As local interests were strong and a broad vision a rare exception, these negotiations only ended in new conflicts and a complete failure of the negotiations in 1724.[15] Until the French revolution every principality bordering the Rhine had its own tolls, while major cities bordering the river claimed staple markets to stimulate economic activity. In 1804, the waning Holy Roman Empire and revolutionary France agreed on centralising the administration of Rhine navigation. In France, the Revolution gave liberal ideas a chance, also in economic matters, causing the abolition of internal custom barriers in 1790 and introduction of freedom of trade in 1791, but also the decision to liberate Rhine shipping in 1792. After the French conquest of the left bank of the Rhine in 1794, diplomats of the new republic started to plead for Rhine liberalisation. In 1798, Paris shifted its custom border to the river and in 1804 it pressed the German Empire to accept an agreement.[16] This charter handed over the authority on navigation to a General Director who not just regulated shipping, but also collected a tax replacing all 32 tolls between the Swiss and Dutch border.[17] Deeply in contrast with the liberal principles was the persistence of Cologne and Mainz as Stations de navigation, where all cargo was to be transhipped. Nevertheless, shipping became more liberal and cheaper. In 1815, after the collapse of Napoleon's Empire, the Rhine banks were split up again over a number of independent states. As it was feared that local interests would reintroduce all obstacles and taxes again, co-operation seemed necessary. Therefore, in 1815 the Vienna Congress founded an international commission, the Central Commission for the Navigation of the Rhine (CCR) which got the authority to organise navigation without discrimination of flag or cargo, to keep tolls low and make sure that the Rhine states kept the towpaths and channel of the river in good shape. Nowadays, the Commission considers it its tasks to uphold free navigation on the Rhine and its tributaries and to monitor uniform regulations of the Rhine system. Members are Switzerland, France, Germany, Belgium, and the Netherlands. In 1815, Bayern, France, Nassau, Baden, Hessen-Darmstadt, the Netherlands, and Prussia were the original member states. In 1831, when the first Rhine Act of Mainz was signed, these Rhine states agreed that initiating new activities to improve Rhine shipping became the duty of this supra-national agent. As the newly industrialized territories along the Rhine and Ruhr needed cheap transport, it was Prussia that used this instrument to improve Rhine shipping. From the mid-nineteenth century, when Prussia became dominant within Germany and as a result also within the CCR, this organization became a tool for this state to realize Rhine canalization. Although the Dutch were opposing it as technically impossible and too expensive, in the end the Dutch did most and spend most money on it. The results also were very much in Dutch favour. From the 1880 on the canalization process including the improved connection between Rotterdam and the sea, was completed. As a result Rhine shipping could increase in scale. While trains of four or five steam-tugged barges became already common on the Rhine from the 1840s, then these were no more than 40 metres long and had a capacity of 400 tons. From the last decades of the century the scale increased, resulting in trains of barges of 400 metres with a capacity of 6000 tons.[18]

While in the mid-nineteenth century, railways had a scale advantage and although freight rates per ton/km were higher, altogether rail transport was cheaper as trains could easier reach final destinations. Transporters thus could economize on transhipment. To compete with railways, barging therefore needed large price advantages per ton/km. This became possible when the Rhine became navigable for large-scale trains of barges towed by steam-tugboats. The CCNR got the task to promote and supervise the adaption of the infrastructure that would cause the costs of Rhine shipping to nose-dive with 75 per cent between 1890 and 1914. In that period, Dutch rail freights increased, while German rail freights decreased a little, and the general price level was more or less stable. In the entire 1860-1913 period, Dutch rail freights decreased with 17, German with 55 per cent, but Rhine freights with 82 per cent.[19] As a consequence, transport from Rotterdam to the German Rhine-Ruhr area became extremely cheap, what was especially favourable for bulk transport. That was exactly what the Rotterdam hinterland needed, as there was an ever-growing demand for iron ore, pit wood, cereals, while it needed to transport enormous quantities of coal to its overseas markets. Thus Rotterdam became a port where enormous quantities of only a very limited number of products were handled. It was a highly specialized, but as a consequence also a highly vulnerable port. While Antwerp remained important as a port for mixed cargo, already before World War I, Rotterdam became the bulk port of Germany. As a consequence, just before the war almost 25 per cent of the volume of all German imports, and over 20 per cent of all German exports crossed the Dutch border on the Rhine. As a consequence, the economic activity within the two countries became closely intertwined.

