

## **Dynamics of overlapping clusters: industrial and institutional revolution in the district of Aachen (Aix-la-Chapelle), 1800-1860.**

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**Draft –please do not quote!**

**Please note that a chapter on cluster theory and a conceptualization of the idea of “overlapping” clusters is missing in the draft. It also lacks a summary.**

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## The dynamics of overlapping clusters: industrial and institutional revolution in the region of Aachen (Aix-la-Chapelle), 1800-1860.

### I. Introduction

In the first half of the 19<sup>th</sup> century, the industrial district of Aachen was a small dynamic economic region in the West of the Prussian Rhineland. It was a leading industrial region in terms of production and a region in which modern economic institutions advanced modern industrial organizations. The regional institutional arrangements were partly based on the French law:<sup>1</sup> During the French Revolutionary Wars, the West of the Rhineland had been a part of France with the region of Aachen (see maps 1 and 2) forming the *Département de la Roer*. After the French defeat in 1814, the Rhineland was integrated as the Rhineprovince into the Prussian State, but with very few exceptions the French legal system continued. The French *code de commerce* rather than the Prussian civil law constructed the norms of business and commercial activities<sup>2</sup> and institutional arrangements that had emerged in the 'French period' continued to influence regional economic development. Not only property rights and civil rights, also other institutions of French origin like chambers of trade and commerce, commercial courts, or collective institutions for the settlement of work related conflicts shaped economic behaviour.<sup>3</sup> New Prussian laws did not dramatically influence regional economic development; only the Railroad Law (1838) and the Prussian Joint Stock Companies Law (*Preußisches Aktiengesetz*) of 1843 had a certain impact. Just like the General German Trade Law (*Allgemeines deutsches Handelsgesetzbuch*) of 1861, the Joint Stock Company Law was based on French ideas and aimed at modernizing the Prussian economy. It perhaps helped developing the eastern parts of Prussia towards a more capitalistic economy; for the region of Aachen it mainly introduced more oversight from the Prussian State. The Prussian integration of the Rhineland did, of course, also induce some economically relevant change; this regards e.g. the introduction of the Prussian currency or the Prussian trade union. These aspects will be discussed later.

In the first half of the 19<sup>th</sup> century, the region of Aachen based on early modern production systems developed towards an industrial district with modern factory production: (1.) Some traditional branches that dominated the regional 17<sup>th</sup> 18<sup>th</sup> century export industries based on artisan workshops and the putting-out system, particularly the woollen cloth industry, transformed to modern industries that organized production in large factories using power engines and machinery. (2.) Also regional coal mining developed to an industrial scale in the 1830s and 1840s. (3) Industrialisation of iron and steel production went hand in hand with a regional concentration of production to the Aachen region, whereas the traditional sites in the hilly Eifel area more distant from coal and from the railway lost its importance. (4.) New industries related to new demand structures such as machinery or railway wagon industries, or related to raw materials like the zinc industry emerged during the 1820s and 1830s respectively.

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<sup>1</sup> Code civile 1804; code de procédure civile 1806; code de commerce 1807; code d'instruction criminelle 1808; code pénal 1810.

<sup>2</sup> Allgemeines Landrecht für die Preußischen Staaten. On the legal institutions in the Rhineprovince and the continuation of French law in the Western part of Prussia see: Conrad, 1969; Faber, 1970; Fehrenbach, 1974; Schuber, 1977; Bernert, 1982; Strauch, 1982.

<sup>3</sup> Reckendrees, 2010a.

Map 1: Prussia. Administrative districts 1850

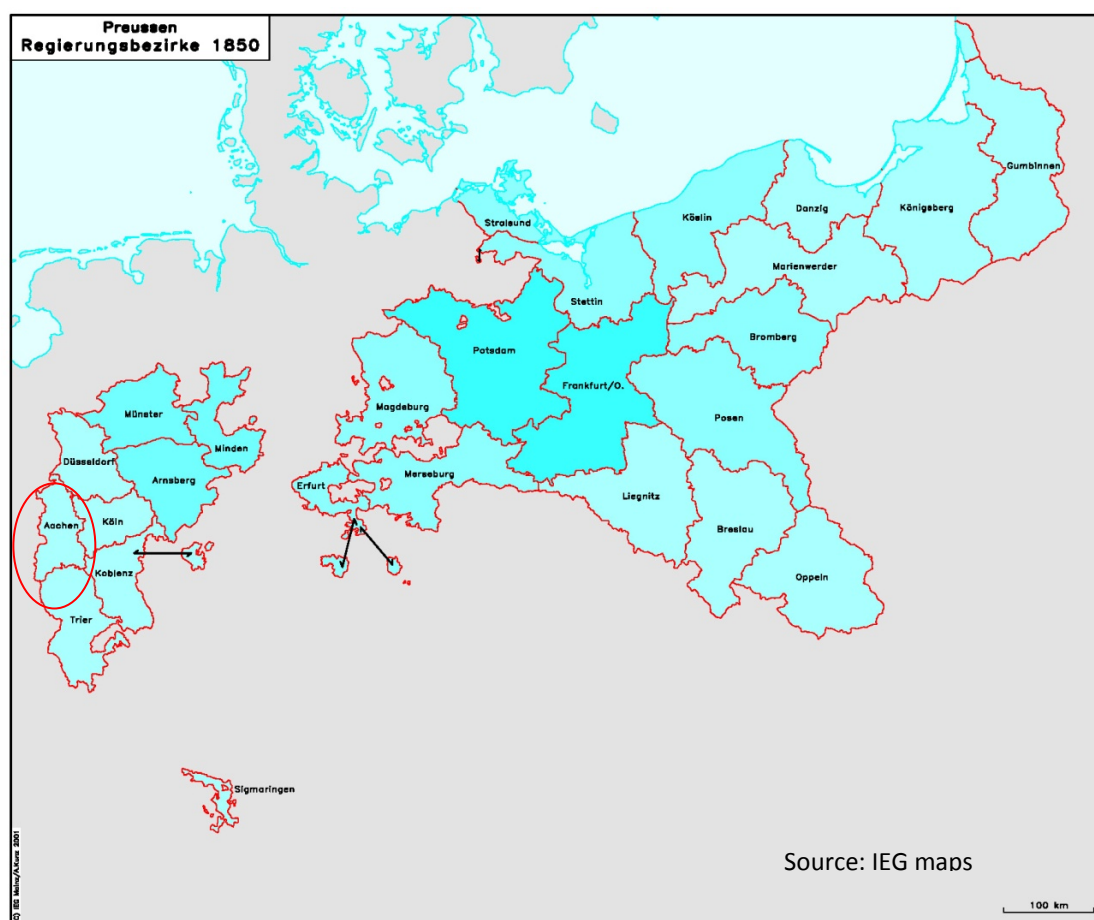


Table 1: Sector employment. Administrative district of Aachen (Regierungsbezirk Aachen), 1861

County	Aachen, city	Aachen, county	Düren	Eupen	Montjoie	Schleiden	Industrial counties	Admin. District total
I. Agriculture	1,7%	18,9%	36,8%	18,1%	41,8%	44,1%		32,3%
<b>II. Industry</b>	<b>66,8%</b>	<b>68,9%</b>	<b>52,6%</b>	<b>70,2%</b>	<b>48,4%</b>	<b>49,8%</b>		<b>52,9%</b>
III. Services	31,5%	12,2%	10,6%	11,7%	9,8%	6,1%		14,8%
Industrial workforce	22.893	21.761	13.465	7.470	4.108	8.164	77.861	103.525
Population	59.941	52.855	58.840	23.750	20.386	40.234	256.006	458.746

Note: mining is calculated as part of "industry". Four agricultural counties are not mentioned.

Population includes non working population.

Sources: own calculation from (Reinick, 1865-1867, vol. I, 152p.).

About 1850s, all the industries of woollen cloth, coal mining, iron and steel, machinery, railway wagons, zinc, lead, glass, paper and needles produced on a large scale using modern factory equipment. Approximately 2/3 of the labour force was working in manufacturing and mining; 50% of them in "large scale" factories with more than 100 employees (see also table 2).<sup>4</sup>

<sup>4</sup> Reckendrees, 2010a: 63; data from 1861.

Map 2: Industrial district of Aachen, counties with a majority of industrial employment



Note: The county of Gemünd became later county of Schleiden.

The economic transition that characterized the process of European industrialisation in the 19<sup>th</sup> century was concentrated on regions rather than on nation states.<sup>5</sup> The Aachen district was a pioneering region on the territory of the German states. A crucial element of the industrialization process was the implementation and diffusion of the factory system; they make the core of this study together with the impact of new institutions such as the joint stock corporation on economic development. The background of this paper is research that focuses on agency and specifically analyses entrepreneurship, firm behaviour, technicians, trade associations, state agencies, and the institutional environment that fostered or hampered economic development.

Cooperation and competition and reciprocal interconnections between firms and between branches shaped the region and its economic dynamics. Until the mid of the 19<sup>th</sup> century a powerful regional industrial district emerged. Investments transgressed the boundaries of industrial branches, which contributed to risk diversification and to the development of new industries. An important feature of the regional production system was knowledge spill-over and knowledge transfer between firms and between branches, nevertheless the firms and industry continued to compete on the markets and also on labour and capital.

I will continue in chapter two with an overview of the development of the industrial structure of the district with a specific focus on three major industries: (1.) the woollen cloth industry as the example for a successful transition of a traditional artisan production and putting-out system to an industrial production system; (2.) coal mining that experienced an industrial reorganisation based on ideas of rationalization and economies of scale; (3.) iron and steel. The

<sup>5</sup> Pollard, 1981, 45-219.

developments in coal and iron and steel will be only briefly sketched because they are also dealt with in the third chapter, which describes the interconnections of the industries in regard to technology and technological expertise that circulated between industries, raw materials (especially coal), the new railway system, corporate finance, and organisational and commercial know-how. The final provides a summarizing discussion and elaborates on some of the reasons for the relative decline of the region from the 1860s onwards.

A comprehensive economic history of the region does not yet exist.<sup>6</sup> I mainly refer to own papers on the woollen cloth industry and on coal mining<sup>7</sup> and two recent articles on institutional change.<sup>8</sup> In order to keep the paper brief, archival material is only referred to if it concerns quotes and data.

## **II. The industrial district**

Expressed in abstract economic terms, the district combined characteristics of the so-called Marshall-Arrow-Romer externalities, which are produced and consumed in a given sector, and characteristics of Jacobs' externalities, which are defined as flows between firms in all sectors.<sup>9</sup> This paper argues that the reciprocal linkages between the different industries (regarding technology, ownership, and governance) were facilitated by specific institutional arrangements that have been crucial for the dynamic regional economic development. Each sector had, of course, specific dynamics in terms of competition and new, production cost reducing technology. Yet regional development was based on knowledge sharing across the branches and cross-industry cooperation as entrepreneurs from 'old industries' strategically diversified their investments into new industrial sectors. Private Banks helped financing the development, just like the universal banks did in the last quarter of the 19th century during the German second industrial revolution.

In the analytical framework of this study a region is an economic entity, rather than a political territory. Thus the region has been constructed in terms of economic activities based on criteria like the level of industrial and factory employment or the use of power engines.<sup>10</sup> Yet the border between Prussia and the Low Countries (and later Belgium) has been accounted for. One could take a different view and also include the Belgian district of Vervier with its cloth industry, the mining region in Southern Limburg (Low Countries) that is part of the same geological structures as the mining region close to Aachen ('Wurm' and 'Inde'), or the iron and steel industry in the west of Liège. A closer look at the economic activities shows however that after the Rhineprovince became Prussian, the connections across the border within and industry were less important for economic development than the newly constructed borderlines and tariffs between the two territories. This holds true for the woollen cloth industry, coal mining, and also iron and steel. The new border and the respective tariffs hindered the exchange across the border regarding raw materials, fabricated goods, and also labour. The bor-

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<sup>6</sup> For a brief outline see: Eyll, 1980.

<sup>7</sup> The manuscripts are available from the author Reckendrees, 2006; Reckendrees, 2010b; Reckendrees, 2011.

<sup>8</sup> Reckendrees, 2010a; Reckendrees, 2012, forthcoming.

<sup>9</sup> Capello, 2002.

<sup>10</sup> See Fremdling et al., 1979; Banken, 2000, on the method to construct economic regions

der had an economically paradox function in that it connected independently developing regions more strongly than without such a border.<sup>11</sup> The tariff border, for example, incentivised Belgian investments to the Aachen district (see below).