The Lower Rhine economy before 1914

In 1850, Dutch imports and exports were respectively 27 and 22 percent of GDP. Ten years later, when the German industrialization assumed large proportions, this increased to 37 and 40 percent.[20] In subsequent years the Ruhr industry developed exceptionally fast and Prussia, especially the Western territories along the Rhine that it had won in 1815 at the Vienna Congress, became the dominant industrial centre of the continent. Between 1860 and 1865 this resulted in an increase with tens of percents of the imports of raw materials and semi-finished products to Frankfurt-am-Main, the West-German transhipment centre along the Main River, a tributary of the river Rhine.[21] During the period 1862-1871, the years that Bismarck in such a rough way midwifed the birth of the Prussian-German *Kaiserreich*, the Netherlands was having an economic boom that Van Zanden and Van Riel attributed to railway construction and the abolition of all kinds of institutional barriers, such as the tolls at city-gates, or taxes on coal. As a consequence, regional fragmentation finally disappeared and a national economy arose, so they think.[22] Precisely in these years, German industrialisation spurted and as the new Germany industry, as most nineteenth century large-scale industrial areas, developed in coal regions, Silesia and the Ruhr area, both located on the borders of the developing *Kaiserreich*, became the new economic centres. As the Ruhr-area, the most important centre of German industry was almost on the German-Dutch border, the supply lines of its industries largely passed through the Netherlands and Belgium, while its foothills resulted in an increase of industrial activity in these countries.

Even before the foundation of the Kaiserreich in 1871, the situation changed in another aspect when both the Netherlands and the German *Zollverein* – the Prussian-led custom union of most German states apart from Austria – introduced free trade.[23] Although nationalism ran rampant in the middle of the nineteenth century, free trade spread like wildfire as a result of the dominant influence of the British Empire.[24] In 1862, the new Prussian Prime Minister Otto von Bismarck in a vain attempt to pacify the liberals with whom his king had a sharp conflict also turned to free trade. He forced the *Zollverein* to accept this liberal policy, thus excluding the Prussian rival Austria, as this empire needed protectionism.[25] At the same time the cabinet of the Dutch liberal J.R. Thorbecke also put an end to most import taxes, excise duties on bread, meat, coal, and a large number of other products.[26] At the moment that transport to and from the sea became of increasing importance for German industrial development along Ruhr and Rhine, the Netherlands and the *Zollverein* turned to free trade. As a result Dutch imports and exports – in the early 1860s each already an impressing 40 percent of GDP – in 1864 suddenly made a great leap to respectively 59 and 56 percent.[27] While before 1864 internal regulations, tolls and the limited railway network caused that many regions still were strongly isolated, from that year the economic activity in the Netherlands was no longer limited by regional, or even by national borders. Not a national, but a transnational economy developed. As a result in 1913, when measured in tons 22 percent of all German exports and 25 percent of all imports of the *Kaiserreich* crossed the Dutch border on Rhine barges.[28] In this period, Rotterdam developed into a major German port, in which 75 percent of all transport was related with the German hinterland. German companies invested in Dutch Rhine shipping, in the Dutch port and in legally Dutch trading companies, banks, and related industries. The German share in Dutch merchandise trade grew substantially. According to not completely reliable, but still usable, pre-1917 statistics, in 1862 and 1875 23 percent of all goods exported by the Netherlands went to Germany. In 1910 this figure was 47 per cent. As exports grew from 43 to 62 per cent of GDP between 1862 and 1875, and were still that high in 1910, exports to Germany grew from circa 10 per cent of GDP in 1862, to 14 per cent in 1875 and 30 per cent in 1910. For imports the figures were equally convincing. In 1862, 14 per cent of Dutch imports came from the *Zollverein*; in 1875 and 1910, respectively, 22 and 42 per cent came from the *Kaiserreich*, while total imports grew from 43 to 64 to 71 per cent of GDP. Imports from Germany thus increased from 6 to 14 to 30 per cent of GDP. Just before the 1914 war, in 1912 when the Dutch foreign trade/GDP-ratio peaked at 1.4, the Dutch German-trade/GDP-ratio was 0.6.[29] On top of that, 60 percent of all German transport on inland waterways was Rhine transportation.[30] From the last decade of the nineteenth century Duisburg-Ruhrort, the river port of the Ruhr area, where most Dutch barges from Rotterdam went to, became the central inland port in Europe. In other words, not just trade, but trade with Germany was vital for the Netherlands. Although no-one will deny this today, in 2011 Dutch imports from Germany were only 6 per cent of GDP, exports 10 per cent; the German-trade/GDP-ratio 0.17. Nowadays, trade with the entire EU is less important than trade with Germany was before the Great War.[31] To conclude that in the late nineteenth century the Dutch economy integrated into the German is too easy, however. The German economy hardly was an entity itself, but fell apart in an eastern and a western part. This western part of the German economy that more or less corresponded to the Rhine river system, together with the Dutch economy this region developed into an integrated Rhine economy.