Table 2: Employment in major industries. Administrative region of Aachen, 1861

	In percent of employees	
<b>Artisans, total</b>	<b>33.517</b>	39,5%
<b>A. Handicraft, local markets</b>	<b>22.983</b>	27,1%
Artisans	15.095	
Journey men	7.888	
Apprentices	2.900	
<b>B. Factory related textile artisans</b>	<b>10.534</b>	12,4%
Artisan weavers	4.080	
Journey men and apprentices	6.454	
<b>C. "Industry"</b>	<b>51.393</b>	60,5%
Employees in total (including management)	<b>84.910</b>	100,0%
<b>I. Mining</b>	<b>9.856</b>	
Coal mining	4.951 #	5,8%
Lead ore mining	3.084 #	3,6%
Zinc ore mining	777 #	0,9%
Iron ore mining	823 #	1,0%
<b>II. Metal production</b>	<b>4.028</b>	
Iron works	818 #	1,0%
Bar iron/steel factories	1.914 #	2,3%
Wire factories	146 #	0,2%
Zinc industry	561 #	0,7%
Lead industry	412 #	0,5%
Brass industry	94 #	0,1%
<b>III. Spinning</b>	<b>4.242</b>	*
Woollen yarn	3.285 #	* 3,9%
<b>IV. Weaving</b>	<b>13.541</b>	*
Woollen cloth industry (vertically integrated)	12.528 #	* 14,8%
<b>V. Bleaching, dye works etc.</b>	<b>495</b>	# * 0,6%
<b>VI. Metal products</b>	<b>6.139</b>	*
Needles industry	2.151 #	* 2,5%
Iron goods	1.890 #	* 2,2%
Machine industry	955 #	* 1,1%
Iron foundries	302 #	* 0,4%
Railway wagon industry	394 #	* 0,5%
Carding industry	236 #	* 0,3%
<b>VI. Minerals</b>	<b>6.152</b>	*
Coke	199 #	* 0,2%
Glass industry	362 #	* 0,4%
Mirror glass factory	463 #	* 0,5%
<b>VIII. Processing of plants and animals for trade</b>	<b>2.533</b>	*
<b>IX. Wooden goods, paper, dry goods</b>	<b>1.742</b>	*
Paper factories	1.567 #	* 1,8%
<b>X. "Foodstuff"</b>	<b>2.292</b>	*
Tobacco factories	1.246 #	* 1,5%
<b>XI. different trades</b>	<b>373</b>	*
	<b>39.158 #</b>	46,1%

\* = including management

# = large industries and factory production

Sources: own calculation from (Reinick, 1865-1867, vol. I, 152p.).

<sup>11</sup> On the border paradox, see Knotter, o.J.

In the region of Aachen very different industries like woollen cloth, needles, cards, copper, paper, glass, coal mining, iron ore mining, zinc and lead mining, iron and steel, iron goods, steel products, zinc, lead, machinery, boiler construction, wagon, tobacco, and also banking and insurances were involved in the process of economic development (see table 2). In most of these industries the district belonged to the technologically leading regions in Europe until approximately 1860. Nevertheless, we do find pioneers and laggards, and we do find dynamic and rewarding as well as stagnating branches that only have been important for the region.

The scope of this paper does not allow for an analysis of all industrial branches and it thus predominantly focuses on the three large industries of woollen cloth, coal mining, and iron and steel, and the interconnections between these industries; firms from other industries were also involved in the respective processes, but they will not be analysed specifically. Most of the regional industries lost their pioneering role in the 1860s due to the improved transportation system that had a negative impact on the Aachen district as it increased its relative distance to the markets, due to new raw materials (especially the large coal fields at the Ruhr), and due to the limited size of the region. Regional entrepreneurs more and more invested outside of the Aachen district, in Germany and internationally, which will be discussed in the final part of this paper.

### *(1.) Woollen cloth<sup>12</sup>*

In the course of the 18<sup>th</sup> century the region of Aachen had become the dominant woollen cloth region in the German cloth trade,<sup>13</sup> and in the early 19<sup>th</sup> century it pioneered the introduction of spinning and carding machines in the woollen cloth industry. The industry was based on the availability of lime-free water that was indispensable for the finest cloth qualities, the typical product of the Aachen region; furthermore the warm springs close to Aachen provided excellent means for finishing and dyeing the cloth. Pre-industrial production was organised as a combination of artisan production and a putting-out system. The putting-out system with domestic spinning and weaving had been established at the end of the 17<sup>th</sup> century in the gild-free towns of Eupen, Montjoie, Burtscheid, and Vaals. In the traditional regional cloth centres, the cities of Aachen and Düren, the cloth-maker and shearers guilds could maintain artisan manufacturing. In Aachen, however, artisan workshops were also integrated in putting-out systems; and especially for spinning artisan workshops employed domestic labour as well as journeymen and apprentices.<sup>14</sup>

The regional production system changed dramatically in the first two decades of the 19<sup>th</sup> century. About 1830, the large clothiers in Aachen, Burtscheid, Düren, and Eupen controlling the larger part of the regional cloth production operated centralised factories and they owned vertically integrated firms. Power machines drove all kinds of machinery (scribbling, carding,

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<sup>12</sup> For more details on the cloth industry see: Reckendrees, 2010b.

<sup>13</sup> Viebahn, 1846: 37; Viebahn, 1868: 915.

<sup>14</sup> Reckendrees, 2006: 15-17. On pre-modern period: Ebeling, 1997; Pfister, 2004; Anonymus, 1788; Anonymus, 1796; Anonymus, 2000; Barkhausen, 1925; Fehr, 1927; Hammer, 1937; Heizmann, 1923; Henkel, 1989; Hermanns, 1982; Kisch, 1964; Kisch, 1981; Kley, 1916; Macco, 1911; Müller, 1982; Müller, 1992/93; Müller, 1998; Schmidt, 1997; Schmidt, 2004; Schollen, 1911; Schoop, 1920; Schoop, 1923; Schulte-Krumpen, 1922; Seidl, 1923; Weingarten, 1922; Winzen, 1994; Schoeller, 1894.

slubbing or roving, spinning, raising, shearing, fulling, pressing etc.). Only weaving was slowly mechanized; until the turn of the century factory workshops were also operating hand-loom, and domestic weaving was still important in the early 20<sup>th</sup> century.<sup>15</sup> One of the crucial differences compared to English cloth districts, where early spinning machines were used in the cottage industry,<sup>16</sup> is that in Aachen scribbling, carding, and spinning machines were introduced together and in factory establishments (table 3).<sup>17</sup>

Table 3: Early scribbling and carding machines, Aachen region (incomplete), 1809-19

		scribbling machines	carding machines	billies*	jennies*	
1809	J.H. Scheibler, Ronstorff, Rahlenbeck & Co.	Montjoie	3	3	3	12
1809	M.P.W. Troisdorff	Montjoie	4	4	4	16
1809	Bernhard Scheibler	Montjoie	8	8	8	32
1809	Ignace van Houtem	Aachen	5	5	5	20
1809	Pranghe Hompt	Aachen	5	5	5	20
1809	Ph.H. Pastor	Burtscheid	4	4	4	16
1809	Edmund Jos. Kelleter	Aachen	2	2	2	8
1809	Brass frères	Aachen	2	2	2	8
1809	Fey frères	Aachen	2	2	2	8
1816	Scheibler & Lenzmann	Montjoie	4	4	4	21
1816	Troistorff, M.L.W.	Montjoie	4	4	4	22
1819	H. von Fisenne	Aachen	9	9	9	36

\* some of the billies and jennies are estimated on the general information about "assortimente"

Note: '1809' indicates that the machines were existing in 1809, the implementation date is unknown.

Sources: Reckendrees, 2006, table 3.

Within a few years the factories erased home spinning and mechanisation was extended to raising and shearing and to the finishing process, resulting in integrated firms that controlled more or less the whole process of cloth production.<sup>18</sup> This dominant system may be called the 'cloth factory system'; it consisted of firms that vertically integrated more or less all stages of production from scouring the wool to finishing and selling the cloth.<sup>19</sup> Vertical integration into one firm does however not mean centralised production in a single establishment. Fulling, for example, required much water and thus the mills were usually established on small rivers; dyeing mills were usually operating outside of the towns because of water pollution. Some cloth industrialists in Aachen possessed scribbling and fulling mills outside of the town, yet they integrated all stages of production into one firm.<sup>20</sup>

The efficient exploitation of spinning and finishing machinery required power engines, steam engines, water wheels or, some years later, water turbines; it depended on resources (water and coal), on institutional arrangements (accession rights), and on the transportation system. Therefore, different patterns emerged within the cloth region. In the towns and counties of Aachen and Düren water was no sufficient power source for the developing industry; further-

<sup>15</sup> Reckendrees, 2006: 19-30.

<sup>16</sup> Hudson, 1975; Hudson, 1986.

<sup>17</sup> On technology used and the diffusion of machinery from England via Belgium to Aachen, see Reckendrees, 2006; Reckendrees, 2009.

<sup>18</sup> See table 5 below and Reckendrees, 2006, table 4 on the 1820s.

<sup>19</sup> Machines were yet not used for all purposes, especially the early models did not allow for finishing fine or superfine cloth. Even when cylinder shearing machines had been introduced and various improvements had been made shearing by hand predominated the production of the top qualities.

<sup>20</sup> Reckendrees, 2006: 22.



more, accession rights were limited and there was an increasing competition on the use of water with other branches and the citizens of the towns. Steam engines provided a more flexible source of power that did not depend so much on location factors as water wheels. They also freed production from climatic uncertainties and allowed for a more continuous utilisation of capital and thus for increases in production.

**Table 4: Steam engines in the woollen cloth factories, cloth region Aix-la-Chapelle, 1830**

	registration	pressure high	low	h.p.	use of the machine, as mentioned
<b>Aachen</b>					
E. J. Kelleter	1817		1	16	cloth factory
E. J. Kelleter	1821/22		1	20	cloth factory and heating
Wagner & Sohn	1822		1	18	gig mills and shearing machines
Gotthard Startz	1822		1	15	spinning sets, fulling mill, gig mills, shearing
Gotthard Startz	1830	1		20	spinning sets, fulling mill, gig mills, shearing
Arnold Dedem	1825		1	18	gig mills and shearing machines
Regnier Poncelet & Desoer	1825		1	8	gig mills
J.M. Nellessen*	1826*		x*	12	
J.M. Nellessen	1828	1		20	cloth factory
J.M. Nellessen	1829			18	spinning sets, washing machines, fulling mill, gig mills, shearing machines
Jos. Math. v. Hoselt	1827		1	10	spinning sets, gig mills, shearing machines
Carl Degive	1829	1		16	spinning sets, washing machines, fulling mill, gig mills, shearing machines
Wwe. Hartogs & Comp.	1830		1	8	cloth factory
Jos. Wilh. Ibels			1	10	gig mills and shearing machines
Geschwister Lennartz			1	10	gig mills and shearing machines
van Gölpen & Kesselkaul	1827		1	12	spinning sets, gig mills, shearing machines
Wittwe Collins*	1830		x*	24	
Ignaz van Houten*	1830		x*	24	
<b>total</b>	<b>14</b>	<b>3</b>	<b>11</b>	<b>219</b>	
<b>Aachen, county</b>					
Wwe. Conrad Pastor, Burtscheid			1	4	woollen yarn spinning
Wwe. Erkens, Burtscheid		1		4	woollen yarn spinning, shearing machines
Wwe. Wilh. Pastor, Burtscheid			1	4	woollen yarn spinning
Jos. Ruland, Burtscheid		1		12	woollen yarn spinning
von Guaita Erben, Laurensberg		1		7	woollen yarn spinning
Offermann & Söhne, Stolberg			1	5	woollen yarn spinning
<b>total</b>	<b>6</b>	<b>3</b>	<b>3</b>	<b>36</b>	
<b>Düren, county</b>					
Schöller Söhne, Düren			1	8	cloth factory, only during water shortages
Ludwig Peil, Birkesdorf		1		18	spinning sets, gig mills, shearing machines
Joh. Peter Schöller, Schönwald			1	10	woollen yarn spinning, shearing machines
Joh. Peter Schöller, Wiesenau			1	15	fulling mill and gig mill
<b>total</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>51</b>	
<b>Eupen, county</b>					
And. Jos. Grand'Ry, Langerthal			1	10	spinning sets, gig mills, shearing machines
Joh. Homberg			1	3	gig mills and shearing machines
Hüffer & Morkramer, Oede			1	10	gig mills and shearing machines
Bernh. Georg von Scheibler			1	10	woollen yarn spinning
Gustav von Scheibler			1	6	woollen yarn spinning
Joh. Christ. Stollé			1	10	spinning sets, gig mills, shearing machines
<b>total</b>	<b>6</b>		<b>6</b>	<b>49</b>	
<b>Montjoie, district</b>					
Voell & Comp., Imgenbroich			1	8	gig mills and shearing machines
<b>total</b>	<b>1</b>	<b>1</b>		<b>8</b>	
<b>Steam engines in the administrative district Aachen</b>					
Woollen cloth industry	<b>31</b>	<b>8</b>	<b>23</b>	<b>362</b>	
Machine manufacturing	<b>2</b>	<b>1</b>	<b>1</b>	<b>12</b>	
Coal mining	<b>28</b>	<b>8</b>	<b>20</b>	<b>735</b>	
	<b>61</b>	<b>17</b>	<b>44</b>	<b>1109</b>	
<i>Prussia, textile industries</i>	<i>79</i>				
<i>Prussia, total</i>	<i>231</i>			<i>3670</i>	

Source: Reckendrees, 2006, table 7.

From 1815 onwards, the regional cloth industrialists increasingly operated steam engines, even if they owned water wheels and accession rights. In later decades a substitution for more powerful and especially more efficient machines can be observed.<sup>21</sup>

In the German context, the woollen cloth industry of Aachen pioneered the implementation of the steam engine into factory production. Table 4 provides more detailed information about the use of steam engines and shows that the regional cloth industry housed about 40% of all steam engines in the Prussian textile industries.<sup>22</sup> New machinery increased labour productivity and reduced production costs dramatically. Both effects can only be estimated, yet it seems as if spinning, scribbling, carding machines, and the gig mill increased increase in labour productivity by about 50%.<sup>23</sup>

As has been mentioned before, power looms were not introduced early; they counted only 380 in 1858. Only two industrialists opted for a relevant number of power looms (85 and 53, respectively).<sup>24</sup> The reluctant implementation of new weaving technology was an economically 'rational' decision as adapting the power loom to fine-cloth weaving was a difficult task; and if there were any productivity gains for the production of fine broadcloth, they were small;<sup>25</sup> because of the weavers' higher qualification wage expenses did not seriously decrease and investment costs were high. The incentives for new investments were thus very weak.

Nevertheless, the size of the integrated firms increased steadily. Unfortunately, the statistics are not fully reliable and partly contradicting. The figures of the following brief overview stem from a sample constructed by the Aachen county administrator and chief director of police (table 5).<sup>26</sup> They are used due to lacking alternative comprehensive data. Around 1850, 19 cloth factories in the city of Aachen employed more than 8.200 workers of which 13% had been children. 1.150 workers were occupied in spinning and wool preparation. It is unknown how many of the weavers were domestic workers. Assuming that the number of factories employees is overestimated by 30%, the 19 factories did employ 5.750 employees in their establishments: Thus the average size of cloth factory might have been 300 workers.

The level of vertical integration, the size of the factories, and the average number of employees indicates that by 1850 the transition from commercial to industrial capitalism was accomplished. Yet in some of cloth producing areas specific patterns had evolved: There was, for example, a larger share of specialised spinning factories and finishing firms in Burtscheid and in Eupen and a lower share of vertically integrated producers.<sup>27</sup>

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<sup>21</sup> Reckendrees, 2006, table 6.

<sup>22</sup> In fact, these figures demonstrate the general backwardness of the Prussian industry.

<sup>23</sup> Reckendrees, 2006: 29.

<sup>24</sup> Düsseldorf State Archives (HSAD) BR 2116-55: Gewerbetabelle der Fabrikations-Anstalten und Fabrik-Unternehmungen aller Art des Regierungs-Bezirks Aachen für das Jahr 1858. HSAD BR 2116-53: Spezielle Nachweisung der in der Gewerbe-Tabelle der Fabrikations-Anstalten und Fabrik-Unternehmungen aller Art des [Regierungs-Bezirks Aachen] für das Jahr 1858 angegebenen Fabriken und Anstalten, welche jede mehr als 50 Arbeiter beschäftigt.

<sup>25</sup> See also Schmoller, 1870: 496.

<sup>26</sup> Reckendrees, 2006: 33; HSAD BR 2116-48: Gewerbetabelle der Fabrikations-Anstalten und Fabrik-Unternehmungen aller Art des Regierungs-Bezirks Aachen für das Jahr 1849, f. 319pp.

<sup>27</sup> HSAD BR 2116-49: Nachweisung derjenigen Fabrikationszweige, welche zusammen eine Anstalt bilden, in der Gewerbe-Tabelle [...] für das Jahr 1849 aber in verschiedene Kolumnen vertheilt sind; HSAD BR 2116-48: Gewerbe-Tabelle der Fabrikations-Anstalten und Fabrik-Unternehmungen aller Art [...] 1849, f. 180pp., f. 209pp.

Table 5: Cloth factories in Aachen (city), 1849

Factory owner	stages of production	ordinarily employed workforce				total	looms, steam engines, water mills
		< 14		> 14			
		male	femal	male	femal		
Nellessen, J.M. Sohn	spinning, weaving, fulling, dyeing	135	86	1.165	369	1.755	2 steam engines 3 water mills spinning and fulling, 1410 looms
Thywissen, Gebrüder	spinning, weaving, fulling	28	16	175	69	288	1 steam engines 1 water mill spinning and fulling 90 looms
Kesselkaul, Jos.	spinning, weaving, fulling, dyeing	45	30	585	165	825	2 steam engines, gas machine 200 looms
Wagner	spinning, weaving, fulling, dyeing	23	18	189	59	289	1 steam engine 80 looms
Van Houtem, Ignatz	spinning, weaving, fulling	18	10	45	20	93	1 steam engine 1 water mill for spinning 25 looms
Visseur	spinning, weaving, fulling	36	21	298	146	501	2 steam engines 120 looms
Hochs, Friedr.	spinning, weaving, fulling, dyeing	25	14	168	85	292	1 steam engine 70 looms
Kuetgens, P.	spinning, weaving, fulling, dyeing	70	45	395	160	670	1 water mill spinning and fulling 160 looms
Startz, G.	spinning, weaving, fulling, dyeing	10	6	55	60	131	1 water mill spinning and fulling 1 steam engine 25 looms
Lingens	spinning, weaving, fulling, dyeing	44	31	320	116	511	1 water mill spinning and fulling 121 looms
Bischoff	spinning, weaving, fulling, dyeing	45	26	325	145	541	2 steam engine 125 looms
Knops	spinning, weaving	25	18	205	80	328	1 steam engine 93 looms
Deutz u. Bündgens	spinning, weaving	24	15	235	99	373	1 water mill spinning and fulling 100 looms
Deden, Arnold	spinning, weaving, fulling, dyeing	65	45	581	289	980	1 water mill spinning and fulling 2 steam engine 215 looms
van Gülpen	spinning, weaving, fulling	40	18	180	62	300	1 steam engine, gas machine 80 looms
Mara u. Lippmann	spinning, weaving, fulling, dyeing	10	8	98	32	148	1 water mill spinning and fulling 1 steam engine 70 looms
Jungbluth	spinning, weaving	4		30	41	75	1 water mill 30 looms
Mallinkrodt	spinning, weaving	5		65	18	88	1 steam engine 40 looms
Lob	spinning, weaving	2		30	4	36	1 steam engine 15 looms
<b>totals</b>	<b>19 firms</b>	<b>654</b>	<b>407</b>	<b>5.144</b>	<b>2.019</b>	<b>8.224</b>	
<b>average</b>	<b>steam engines</b>	<b>water mills</b>		<b>looms</b>		<b>workforce</b>	
	<b>1</b>	<b>0,5</b>		<b>110</b>		<b>433</b>	

Source: Reckendrees, 2006, table 7.

In Montjoie, the putting-out system with centralised dressing workshops survived until the 1860s, when the local cloth industry finally collapsed. These diverging local patterns can be explained by two factors: (1.) the local labour markets; Eupen and Montjoie did offer alternatives to the textile industry for wage labourers, whereas various alternatives existed in Aachen (e.g. for qualified workers in machine factories, for unqualified workers in mining or in the steel industry, for children and young women in tobacco manufactures); (2.) the railway between Antwerp and Cologne with a station in Aachen, but not in Eupen or Montjoie, changed

relative transportation costs dramatically; the farther away from the railway the more difficult was it for the industries to survive. These ideas will be further developed in the following chapters.

Due to lack of sufficiently detailed information like commercial correspondence and letters of the entrepreneurs, it is almost impossible to reconstruct how competition and cooperation in the cloth cluster worked. Yet it can be shown that institutions like the Chamber of Commerce contributed to knowledge distribution among industrialists; its library provided f.e. newspapers and business journals. Also social places should not be underestimated, like the Aachen-Casino Society (*Casino-Gesellschaft*) with its own library also providing newspapers and business journals; it was also a place to arrange marriages; at least marriages were often concluded among families that had access to the Casino-Society.<sup>28</sup> The Chamber of Commerce and the local government also distributed blueprints of new machines and they established contacts to a national agency for industrial knowledge development (*Gewerbeinstitut zu Berlin*)<sup>29</sup>. The relevance of state institutions should however not be overestimated, as industrialists were often reluctant to accept the conditions of the *Gewerbeinstitut*. It, for instance, required that new machines provided to the cloth producers (especially models from France and the United States of North America) should be accessible for the other cloth producers. The documented cases<sup>30</sup> show that industrialists did not always want to share detailed information about their processes. – They also collaborated, which will be shown in more detail in chapter III, but this collaboration did not regard cloth production, it rather concerned new industries.

In the two other large industries of the 17<sup>th</sup> and 18<sup>th</sup> centuries, needle making and copper and brass production, ‘industrialization’ started later (in needle production) or it lagged much behind (in copper and brass). The specific reasons for the respective differences cannot be discussed here; the paper rather focuses on other industries, coal mining and iron and steel that were as important as the woollen cloth industry.

## (2.) Coal mining

The two mining areas of the region, the *Inderegion* (Inde-Revier) and the *Wurmregion* (Wurm-Revier), produced mineral coal since the 13<sup>th</sup> century, and coal mining ‘industrialized’ in the early 19<sup>th</sup> century. Until then the production systems in the two areas had differed greatly.<sup>31</sup>

(1.) The small mining district of the *Wurmregion* touched five different states with different legal systems; ownership was thus much dispersed and the mines in general smaller and less productive than in the neighbouring *Inderegion*. (2.) Due to geological reasons and due to complex property rights because of the different legal systems water handling was more difficult in the *Wurm* than in the *Inderegion*; nevertheless, a few larger mines had already in the

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<sup>28</sup> Reckendrees, 2010a: 58pp.; Sobania, 1991; Thomes, 2004.

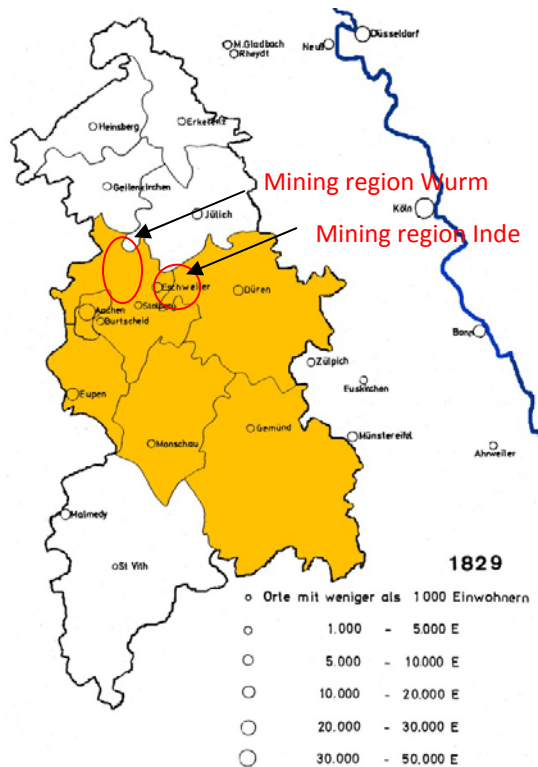
<sup>29</sup> See: Mieck, 1965.

<sup>30</sup> HSAD Reg. Aachen 1636, different cases.

<sup>31</sup> For a detailed description of pre-industrial regional coal mining see: Reckendrees, 2011: 4-32.

17<sup>th</sup> and 18<sup>th</sup> century established sophisticated water pumping systems. And (3.), the products differed: anthracite coal in the *Wurmregion* and bituminous coal in *Inderegion*.<sup>32</sup>

Map 3: Industrial district of Aachen, coal mining areas (approximately)



On the *Inde*,<sup>33</sup> the Duke of Jülich owned the coal fields and his administration organised mining by renting out the extraction of mineral coal. When coalmining required deeper pits and more sophisticated water handling systems in the second half of the 18<sup>th</sup> century, a consortium achieved the extraction rights of most of the mines, which allowed for a more economical production. Over time the Wültgens-Englerth family concentrated most of the property rights; and with the French government after 1798, the family was able to contract a long term leasing agreement of 50 years. In 1810, due to a new French mining law, the two most important mines became private property.<sup>34</sup> The institutional arrangements of the 18<sup>th</sup> century and the further institutional development in the early 19<sup>th</sup> century resulted in a consolidation of the mines, in a relatively early capitalist entrepreneurship with long-term large scale investments in the *Inderegion*.