In nineteenth century nationalist literature the Rhine is often sung about as a German stream. In fact, it is an international waterway that travels through Switzerland and Liechtenstein, and after eight hundred kilometres through Germany – of which since World War I, but also before 1870, several hundred kilometres were the border with France – it formed a delta in the Netherlands together with the Meuse River that came from Belgium. As a result of its delta character the Rhine meets the North Sea at a number of places and under diverse names. The small rivers that still have the name Rhine – The Leidse Rijn and Oude Rijn, in fact are the remains of the medieval river and were hardly relevant for shipping anymore. Since the nineteenth century, the prime estuary of this river system is near Rotterdam, where it is called the Nieuwe Maas – New Meuse. The Rhine is the only major river in Germany that not just sprang on foreign soil, but also had its estuary in a foreign country. Because the river became the central inland waterway of Germany, the Dutch port of Rotterdam developed into the most important German port. After 1890, when Rhine shipping became much cheaper, for the bulk goods of Ruhr area there was no alternative to the river or the port of Rotterdam anymore. Railways and German or Belgian ports were too expensive for such transport. Since the late nineteenth century the lion's share of Rotterdam transit was German. In some years, the share of Germany in that transport was as much as 80 percent. These relations were decisive for the West German, as well as the Dutch economy. Consequently, it was not just the economy of the small Netherlands that was dependent on Germany, but also that of big Germany that was dependent of the Dutch. Moreover, because Germany lost significant territories in the East after each of the two world wars, each time the relative importance of its Western part – the part closely connected to the Netherlands – increased.

For the 1874–1913 period (the years for which data are available), there was a close correlation between the share of Rhine transport in German imports and freight rates of rail transport in percentage terms of those of Rhine shipping, r = 0.855; *n* = 39. For exports this relationship was weaker, but significant nonetheless: r = 0.780. That it was weaker is explainable from the policy of the German coal cartel – *Rheinisch-Westfälisches Kohlensyndikat* – which until 1904 could not control exports by barges and therefore sent its coal by rail.[32] Transport by barge between German industrial centres and the sea was closely related to German activity in the Dutch port.[33] The correlation between the outgoing cargo from Rotterdam and German exports was only r = 0.282, *n* = 32. Many other developments influenced Rotterdam transport, especially the policy of the Coal Cartel. Nonetheless, incoming cargo and German imports sailing the Rhine were closely related: r = 0.802. The German need for the importation of bulk goods transported by Rhine barges determined developments in the port of Rotterdam. During the interwar period Rhine shipping would also transport German coal to its export markets. As a consequence, an almost complete balance in upstream and downstream barging developed, making Rhine shipping even cheaper. Rotterdam became so important that even the Nazis, although endeavouring autarky recognized its importance during the late 1930s.