In the *Wurmregion* major transitions in the industry took place in the late 1810s and 1820s. They can be regarded technology driven. Modern steam engines were introduced in all the mines; they allowed for more continuous and safer production; they also increased water handling capacities so that water pumping systems of different mines were connected to each other. A second transition took place in the 1830s, which is related to ownership concentration

<sup>32</sup> For more details and literature Reckendrees, 2011: 18-23; see also Wiesemann, 1995: passim; Schunder, 1968: passim; Hinzen, 1929, Willms, 1923, 86f.

<sup>33</sup> Reckendrees, 2011: 13-18; see also: Schunder, 1968: 26-31; Büttgenbach, 1898b, Büttgenbach, 1898a; Stegemann, 1910b: 354pp.; Wiesemann, 1995: passim.

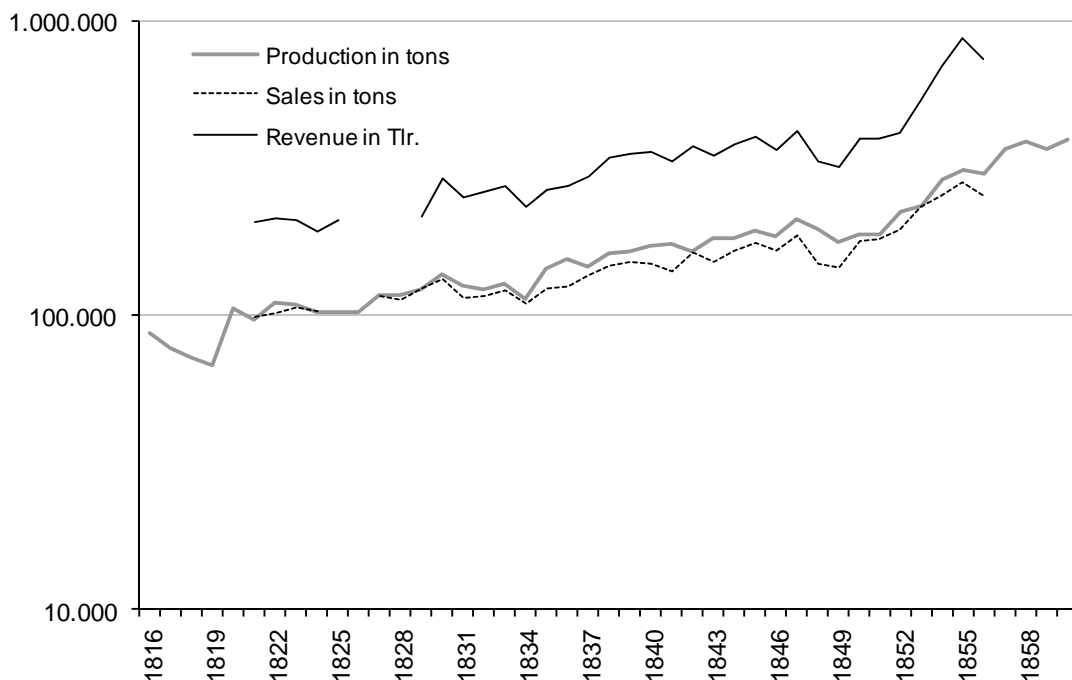
<sup>34</sup> Reckendrees, 2011: 108pp.; Stegemann, 1910a, 14f.

that allowed for a rationalization of production. [This argument is developed below as it is connected to the institution of the joint stock companies and the ownership concentration involved capital investments across the different industries of the industrial district.]

Both mining regions, the *Wurm* and the *Inde*, prospered during the 1840s and especially in the 1850s with increasing industrial demand for coal and with railway access to more distant markets. However, the railway also allowed the competitors from the Ruhr mining district to expand their markets – and over time the disputed markets were even closer the *Wurm*- and *Indere* region than before.

For the *Wurm* region production and sales data (figure 1, below) shows an upward but volatile development between 1820 and 1835, before the foundation of the consolidated joint stock company *Vereinigungs-Gesellschaft für den Steinkohlenbau im Wurmrevier* (see below). The concentration of a large number of the mines, however, allowed for a rationalization of production, this went hand in hand with increases in production and sales, and also with increasing profitability only interrupted by the years following the economic crisis of 1847 and the revolutionary conflicts of 1848.

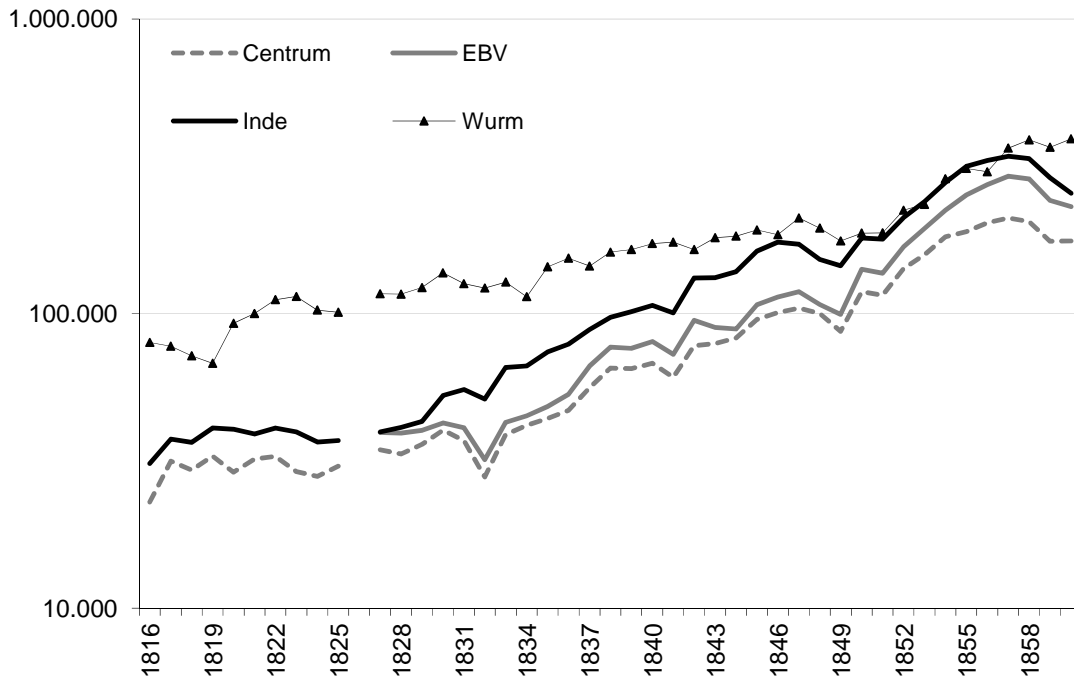
Figure 1: Wurm. Production (metric tons, log.), sales (metric tons, log.), revenue (Prussian Thaler, log.), 1814-60



The coal mines in the *Indere* region owned by the *EBV* (*Eschweiler Bergwerksverein; Eschweiler Mining Company*) and the largest mine of this company, *Centrum*, performed relatively better from the late 1820s onwards (figure 2). This is not related to the briefly described differences of the institutional arrangements of the 18<sup>th</sup> century or to the concentration of ownership in the *Indere* region, which might have played a role as well. The basic reason for the higher performance of the mines in the *Indere* region was its specific product, bituminous coal. At that time, anthracite coal (the product of the *Wurm* region) was a preferred coal for household consumption; bituminous coal was rather used by industrial producers (steam engines, puddling works, glass- and zinc production etc.). Thus, from the late 1820s onwards with increasing mechanical

production (see e.g. above on the use of steam engines in the woollen cloth industry) the market for coal from the *Inderegion* grew much faster than the market for the anthracite coal from the *Wurmregion*. This changed in the 1850s when steam engines and other production units were adjusted to anthracite coal.

Figure 2: Inde and Wurm. Production (metric tons, log) 1814-60



Sources for fig. 1 and 2: Reckendrees, 2011: 38, 116, 181, 187. Detailed description of the data: *ibid.* 167-173.

### (3.) Iron and steel

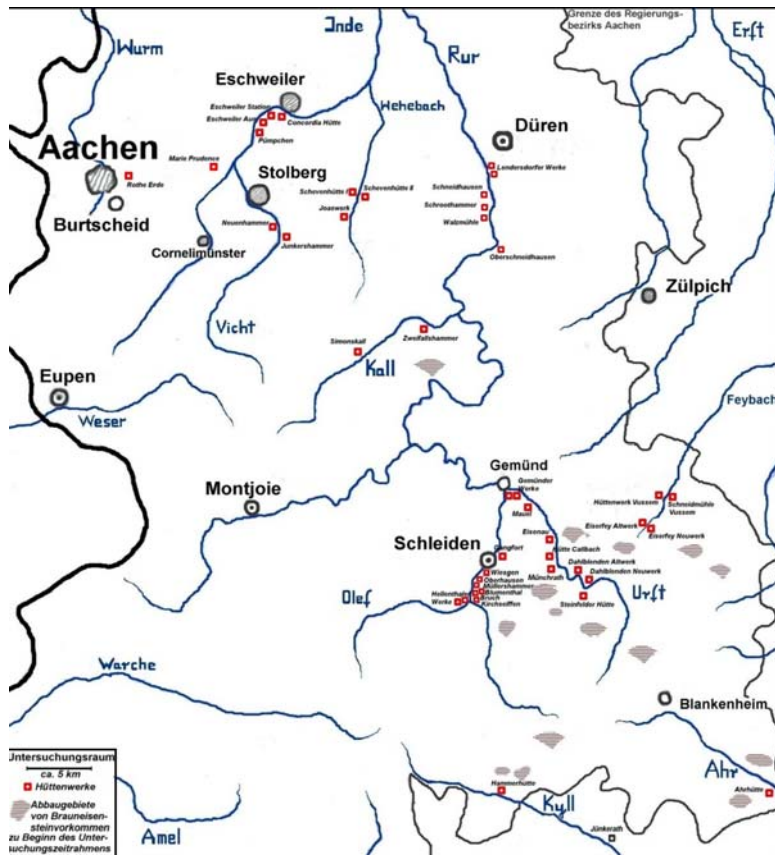
The major developments in iron and steel are only briefly described here. The literature<sup>35</sup> does not provide comprehensive reliable data and my own data construction is not yet completed.<sup>36</sup> The presented arguments are based on reconstructions from plant level information, but this is not fully reliable: (1) some reports obviously reported capacities rather than production; (2) double counting of pig iron, cast iron, or wrought iron cannot always be excluded; (3) weight specifications differ and are not always clear; (4) price information is often summarized and given as a range of prices (e.g. 24-28 Thaler). Thus reliable estimates are difficult to undertake and are still in work. The tendencies of the development in the regional iron and steel industry are however quite clear.

<sup>35</sup> The best overview can be found in the unpublished doctoral thesis Schainberg, 2004/1997 (available online); on the Eifel region Bömmels, 1925; Neu, 1989.

<sup>36</sup> The regional industrial district did not overlap with the administrative units of the Mining Authority ("Oberbergamt Bonn") that did the iron statistics as well. The aggregate data cannot be used as the Mining Authority was also responsible for more Western and more Southern mining districts. The industrial district of Aachen corresponds to the so-called "Bergamt Düren" consisting of four mining regions: Inderevier, Wurmrevier, Bergrevier Gemünd/Schleiden, and Bleiberger Revier; the latter however extended the industrial district in the west. Original statistics for the four regions is not completely extant; some annual reports are missing; and due to changing borders of the respective regions and the whole administrative district of the Mining Authority, any estimate of production requires detailed information on plant level.

Up until the 1850s the major regional production of pig iron was situated in the Eifel close to the country cities of Gemünd and Schleiden, the traditional area of blast furnaces (see map 4).