From the 1890s until the early 1960s, bulk cargo like ore, coal, cereals, oil, or fertilizers, primarily went by barge. Consequently, Rotterdam became Europe's major seaport.[34] Still in 2001, of all Dutch cross border traffic, 60 per cent (in weight) was transported by inland navigation, most of it on the Rhine.[35] Nonetheless, something fundamentally changed after World War II.

The post-war period

Rotterdam was an enormous port for a very limited number of products: coal, iron ore, and cereals. After 1945, coal lost most of its importance. Coal mining in Europe was expensive as wages increased. This was especially problematic in Germany because during the 1930s and 40s investments in coal mining were too small to keep the mines up-to-date. As a consequence, liberalization of the energy market and opening the German market for foreign oil and oil products could only result in a transfer from coal to oil. While most energy came from coal in the 1950, oil and oil products covered most of the enormously increased need for energy of the 1960s and 1970s. In the same period the dominant German chemical industry also changed from coal to oil as its basic raw material. Coal simply was too expensive. Consequently, along the Rhine the balance between upstream and downstream transport, that was characteristic for the situation on the lower-Rhine in the interwar years, disappeared. Downstream transport became less important, while upstream transport increased, but with a new type of bulk product that would not necessarily be transported by barges. As quickly as quantities became large enough, pipelines were a better solution. At the same time barge transport, that until the Second World War only was competed by railways, now needed to compete with trucks. Rotterdam's safe position as the only port at the estuary of the Rhine with a link with the German hinterland that guaranteed cheap bulk transport was thus undermined. Trucks and pipelines were footloose and could come and go everywhere.

That Rotterdam remained the most important port of Europe and in the 1960s even became the largest port of the world, was because it could attract the main oil streams and became center of oil refinery itself. The reasons why Rotterdam remained Europe's most import port, notwithstanding the fact that oil could come ashore everywhere in Europe as a pipeline could be build from every port, while its main advantage, cheap Rhine transport, had lost its relevance, was a result of the reaction on the developments by Dutch (local) politicians, Royal Dutch Shell as a Dutch company, and the policy of some mayor German chemical companies. The answer to this question, however, will be given in the PhD-thesis of Marten Boon that he will defend before the end of 2014. It is clear that the energy policy of the German government is a serious problem for the port of Rotterdam, as it is nowadays is in the first place an oil port. The reason that Rotterdam became a central port in Europe for container transport, had to do with the transport policy of the US Army. From the 1960s on, Rotterdam became very important in this new niche. In her recent PhD-thesis Klara Paardenkooper made clear, however, that this position is very insecure as the German transport policy gives preference to the German ports which have much better rail connections with the more dynamic parts of the German economy in Bavaria and Baden-Wurtemberg than the Dutch port. As a consequence, Rotterdam's hinterland is limited more and more just to the Ruhr Area nowadays . With that, it regained its traditional position, being the main port of that region. However, the main difference with the past is of course that nowadays the Ruhr area is no longer the centre of the German economy, but a post-industrial region with high unemployment rates and and a severe social crisis. Rotterdam still is the biggest port of Europe and the fact that it had this position since almost a century suggest an enormous continuity, but this continuity is in fact only partial and apparent. The Rotterdam port survived the transition from coal to oil it partly as a result of an adequate reaction, but also because the hinterland still was the industrial centre of Europe at the time. As even that is no longer the case, the present crisis seems much more challenging for the Dutch port.

Conclusions

This synthetic paper highlights three major findings. Firstly, it reveals that the low costs of Rhine transportation have forged sustainable economic relations between Rotterdam and its main hinterland since the 1870s. We find that the efficiency of transportation in the region contributed to agglomeration effects in both the port and its hinterland, as postulated by new economic geography (NEG), allowing port-hinterland relations to recover from technological and institutional shocks time and again. However, taking cue from critical reviews of NEG, the study also stresses the importance of institutions and historical contingency on the path of regional economic evolution. Secondly, we find that, notwithstanding the observed continuity, port-hinterland relations underwent significant changes over the long run. Drivers of change included waves of globalisation and their technological implications and institutional processes of regulation and deregulation. The study reveals that both technological and institutional shifts were consequential for the economic structure of the hinterland and formed a constant force of change for the character of the port itself and its relations with the hinterland. Although port-hinterland relations were only severed completely during war, the Dutch-German border has been and still is a source of friction. Thirdly, we find that in most cases changing demand for transportation in the hinterland was the main driver of change in the Rotterdam port and its relations to the hinterland, although in the case of containerisation the early adoption of container transport by the Rotterdam port caused the pattern and structure of transportation in the hinterland to change.