Map 4: Industrial district of Aachen. Location of iron and steel production, 1850s



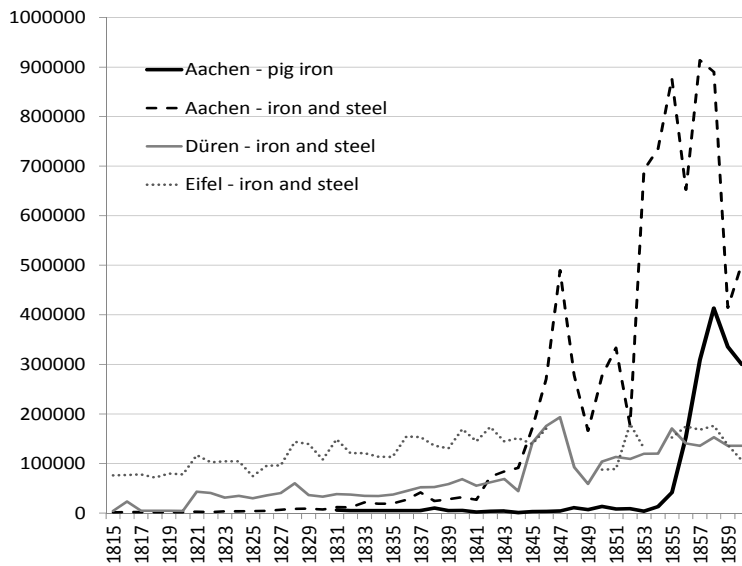
Source: Annuschat, 2007.

Its importance for the production of wrought iron however relatively declined for three reasons from the mid 1820s onwards: first, the implementation of the puddling process at the Hoesch plants close to Düren (Lendersdorf); with the decision to build the Rhenish railway (between Cologne and Antwerp, see below) new puddling works and rolling mills were setup in the Eschweiler valley on top of the coal and with direct access to the railway (puddlingworks and rolling mills “Eschweiler-Aue”; rolling mill and hammer works “Rothe Erde”, puddling works and rolling mills “Eschweiler Station”); and third, with the new railway the works around Eschweiler and Düren increasingly imported pig iron from Belgium<sup>37</sup> due to lower transportation costs compared to supply from the production sites in the Eifel. Finally, in the 1850s new blast furnaces based on coke iron were setup between Stolberg and Eschweiler on the coal from the Inderevier. From then on traditional charcoal iron production in the Eifel contributed only marginal quantities of special quality iron. It did not fully decline, but it did not grow (figure 3, below).

<sup>37</sup> Fremdling, 1986: 134; Schainberg, 2004/1997. On the iron industry in Belgium and Liège see: Fremdling and Gales, 1994; Pasleau, 1993; Leboutte, 1988.



Figure 3: Industrial district of Aachen. Estimate of iron and steel production 1815-60  
(I. Aachen-Stolberg-Eschweiler; II. Düren; III. Eifel)



Source: own date collection not yet fully consolidated.

The development of the modern iron and steel industry was thus in its early beginning in the 1820s technologically driven. This concerns especially the technology transfer of the puddling process (1825) and new rolling mills, both were dependent on foreign experts (see below on Samuel Dobbs).<sup>38</sup>

During the 1840s, the development is better described as a demand driven process. Eberhard Hoesch for example, the owner of the Hoesch puddling works and rolling mills in Düren (Lendersdorf) motivated the establishment of new production sites in Eschweiler (1847) with the argument: *'The increasing demand for rails and considering that ... Michiels [a competitor in Eschweiler] due to the nearby coal mines ... has an advantage of almost 2,000 Thaler a year, encouraged me to build a rolling mill in Eschweiler ... so that I only needed Lendersdorf for peak production'*.<sup>39</sup> Already the increasing machinery production in the 1830s had created a new, but very small market for wrought iron and also new puddling works.<sup>40</sup> But from 1839 onwards, the construction of the Rhenish railway (see below) radically expanded the market; moreover it required relatively standardized products in large scale (rails, wagon material) and attracted the establishment of new factories.<sup>41</sup> Soon, the regional producers (*Hoesch; Michiels; Pawels & Talbot*) belonged to the largest suppliers of rails and wagons not only in Prussia but

<sup>38</sup> Fremdling, 1984; Fremdling, 1991.

<sup>39</sup> Hashagen and Brüggemann, 1916: 559.

<sup>40</sup> 1832: KG Englerth & Cünzer; Annuschat, 2007: 50.

<sup>41</sup> 1842: KG T. Michiels & Cie.; 1846 "Rothe Erde" OHG Piedboeuf & Co.; 1847: Hoesch plant "Eschweiler Station", Annuschat, 2007: 50.

rather in all German states. As the Rhenish railway was one of the first long distance railway projects in Germany, the regional producers were first movers in their respective industries and soon exported mass produced goods to other German and also Austrian regions.<sup>42</sup>

The following establishment of coke blast furnaces in the 1850s was both demand and technologically driven; on the one hand, technological knowledge of iron production with coke had been systematised,<sup>43</sup> which allowed for knowledge transfer from Belgium to the major iron regions in Germany;<sup>44</sup> on the other hand the amount of iron processed in the puddling works and rolling mills in Stolberg, Eschweiler, and Düren had so much increased that import substitution for pig iron imports from Belgium seemed to be an economically reasonable strategy (see below on Concordia, joint stock company).

#### (4.) Workforce and labour markets

In the beginning of the 19<sup>th</sup> century, workforce was relatively easily available. The coal miners mainly belonged to the small local farmers especially working in the mines during fall and winter, when the harvest was brought in, they were supplemented by day labourers from adjunct regions.<sup>45</sup> The district's steel industry was still rather small until the 1830s; and in the cloth industry new carding and spinning machinery had set free huge parts of the workforce during the 1810s and 1820s. There was thus no labour shortage until the 1830s: Additional workforce was supplied by normal population increase, by migrants from the rural hinterland, and if necessary also from Limburg or Belgium. Around 1830 some hundred Belgian migrant workers worked as day labourers in the Aachen cloth factories, also the machinery industry employed increasingly Belgian workforce; they had industrial experience, were used to low payment, and they were easily disposable, as Belgian workers were simply sent back home, if they could get no work.<sup>46</sup>

With increasing production however labour market conditions changed dramatically, starting in the mid of the 1830s, and especially during the 1850s. In order to be able to compete for workforce with the neighbouring mines, the coal mines on the *Wurm*, for example, had provide institutions for social security (a *Knappschaft* was founded in 1839) as they were already existing on the *Inde*.<sup>47</sup> The *Inde* mines, on the other hand, were competing on wages with new establishments in the iron and steel industry and in the zinc industry that were set-up on top of the coal fields (see below). Heavy industry, construction work on the Rhenish railway (and the railway company itself) offered new jobs to male workers; thus, the coal mines on the *Inde* started with providing housing for some of its workers.<sup>48</sup> The woollen cloth industry in which

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<sup>42</sup> Wagenblaus, 1973; Seeling, 1983; HSAD RA 1599: The authorized representatives of the Collectiv Gesellschaft T. Michiels & Cie. to the Royal Government Aachen, A.W. Hüffer, St. Beissel, 1.10.1846, F. 1pp.

<sup>43</sup> Schubert, 1958.

<sup>44</sup> Behrens, 1960; Fremdling, 1983.

<sup>45</sup> Reckendrees, 2011.

<sup>46</sup> Reckendrees, 2010a: 75; Althammer, 2002: 376; Schainberg, (Diss. Trier 1997) 2004.

<sup>47</sup> The mining districts *Inde* and *Wurm* did not fall under the Prussian mining law, rather the French law set the standards where *Knappschaften* were not mandatory (Reckendrees, 2013, forthcoming; Simons, 1890).

<sup>48</sup> Reckendrees, 2011: 57, 92, 128, 138-42, 152; Reckendrees, 2010a: 79;

many young women were occupied was challenged by newly set-up cigar manufactories that offered more attractive and relatively well paid work to girls and young women.<sup>49</sup>

In the early 1830s labour conflicts and social upheaval in the city of Aachen suggested local industrialists and the chamber of commerce to suggest collective labour agreements (on working hours, labour contracts, payment in money etc.); the suggested regulations did not however materialize because the as the Prussian Government did not want to interfere in private contracting. In the 1860s the same group of industrialists and the chamber of commerce suggested a pension scheme for old workers with contributions from the employers, the workers, and the city government in order to make it more attractive to continue working in the textile and needle industry, but also to make capitalism more attractive to the working class. – Here is not the place to deal with these issues in more detail; the suggestions do however indicate the changes in the working environment, the development of more competitive labour markets, and the social change in this formative period of industrial capitalism. The industrial district of Aachen was far ahead of the developments on the national scale; some 20 years before the German Government and chancellor Bismarck implemented basic social security for factory workers in the 1880s, similar ideas had not only been proposed by industrialists from Aachen, they even demanded such social institutions that allowed for mitigating some of the negative impacts of industrialization and societal change. Their main concern was however to legitimize the capitalist order.<sup>50</sup>

### **III. Interconnections**

The three clusters that have been described on the previous pages did not exist completely independently from each other. Of course, each cluster had its own historical routes and followed a specific pattern of development.

*Coal mining* is an industry where geographical concentration is determined by natural resources. The cases of the *Inde-* and *Wurmrevier* show how important economies of scale have been for a profitable production of coal especially on the *Wurm*, but also on the *Inde*. Two factors seem to be relevant in regard to cluster-theory. First, backward linkages: the huge demand of the coal mines for steam engines for water pumping stations and for coal production created a market for local steam engines and boiler producers that soon employed some thousand workers and not only produced for the regional market (see below). Second, capital diversification and commercial knowledge transfer: On the *Wurm*, agreements on rationalization and economic concentration were only possibly when capitalists from the traditional industries (especially woollen cloth and needles) and administrative elites invested into coal mining and set-up a huge merger project aiming at a regional monopoly for coal production.

The *iron and steel industry* is also relatively dependent on resources; yet not only the price of raw materials (especially coal or coke and iron ore) is relevant, the transportation costs of raw material supply and the access costs of the respective markets are also relevant factors of competitiveness, which means that location depends on resources and infrastructure. Furthermore the combination of raw materials depends on technology used. From the 1820s on-

<sup>49</sup> HSAD RA 1542, F. 65-70: Chamber of Commerce top Royal Government, Aachen, 24.4.1857.

<sup>50</sup> For more details see Reckendrees, 2010a: 72-80.

wards, puddling technology and steam engines allowed for an increased use of hard coal for steel and rolling mill production; from the 1850s onwards, hard coal and coke substituted for charcoal in the blast iron process. For these reasons and because of the new railway between Antwerp–Aachen–Cologne that gave access to the river Rhine, steel and rolling mills concentrated close to the *Inde* coal mines in the 1840s; blast furnaces followed in the 1850s. The traditional blast furnaces in the Eifel were no longer supplying pig iron to the steel works and rolling mills as they did before, when high transportation costs and the physical structure of charcoal did not allow for long-distance transports. Charcoal iron from the Eifel became relatively more expensive as it did not allow for similar economies of scale and was mainly used in processes and for goods that required high quality inputs. – From the 1830s until the mid 1850s, the district of Aachen thus developed a new iron and steel cluster that comprised all levels of iron and steel production including finished goods. The reasons to concentrate in the area of Aachen–Eschweiler were availability of coal (and coke), railway infrastructure, and the existence of a regional market for steel products (machinery industry, steam engines and boilers, railways, wagon industry, etc.).

In the *woollen cloth industry* the development from traditional artisan workshops and putting-out systems to industrial production followed a different path. Technological development, the mechanisation of carding, spinning, raising etc., and – compared to the surrounding countryside relatively high labour costs – induced a process of integration of production into vertically integrated factories that required power machines, larger buildings, and an increasing amount of fixed capital (especially for the buildings); technology was however labour saving.<sup>51</sup> Yet in Montjoie, 10 miles away from Aachen the putting-out system continued to exist; with a large rural hinterland there was no incentive to save on labour costs and instead invest into fixed capital. This does not mean that the cloth merchants, who were the first to establish shearing manufactures, had become technology adverse. They rather used new technology where it reduced total cost (carding and spinning machines) and stuck to the putting-out system that covered a larger rural region including parts of the Netherlands, as long as transactions costs were lower than necessary investments in a centralized production.<sup>52</sup> Yet over time they lost the ability to compete with the producers in Aachen, who successfully employed machinery and scale economies. – While the first machines were imported from the workshops of William Cockerill in Verviers (respectively Liège), local supply was soon built up. A crucial step in the regional development was the decision of the cloth merchant Heinrich Kelleter in 1816/17 to build a spinning factory using a steam engine and to employ two British mechanics, ‘*very dextrous artists*’<sup>53</sup>, for constructing the factory.

#### (1.) *Machinery production: a bridge between the industries*

One of them, Samuel Dobbs (also written Dobs) stayed in Aachen/Eschweiler; in cooperation with Friedrich Englerth, from the family that owned the *Inde* coal mines, and Reuleaux, an engineer at these mines, Dobbs founded the machine factory *Englerth, Reuleaux & Dobbs* in

<sup>51</sup> In this regard the development of the woollen cloth industry supports the argument in Allen, 2009.

<sup>52</sup> Reckendrees, 2010b: 18p. HSAD RA 1567, F. 68pp.: Major, Aachen City, 22.10.1816.

<sup>53</sup> Prussian State Archives, Berlin (GStA-PK) I.HA 120D XIII 2 no. 9, F. 1.: Chief-President Reimann, Aachen, to the Royal State Minister and Minister of Trade and Commerce, 19.12.1822.

1819. The first engines were produced for the family's mines, but other mines, cloth factories, and distant customers soon wanted to buy Dobbs' steam engines that could compete with Cockerill's and others' machines.<sup>54</sup> Dobbs also set-up a wire factory in Eschweiler (1822), he constructed the puddling works of *Hoesch* in Düren (see above), and was in the 1830s engaged in several new machinery firms in the Aachen district (*Dobbs & Nellessen* 1833-36; *Poensgen & Dobbs* 1837-40). Everything '*that comes from the hands of this man is beautiful*', wrote the district president to the Ministry in Berlin.<sup>55</sup> What is furthermore interesting is that Dobbs was not the first to produce steam engines in the region, but his cooperation with the mine owning Englerth family enabled him to be the first to have a commercial success.<sup>56</sup>

In the following two decades a number of machinery, steam engine, and boiler factories were set up. Some of them started out as workshops of cloth factories (Gotthard Startz), others started as specialized textile machinery producers (*Regnier Poncelet & Desoer*, or the boiler company *J. Piedbeuf*).<sup>57</sup> In 1832, ten machinery producers employed approximately 280 workers, seven years later twelve factories employed 600 workers. Most firms had only 10-30 workers, but the four larger ones between 70 and 250. *Englerth & Reuleaux* (later under the name of *Graeser*) continued to be one of the large producers. With the Rhenish railway (from Cologne to Antwerp) that was opened in 1841, and with the increasing number of large scale factories for steel and zinc production (see below) the structure of the machinery industry however changed.<sup>58</sup>

In 1820s and 1830s, the machinery sector connected the woollen cloth industry, coal mining, and the steel industry. Woollen cloth and coal mining companies founded machinery workshops, thus backward linkages and diversification provide an explanation of the development. The new machinery factories also created a new market (forward linkages) for the iron and steel industry, especially steam engines, steam boilers, railway material required more and more rolling mill and casted products. In the 1840s, the machinery factories were no longer appendixes to other industries, the largest of these firms rather belonged to the most advanced of their kind in Prussia. About 1860, almost 1.000 people worked for the machinery industry. Pawels & Talbot, founded in 1839 and the second largest railway wagon producer in Prussia employed almost 400 (see Table 2).<sup>59</sup>

The large number of companies within the woollen cloth industry, the iron and steel industry, and coal mining (this holds also true for the needle industry in Aachen and the paper industry

<sup>54</sup> Reckendrees, 2011: 111; some of the machines are mentioned in Severin, 1826: 320, 321, 325; see also Schainberg, 2004/1997: 237-42.

<sup>55</sup> GStA-PK I.HA 120D XIII 2 no. 9, F. 1: Chief-President Reimann, Aachen, to the Royal State Minister and Minister of Trade and Commerce, 19.12.1822. - The biography of Dobbs is not well known (briefly noted in Henderson, 1954: 145); his activities are documented in several contexts, e.g. Hoesch puddling works (Beck, 1899: 703); Eschweiler wire corporation (*Draht-Fabrique Compagnie*) (Reckendrees, 2010a: 64-66).

<sup>56</sup> The first was Wilhelm Dinnendahl, who due to the high costs leased his steam engines, Reckendrees, 2011: 35. On Dinnendahl see Behrens, 1974: 374f.; Behrens, 1970: 9. He started his business with the production of horse driven water pumps (Behrens, 1970: 59).

<sup>57</sup> Seeling, 1983.

<sup>58</sup> See HSAD BR 2116-45, 2116-46, 2116-47, 2116-48, 2116-49, 2116-50, 2116-51, 2116-52, 2116-53: Gewerbetafelte der Fabrikations-Anstalten und Fabrik-Unternehmungen aller Art; and Anhang zur Gewerbe-Tabelle des Regierungs-Bezirks Aachen pro [1837, 1840, 1843, 1846, 1849, 1852, 1855, 1858] enthaltend Dampfmaschinen, Maschinenspinnereien und Fabrikanstalten.

<sup>59</sup> On Pawels & Talbot see: Seeling, 1983.

in Düren) created a competitive environment, as all companies in the respective industry were aiming at similar markets. The industrial district allowed them to closely observe different practices and technology used (especially when the *Gewerbeinstitut* had provided the machines); it seems however as if they did not cooperate within their industries and if they tried to keep production knowledge secret.<sup>60</sup> Firms from one industry did however cooperate in cross-industry activities.

*(2.) Joint stock companies: Cross industrial cooperation in new and old industries*

Under French commercial law it was easier than under Prussian law to establish a joint stock company (JSC), yet in both cases a royal charter was necessary. Comparing JSC birth, the districts of Aachen and Düsseldorf (also in the Rhineprovince) pioneered Prussian industrial JSC; 50% were founded in the Rhineprovince, 15%-20% of all Prussian industrial JSC in the district of Aachen that inhabited only 2.5% of the Prussian population. The total number of JSC was however small.<sup>61</sup>

**Table 6: Joint stock companies. District of Aachen, 1820-1869**

sector	name (not translated)	seat	concession	share capital
wire	Aachener Draht-Fabrik-Compagnie (Eschweiler Drahtfabrique-Kompagnie)	Aachen	1822/	26.400
insurance	Aachener Feuer-Versicherungs-Gesellschaft	Aachen	1825/06/24	1.000.000
coal mining	Eschweiler Bergwerksverein zu Eschweiler-Pumpe	Eschweiler-Pumpe	1835/05/31	3.000.000
coal mining	Vereinigungs-Gesellschaft für Steinkohlenbau im Wurmrevier	Aachen	1836/10/30	500.000
insurance	Eschweiler Vieh-Versicherungs Gesellschaft	Eschweiler	1838/	42.000
zinc	Metallurgische Gesellschaft zu Stolberg	Stolberg	1838/05/28	2.000.000
construction	Aachener Baugesellschaft	Aachen	1839/03/07	500.000
social	Verein zur Beschaffung besserer Wohnungen für die unbemittelte Volksklasse in Aachen und	Aachen	1839/05/07	150.000
coal mining	Pannesheider-Bergwerks-Verein	Pannesheide	1842/06/20	1.200.000
railways	Aachen-Düsseldorfer Eisenbahn-Gesellschaft	Aachen	1844/	4.000.000
zinc	Aktien-Gesellschaft für Bergbau, Blei- und Zinkfabrikation zu Stolberg und in Westphalen	Aachen	1845/12/31	2.000.000
railways	Aachen-Maastrichter Eisenbahn-Gesellschaft	Aachen	1846/01/30	2.750.000
iron and steel	Eschweiler Gesellschaft für Bergbau und Hütten	Eschweiler	1848/09/01	1.000.000
zinc	Allianz, Anonyme Gesellschaft für Bergbau und	Stolberg/ Köln	1851/05/30	533.333
iron and steel	Phoenix, anonyme Gesellschaft für Bergbau und Hüttenbetrieb	Eschweiler-Aue	1852/11/10	1.500.000
glas	Aktien-Gesellschaft der Aachener Spiegel-	Aachen	1853/01/22	2.000.000
iron and steel	Concordia, Eschweiler Verein für Bergbau und	Eschweiler	1853/05/16	1.000.000
railways	Eifeler Eisenbahn-Gesellschaft		1853/05/16	2.400.000
insurance	Aachener Rückversicherungs-Gesellschaft	Aachen	1853/05/28	1.200.000
iron and steel	Aachener Hütten-Aktien-Verein	Aachen	1854/	425.000
chemicals	Chemische Fabrik Rhenania	Aachen	1855/09/12	1.000.000
zinc	Badische Zink-Gesellschaft	Mannheim/Eschwei	1857/03/16	3.000.000
gas	Dürener Aktien-Gesellschaft für Gasbeleuchtung	Düren	1857/04/20	36.000
gas	Aachener Actien-Gesellschaft für Gasbeleuchtung	Aachen	1861/08/02	200.000
coal mining	Aachen-Höngener Bergwerks-Aktiengesellschaft	Aachen	1863/11/30	2.000.000
social	Eupener gemeinnützige Aktienbaugesellschaft	Eupen	1866/03/05	20.000
				<b>26.801.733</b>

Note: Turnpikes are not included.

Source: Reckendrees, 2012, forthcoming, table 9.

<sup>60</sup> See above on woollen cloth, on the paper industry that is not dealt with in this paper see Geuenich, 1959; Girkes, 1921; Saldern, 2009; Schaumann, 1977.

<sup>61</sup> Details on Prussian JSC 1800-1870 and an analysis of regional and branch composition: Reckendrees, 2012, forthcoming.

The institution of the JSC encompassed limited liability,<sup>62</sup> shared ownership and legal personality of the business. Despite of the small number of projects were they crucial for the industrial district's dynamics and the inter-connections between the clusters of woollen cloth, needles, coal mining, iron and steel, and zinc. The institution of the JSC allowed for the diversification of capital investments and knowledge sharing between the industries. It helped creating inter-sector cooperation with capital accumulated in the traditional industries (especially woollen cloth and needles). In the industrial district of Aachen regional industrialists, merchants, bankers, rentier-capitalist, and enlightened officials from the district government jointly invested in regional industrial and insurance projects rather than in high-risk investments in over-sea trade or mining projects in Central America that elsewhere were among the first JSC projects.<sup>63</sup>

- In the following I will briefly describe some exemplary JSC projects.

*Wire joint stock company, Eschweiler (1822)*  
(*Drath Fabrick-Compagnie, anonyme Gesellschaft auf Aktien*)

This company had its roots in the French period and it was one of the altogether 13 industrial JSC founded in Prussia in the 1820s and 1830s.<sup>64</sup> In the following I will briefly describe five of JSC projects. The idea was import substitution of expensive raw materials. The founding aimed at producing 'fine English steel' and 'drawing English iron and steel wire' in order to supply the regional needle industry with high-quality raw materials; the needle industry should become internationally more competitive due to cost advantages of locally produced wire.<sup>65</sup> These expectations could not be fulfilled at first;<sup>66</sup> the founding nevertheless demonstrated some of the important functions of JSC in the process of industrialization.

The initiators of this projects have been a heterogeneous group of needle producers (who wanted to have an easy access to raw materials), owners of coal mines (who wanted to have an outlet for their production), and cloth producers (who wanted to diversify their capital into new ventures). The initiators also included members of the Royal Government of the district of Aachen and members of the Prussian State bureaucracy in order to politically safeguard the new venture. The company was managed by a salaried manager, Friedrich Thyssen (the father of the steel tycoon August Thyssen<sup>67</sup>). The factories and machines were constructed by the aforementioned engineer Samuel Dobbs, which shows on the one hand that technical expertise available in the region was used in different sectors, and on the other hand how crucial the few technical experts have been for industrial development (Dobbs continued with setting up the puddling works of Hoesch in Düren-Lendersdorf). – It was however difficult for the initiators to sell the company's share on the markets; people were obviously not used to invest money without the money-back guarantee that state bonds offered.<sup>68</sup>

<sup>62</sup> In this regard Prussian and French JSC (Freedeman, 1979) differed from British JSC, see Harris, 2000.

<sup>63</sup> E.g. Rhenish Westindian Comp. (Rheinisch-Westindische Compagnie, 1821) or German-American Mining Association (Deutsch-Amerikanische Bergwerksverein, 1824), both Elberfeld, see Boch, 1991.

<sup>64</sup> See Reckendrees, 2010a: 63-66; Reckendrees, 2012, forthcoming; Gilson, 2005.

<sup>65</sup> GStA-PK I. HA Rep. 74K, IX Niederrhein no. 6: Concession application, 19.3.1822, F. 1; Founding contract, 9.1.1822, F. 4-11.

<sup>66</sup> Gilson, 2005.

<sup>67</sup> On August Thyssen business on the Ruhr (1870-1924) see Fear, 2005.