In the nineteenth century in the Rhine area a regional economy developed– especially in the Lower Rhine region. This stretched at least from the Ruhr to Rotterdam. In that period political borders were of minor importance for economic life. The strong economic contacts that developed in those years seemed logical: the Ruhr area used the Rhine, its natural transport route to the sea, and the Port of Rotterdam. That the then resulting international economic region still is largely intact, is however less logical than it appears. Not only the world suffered– and this area in particular – from two world wars, a severe economic depression and sharp protectionism, on top of that the nineteenth-century industries that once gave rise to the emergence of the region disappeared. Coal lost much of his position after the Second World War. Oil and the associated chemical industries seemingly without much effort took over its position in the Ruhr, but also in the transport route from the Ruhr to Rotterdam and the sea. Altough pipelines made the river connection less important. The economic links between Dutch transport and trading centres and its German industrial hinterland recovered each time, and even now this cross-border area from Rotterdam to the German lower Rhine and Ruhr area is characterised by an in Europe unmatched concentration of economic activity and population. The question why and how these cross-border relations survived all external shocks and technological changes in the past century, requires further investigation, but that the tension between path dependence and increasing returns to scale played a major role, seems clear. These concepts can explain that the influence of the historical contingency that is apparently no longer relevant (for example the fact that the largest German coal layers were located near the Dutch border) is still felt. "History matters," two economic geographers wrote in response to such theories.[36] Nevertheless, the exact reasons why these contacts survived the transition from coal to oil, are complex and it is too easy to use container concepts like path dependence and increasing returns. To unwrap these, it is necessary to look into questions like who took the decision, what were the motives, and why did it better work than competiting economic regions.

[1] This text is partly based on: Hein A.M. Klemann, *Waarom bestaat Nederland eigenlijk nog? Nederland-Duitsland: Economische integratie en politieke consequenties 1860-2000* (Rotterdam 2006); Hein A.M. Klemann, Ben Wubs, 'River dependence: Creating a Transnational Rhine Economy, 1850-2000.' In: J.-O. Hesse, Ch. Kleinschmidt, A. Reckendrees and R. Stokes (Eds.), *Perspectives on European Economic and Social History (Economic and Social History of Modern Europe*, 1). (Baden-Baden 2014) 219-245 and Hein A.M. Klemann, Dirk M. Koppenol, 'Port Competition with the Le-Havre-Hamburg range (1850-2013).' In: B. Kuipers, R. Zuidwijk (Eds.), *Smart Port Perspectives. Essays in honor of Hans Smits* (Rotterdam 2013) 63-76.

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[13] V. Kurs, ‚Schiffahrtsstraßen im Deutschen Reich, ihre bisherige und zukünftige Entwicklung und ihre gegenwärtige wirtschaftliche und finanzielle Ausnutzung.' *Jahrbuch für Nationalökonomie und Statistik*, 65, (1895) 641-704, 664.

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[15] Elix, *Echte stukken betreffende de vrije vaart op den Rijn,* xi-xiii. Van Dillen found a conference of the Riparian states in 1699, but he did not mention any sources and I could not find anything about it. Van Dillen*, Van Rijkdom en regenten,* 364.

[16] Schawacht, *Schiffahrt und Güterverkehr,* 17-18.

[17] Meidiger, *Die deutschen Ströme,* 3; Haak/De Savornin Lohman, *Procederen*, 3-4.

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[19] Klemann, Schenk, 'Competition in the Rhine delta,' 838-839.

[20] CBS, *Tweehonderd jaar statistiek in tijdreeksen, 1800-1999* (Voorburg 2001); author's own calculations.

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