<sup>68</sup> 'Da nun aber das Mittel, grössere Unternehmungen durch Actien zu befördern und zur Ausführung zu bringen, hier noch nicht recht erkannt werden will und Eigennutz den Beitritt zurückhält, wo nicht bestimmte Prozente

*United Coal Mines on the Wurm (1836)*  
*Vereinigungs-Gesellschaft für Steinkohlenbau im Wurm Revier*

From the mid 1820s onwards several initiatives failed to economically concentrate the coal mines on the *Wurm*, to combine the water handling and pumping systems, to reduce the number of pits, and to connect the access tunnels. It was too difficult to overcome the particular interests of the owners of the single mines, who did not want to give away their physical property and thus could not agree on a closer cooperation. But in 1836 a new joint project finally succeeded, in which similar groups of investors like in the wire company were involved. Legally, it was not the first coal mining JSC in Prussia: In 1835 the *Eschweiler Mining Association (Eschweiler Bergwerksverein)* was founded; this company was however still a family business of the Englerth family and it also had no limited liability. It was set-up to keep the mines together in case of the death of the head of the family, Christine Englerth. Only after some period of crisis it turned into a 'normal' JSC in 1849/1850.<sup>69</sup>

*United Coal Mines* however showed all characteristics of a JSC.<sup>70</sup> – A competing corporation, the *Pannesheider Mining Association (Pannesheider Bergwerksverein)*, was founded in 1842; its structure and approach was rather similar; the company was however less successful and was taken over by the United coal mines in 1858.<sup>71</sup>

With an initial share capital of 250.000 Prussian Thaler the *United Coal Mines* was one of the largest industrial corporations at that time, founded by 'respectable industrialist, public servants, and respectable capitalists'<sup>72</sup>. Most of them were owners of cloth factories, spinning factories, and machinery factories, who aimed at cheap access to coal for their steam engines and who also wanted to monopolize the regional coal trade of house coal. It had been important that they had been able to convince the rentier-capitalist and coal mine owner James Cockerill (the brother of the Liège industrialist John Cockerill)<sup>73</sup> and the private bank of *Sal. Oppenheim jr. & Cie.* in Cologne.<sup>74</sup> Coal mining promised high return in the future, but rationalization and technical combination of the mines was a requirement for profitability of the *Wurm* mines. The aim was to unite 'all anthracite mines of the Wurmrevier and to eliminate the harmful competition in order to achieve higher prices and to reduce the production costs by more rational production methods'.<sup>75</sup> The JSC should buy and merge the existing coal mines and connect the production sites above ground and below ground. Furthermore the new com-

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von dem Einlage-Kapital zu versichern sind, so erfährt auch die Drath-Fabrik-Gesellschaft nur schwachen Beitritt von Actionairen zu ihrer Aufnahme [...].’ GStA-PK I.HA Rep.120D, XIII Fach 2 no. 9: Chief President Reimann to the Royal State Minister and Minister for Trade and Commerce, Count von Bülow in Berlin, Aachen, 19.12.1822, F. 1.

<sup>69</sup> Reckendrees, 2011: 119-144; Reckendrees, 2012, forthcoming.

<sup>70</sup> On the following see Reckendrees, 2011: 49-76; Reckendrees, 2010a: 66-69; Reckendrees, 2012, forthcoming

<sup>71</sup> Reckendrees, 2011: 77-92.

<sup>72</sup> GStA-PK 120A XII 7 no. 113: Royal Concession for the 'Vereinigungs-Gesellschaft für Steinkohlenbau im Wurm Revier', Royal Government Aachen, 11.7.1836, F. 2p. – List of shareholders in Reckendrees, 2010a, tab. 2, 68.

<sup>73</sup> On John Cockerill (1790-1840) who had established the largest European blast furnace, steel and rolling mill establishment in Seraing see Jaquemin, 1878, Mahaim, 1905, Lotz, 1920; Hodges, 1960, Fremdling, 1981, Pasleau, 1993.

<sup>74</sup> On Oppenheim and the district of Aachen see Teichmann, 1995.

<sup>75</sup> 'sämtliche [!] magere Kohlen fördernden Gruben des Wurmreviers [...] vereinigen [und] die allen Gruben so schädliche innere Concurrenz [...] beseitigen, um hierdurch höhere Kohlenpreise zu erzielen [und] durch Einführung eines rationellen Betriebes die Selbstkosten zu verringern [...].’ Hilt, 1886: 3.



pany should invest in coal fields and in railways in order to create new markets for coal.<sup>76</sup> – The monopolistic strategy created of course also opposition,<sup>77</sup> but this is less important in this context; it took finally 22 years to unite all coal mines on the *Wurm* and to take-over the competing *Pannesheider Mining Association*.

The project turned out to be ambitious also in regard to technical and commercial problems. The concentration of operating sites and the improvement of water handling and pumping was much more difficult than expected and required huge investments. Also the new railway to Cologne and the Rhine (1841) and improved means of transportation were more ambiguous than expected: The railway did not only provide larger markets to the regional mining companies, it offered the same to the competitors from the Ruhr, who had very low shipping costs on the Rhine, and could now use the railway for transportation to the city of Düren. The impact of the railway, for the coal industry, was that the borders of the disputed markets were rearranged, those markets where the sum of the respective production costs and transportation costs of two mining regions were equal. For the Aachen region, the railway did not relevantly enlarge the undisputed markets.<sup>78</sup> The JSC was yet able to provide 5% dividends to its shareholders in the first fifteen years, in the 1850s the dividends reached 10%.<sup>79</sup>

What is important about the *United Coal Mines* is that it offered regional industrialists and capitalist a new opportunity to regionally invested accumulated capital in new business ventures and new industries. It induced long term cooperation between companies and entrepreneurs from different industrial branches, it intensified and interconnected regional economic activities and it integrated the large private bank of *Sal. Oppenheim jr. & Cie.* that did not only engage in the IPO but acted as a long term shareholder that also helped the company to overcome financial difficulties.<sup>80</sup> – The mentioned industrialists did not however only invest their money they also actively tried to turn the coal mines into a profitable business. Thus (and due to lack of salaried commercial and technical expertise) some of the shareholders formed the executive board of the company: the administrative expert, senior civil servant Ritz, and the lawyer, prosecutor von Fisenne, who had excellent political contacts, the mining engineer Rasquinet, and the cloth industrialists van Houtem and Küttgens, who were responsible for accounting and financial administration, sales, and workforce management. They did however not fully concentrate on the coal company, the cloth industry continued to be their main business.

#### *Société Métallurgique de Stolberg, Aix-la-Chapelle*

A similar group of capitalist as in the case of the *United Coal Mines*, joined for the development of a new industry in the region, the zinc industry. It consisted of a number of industrialists 'from Cologne, Bonn, and Aachen', the rentier-capitalist James Cockerill, the private banker Suermondt from Aachen, *Sal. Oppenheim jr. & Cie.*, and Friedrich Thyssen, the director of the

<sup>76</sup> HSAD RA 7951: Statutes of United coal mines, 1836, F 19-26.

<sup>77</sup> On resistance to the monopolist aims see Reckendrees, 2011: 67, 80.

<sup>78</sup> Reckendrees, 2011: 92-102.

<sup>79</sup> Hilt, 1886: 6.

<sup>80</sup> In the competing *Pannesheider mining association* (see above, fn. xxx) the joint stock bank *A. Schaaffhausen* (Cologne) and the fire insurance company *Colonia* (Cologne) had a similar role in the 1850s, Reckendrees, 2011: 103-07.

wire company in Eschweiler (see above).<sup>81</sup> The *Société Métallurgique* should operate rolling mills for zinc, copper, and brass plates, it should increase zinc production capacities by three times, it should operate own coal mines, and – if iron ore was found in the mines – it should also operate blast furnaces, steel works, and rolling mills for the production of boiler sheets, rails, and other iron and steel products.<sup>82</sup> These ambitions did not really fit to the rather limited aims of the regional industrialists; they rather correspond to the large scale visions of James Cockerill (see above). Due to the death of the two Cockerill brothers in 1837 and 1840 was the plan to invest into iron and steel production not followed, and the whole project was scaled down.<sup>83</sup> In 1841, for financial reasons the zinc furnaces were rented out to a Belgian-French investment group; the local investors wanted to get rid of the large investment risk, as zinc ore mining was an expensive and risky undertaking. They focused on rolling mills and contracted stable raw zinc supply from the new French company. The local industrialists obviously did not understand the international zinc market. The demand for zinc products was especially increasing on the Paris and Brussels markets where more and more luxurious houses with zinc on the roof were built. Two years after the local industrialists had left zinc production, observers talked about ‘*a general rage to go into the zinc business now*’.<sup>84</sup>

The *Société Métallurgique* could soon no longer compete with its vertically integrated competitor and sold all its manufacturing sites to the Belgian-French group in order to focus on ore explorations. This group participated in the new *Société Anonyme des Mines et Fonderies de Zinc de Stolberg (Gesellschaft für Bergbau- und Zinkfabrikation zu Stolberg)*, a 1.6mn Prussian Thaler company. The Belgian-French group brought in all the physical assets and all its debt (0.56mn Prussian Thaler) – probably the most successful IPO speculation of the 1840s. More than 50% of the shares were now with the Paris bank *Gouin & Co.*, the Earl d’Agoult (governor of the Bank of France), and *Sal. Oppenheim jr. & Cie.*<sup>85</sup>

One hand showed, this JSC project had similarities with other regional projects (see below on the iron and steel corporations) especially concerning ownership and governance and the regional context of the project; on the other hand, it was a far more risky investment that transgressed the regional economy. Thus, most of the regional shareholders decided to leave the project, when it became too risky, and left the business idea to more speculative investors. In this regard, the project indirectly confirms the regional pattern of collaborative industrial projects. – Having said this I should also mention that the regional industrialists not only invested inside of the region, for some of them – like the Schöller family in Düren<sup>86</sup> – part of the business strategy was expanding the core business to other parts of Europe. Many regional industrialists also invested in JSC outside of the region, in state bonds, and in commercial papers.

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<sup>81</sup> HSAD RA 7957: Mining Authority Bonn to Royal Government Aachen, 7.9.1836, F. 80; Klass, 1957: 39.

<sup>82</sup> HSAD RA 7957: Cockerill, Pierlot, Preston & Lambion to Royal Government Aachen, 31.8.1837, F 2. GStA-PK I.HA Rep. 120A XII 7 no. 58: Statutes of *Société Métallurgique de Stolberg*, Aix-la-Chapelle, F 16-24.

<sup>83</sup> HSAD RA 7957, F. 87: Mining Authority Bonn to Royal Government Aachen, 11.12.1841; HSAD BAD 57: Annual Report on the Inde mining region 1841, F. 169.

<sup>84</sup> HSAD BAD 59: Annual Report on the Inde mining region 1843, F. 110.

<sup>85</sup> HSAD RA 7957: Royal Government Aachen, 18.11.1845, F. 95; *ibid.*: *Société Métallurgique* to Royal Government Aachen, 27.11.1845, F. 96; Klass, 1957: 46, 49pp.

<sup>86</sup> See von Saldern, 2009.

This investment strategy concerns however individual investments, the purpose of this chapter is to demonstrate how joint projects contributed to regional industrial development.

#### *Joint stock companies in the iron and steel industry*

The iron and steel industry was not only developed by JSC, also family companies and partnerships contributed to the rapid development during the late 1830s and 1840s (see above). When the investment cost for the minimum efficient plant size however increased dramatically due to the possibility and need to set-up coke blast furnaces, the JSC became the dominant type of new companies. Three of the four JSC in this branch followed the 'regional pattern' of *United Coal Mines* and *Pannesheider Mining Association (Eschweiler Society for Mining and Ironworks, 1848; Concordia Corporation, Eschweiler Association for Mining and Ironworks, 1853; Aachen Ironworks Corporation, 1854)*.

The largest project, *Phoenix, Mining and Ironworks Corporation (Phoenix, anonyme Gesellschaft für Bergbau und Hüttenbetrieb, 1852)*<sup>87</sup>, followed a slightly different route. Its origins laid in the partnership of *T. Michiels & Cie.*, a rolling mill founded 1841 in Eschweiler; the partners were a group of needle and industrialists industry especially fromurtscheid and Eupen. From 1846 onward they repeatedly applied for a JSC concession. This case is interesting as it is one of the few regional examples for problems in the concession process. *T. Michiels & Cie.* wanted to attract new investors in order to establish coke blast furnaces, which was almost impossible for a partnership. The authorities thought however that the planned capital of 2mn. Prussian Thaler was far too high and would be too risky an investment for new shareholders.<sup>88</sup> Even the strongly increased demand for railways did not eliminate the officials' opposition to the project: In their application they wrote that they had made very high investments and the plant now had the '*largest capacity in Germany and its products are appreciated by all German railway authorities*'.<sup>89</sup> Due to the high level of investments the partners predominantly wanted to limit their individual liability; another reason for the aim of limiting liability was that *T. Michiels & Cie.* owned a substantial amount of shares in a machinery factory in Karlsruhe.<sup>90</sup>

Even though the mining authorities confirmed (1.) that the capital of 2mn. Thaler was represented by the assets; (2.) that a further expansion was not possible within the legal construction of a partnership; and (3.) that production of pig iron with coke should be encouraged; before the revolutionary period of 1848 the conservative Minister of Finance in Berlin did not approve the concession.<sup>91</sup> It took some more years before the group succeeded founding the *Phoenix* in 1852, which integrated the production sites of *T. Michiels & Cie.* – The reasons for the slow process are far from being clear; on the one hand the restrictive conservative agrarians in the Ministry of Finance of the 1840s might be responsible for the repeated rejections.<sup>92</sup>

<sup>87</sup> General information on the company: Kunze, 1926. HSAD RA 1599 and GStA-PK I.HA Rep. 120A XII, 7, no. 67, vol. 1: Papers on the founding and development of the company.

<sup>88</sup> HSAD RA 7889: Opinion of Royal Government Aachen, undated, F 24p.

<sup>89</sup> HSAD RA 1599: The authorized representatives of the Collectiv Gesellschaft T. Michiels & Cie. to the Royal Government Aachen, A.W. Hüffer, St. Beissel, 1.10.1846, F. 1pp.

<sup>90</sup> Hatzfeld, 1994.

<sup>91</sup> HSAD RA 1599: Royal Government Aachen to mining authorities Bonn (concept), 8.10.1846, F. 3pp.; revised statutes, 4.1.1847, F. 33; Royal Government Aachen to Ministry of Finance, Berlin, 13.1.1847, F. 34; Minister of Finance, Pommer-Esche, 28.2.1847, F. 40, F. 43.

<sup>92</sup> See Eichholtz, 1962, on the Berlin politics towards JSC in that period.

On the other hand was the project a project of outsiders. It required support from the mining authorities to convince the Royal Government in Aachen that was usually in favour of industrial JSC about the benefits of the new JSC. It seems as if the original founders, two Belgians T. Michiels and N.J. Bourdouxhe, industrialists from Burtscheid, and cloth industrialist from Eupen were not able to find support from the local business elite – but this is partly speculation.<sup>93</sup>

Anyway, the foundation of the *Concordia Corp. Eschweiler Association for Mining and Ironworks* (1853, *Concordia, Eschweiler Verein für Bergbau und Hüttenbetrieb*) had been much easier. In this case respectable local industrialists belonging to the ‘cycle of most wealthy mining and steel industrialists of the district and the best families of Aachen and Cologne’<sup>94</sup> joined forces. It is yet not clear if this ‘social capital’ has been the decisive reason for a quick procedure or whether the local Royal Government highlighted the founders’ reputation in order to get the project more easily approved compared to the Phoenix. Concordia’s founders were the large mining company *EBV*, two owners of blast furnaces, Cünzer and Hoesch, the joint stock bank *A. Schaaffhausen* from Cologne, and merchants and industrialists from Eschweiler, Aachen, Düren, and Cologne – indeed an elite circle.<sup>95</sup> In this case not even the normal basic requirements for the concession of a JSC were fulfilled: it was not a new industry that should be promoted, and the company did not need very high capital investments. The Royal Government in Aachen instead argued that due to the crisis years from 1847-50, it was ‘very pleasing if mining and iron and steel on the Inde would get new dynamics and would be able to successfully compete with the industry on the Ruhr.’<sup>96</sup> The directors of the company however explained that the major reason for the new company was import substitution from Belgium, what for them was a market opportunity, they rephrased as a national task: Pig iron should be produced close to the puddling and rolling mills, and not in Belgium; otherwise security of supply was not guaranteed.<sup>97</sup>

#### *Fire Insurance Comp. Aachen (1825) - Aachener Feuer-Versicherungs-Gesellschaft*

The Fire Insurance Comp. (*Aachener Feuer-Versicherungs-Gesellschaft* 1825) was of course not an industrial JSC. It was however, one of the most successful startups in German economic history. In the 1830s it merged with the *Münchener Feuer-Versicherungs-Gesellschaft* (today *Aachener and Münchener Versicherungen*) and some years later it set-up the first re-insurance company in Germany (today *Munich Re*), but this is not the reason why this insurance is interesting for regional industrial development and inter-sector collaboration.

More than 90% of the initial shareholders came from the region, most important were the factory owners, which is not surprising as the company insured houses and industrial property

<sup>93</sup> HSAD RA 1599: Protocol of 3.1.1852, F. 125. Seeling, 1983, Seeling, 1996 on Michiels & Bourdouxhe.

<sup>94</sup> GStA-PK I. HA Rep. 120 Abt. A XII 7 no. 69: Opinion of the Royal Government Aachen, 21.3.1853, F. 21pp.

<sup>95</sup> HSAD RA 7990: First general assembly and list of shareholders, 28.5.1853.

<sup>96</sup> GStA-PK I. HA Rep. 120 Abt. A XII 7 no. 69: Opinion of the Royal Government Aachen, 21.3.1853, F. 21pp.

<sup>97</sup> HSAD RA 7990: J. vom Rath & W. Steffens, Appeal for the concession of a joint stock company for the construction and operation of blast furnaces in Eschweiler, 28.2.1853, F. 3pp.

against fire.<sup>98</sup> The insurance is especially interesting in regard to social aspects of industrialization. In order to be accepted by the authorities, 50% of its net-income (after sufficient reserves were accumulated) had to be spent for social purposes; they cannot be fully described here.<sup>99</sup> Its main instrument was the establishment of a savings bank for the working classes (1834, *Aachener Verein zur Beförderung der Arbeitsamkeit*). It aimed at individual financial precaution for unexpected urgencies like unemployment or illness. The savings accounts were subsidized by funds from the net-earnings of the insurance and the interest rates were thus high and attractive. The Savings Bank, on the other hand, aimed at socially disciplining and educating the working classes. It had been established in reaction to a social upheaval in 1830,<sup>100</sup> which was a violent underclass's revolt, in which e.g. the home of James Cockerill was completely demolished (Cockerill was a symbol for the rentier-capitalist who did not work, rather went to horse races and was nevertheless incredibly rich).

The Savings Bank was not only a savings institution but also an instrument to ideologically integrate the working classes into the capitalist system, which from the view of farsighted industrialists depended on social systems that safeguarded the workers from the risks of wage labour. Saving should allow workers to survive in times of individual crisis (unemployment, illness), because most of the workers did not have access to any other means; they did not even own a small garden. Thus the Savings Bank offered high interest rates, which made saving attractive to those who had almost no means to save anything. But high interest rates were made dependent on well behaviour: depending on the level of industriousness, order, and well conduct, a premium of five to 12.5% interest should be paid. People who continuously saved for three years and accumulated 20 Prussian Thaler (the wage of approximately 50 working days of day labourers) should e.g. get three Thaler premium.<sup>101</sup> - The Savings Bank was extremely successful. It not only attracted 27,000 savings accounts in the Rhineprovince, it advanced to the largest Prussian savings bank at that time.<sup>102</sup>

This project did not directly contribute to industrial development, but it is one of the regional JSC projects that had an impact on regional economic development as it helped integrating the working classes into the capitalist system and also to moderate the existential problems of unemployment and illness.<sup>103</sup>

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<sup>98</sup> HSAD BA 16058: List of shareholders, F. 42pp.; on the early years of the insurance see: without author, 1925; Seyffart, 1827; Masius, 1846, 116-124; Hanseemann, 1834; Berndt, 1884; *Aachener Verein zur Beförderung der Arbeitsamkeit*, 1909.

<sup>99</sup> For more details and literature see Reckendrees, 2012, forthcoming; Reckendrees, 2010a: 75-77; statutes in GStA-PK I. HA Rep. 120 D XXII 9 no. 4.

<sup>100</sup> For literature see: Reckendrees, 2010a: 73.

<sup>101</sup> HSAD RA 16058: Direktion der Aachener Feuerversicherungs-Gesellschaft als provisorischer Ausschuss des Vereins zur Beförderung der Arbeitsamkeit (Pastor, Hanseemann, Seyffart), 25.10.1833; *'je nachdem der Sparer einen hohen oder minderen Grad von Fleiss, Ordnung und gutem Betragen voraussetzt [...] vermittelt grösserer oder kleinerer Zinsen – etwa von 5 bis 12 ½ Prozent, oder auch auf andere Weise, eine Prämie auf Fleiss und gutes Betragen' zu zahlen.*

<sup>102</sup> Pohl, 1999; Thomes, 1999

<sup>103</sup> On further attempts of social inclusion see Reckendrees, 2010a, 71-80.

### *Join projects and inter-sector cooperation – brief summary*

One of the regional specificities was the inter-sector cooperation in new JSC. This institution allowed for limited liability and diversification of capital risks, as such it allowed for attracting capital to new ventures and industries. The institution contributed however also to the diffusion of the scarce resource of knowledge and expertise in regard to entrepreneurial, organizational, commercial and technical knowledge. The social composition of the respective corporations represents core businesses and successful entrepreneurs from the different clusters – which is an interesting observation in itself and will be evaluated in more detail in the summary.

### *(3.) Infrastructure and the Rhenish railway*

Improvements of infrastructure, especially for the transport of coal and iron goods were a prerequisite of industrial development. And from the 1820s onwards regional companies and entrepreneurs engaged in improving the transportation systems. In the beginning, this mainly concerned turnpikes, from the early 1830s onwards they bargained for a railway connecting Aachen, Düren, and Cologne and thus the regional industry to ship routes on the river Rhine. The turnpikes mostly aimed at connecting the coal mines with the centres of coal consumption. They have not been economically successful, but the streets from Eschweiler to Düren, from Weiden to Eschweiler, from Düren to Cologne and from Aachen to Eupen connected the commercial centres more closely and contributed to increases in coal trade.<sup>104</sup> Also the Prussian State engaged in new streets, of specific importance was the street from Aachen to Duisburg that connected the *Wurm* coal mines with Aachen and some cities north of the mines.

The *Rhenish railway* had originally been projected in 1833 as a railway from Cologne to Antwerp bypassing Aachen some kilometres north. The Aachen chamber of commerce, under its chairman David Hansemann, did however engage in persistent negotiations with the Prussian Government and was finally able to attract the railway to the city Aachen. It thus connected Aachen, the coal mines around Eschweiler, and Düren with the Rhine port in Cologne, the steel region of Liège, and the harbour of Antwerp. The tough negotiations described in the comprehensive account by Kumpmann and contemporary documentation allows concluding that it was the industrial district and the expected transports of goods and people that allowed for the successful reallocation of the railway.<sup>105</sup>

The railway was opened in 1841 and had an ambiguous impact on the different industries and even on the two mining districts. It connected Aachen, Düren, the *Inde* mines, and the locations of the iron and steel producers both to Cologne and Antwerp, which reduced transportation costs and increased the markets. It had however a negative impact on the *Wurm* mines being relatively too far away from the railway.<sup>106</sup> This situation only changed when an addi-

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<sup>104</sup> Reimann, 1834: 48-50.

<sup>105</sup> Kumpmann, 1910; Hansemann, 1835; Hansemann, 1837a; Hansemann, 1837b; Hansemann, 1838. On Hansemann: Bergengrün, 1901; Däbritz, 1960; Eyll, 1966; Malangré, 1991.

<sup>106</sup> HSAD BAD 60: Annual report on the Wurm mines, 1844, F. 106.

tional railway from Aachen to Düsseldorf was built that connected the mines on the *Wurm* with the cities of Aachen and Gladbach.<sup>107</sup>

In the late 1830s and early 1840s however, the railway created high expectations for the regional industry and a new market for some of the major products (coal, iron and steel, and machinery). Thus, the new iron and steel new factories were set up on the coal in the *Inderevier* and close to the railway (in the small area between Eschweiler and Stolberg, see also the paragraphs on JSCs). – The regional development confirms the strong forward and backward linkages of the railways, which have been analysed in detail by Rainer Fremdling.<sup>108</sup> In the region the railway had a very strong impact on the iron and steel industry and on machinery, which again created new demand for coal. The railway did not so much allow for a geographic expansion of the coal markets, and it thus did not fulfil the expectations of the owners of the coal mines. The reason for this effect is rather trivial: the further development of the railway system during the 1840s re-connected the mining region of the Ruhr to the newly conquered markets and moved the disputed markets back almost to the previous ‘equilibrium’ that existed before railway support. The impact of the railway was thus reduced to the railway consumption of coal and to additional demand for coal from industries that benefitted from the railway, like iron and steel, zinc, and machinery.

A further implication of the railway between Antwerp and Cologne in connection with the coal resources of the Inde- and Wurmregion was the regional concentration of the major industries in the area between Aachen, Stolberg, and Eschweiler. This has been demonstrated for iron and steel, but the location of the cloth industry was also affected by the new means of transportation. Aachen/Burtscheid, Eupen, and Montjoie were three centres of early modern cloth production, but only Aachen/Burtscheid got direct access to the railway. Already in the early 19<sup>th</sup> century the larger distance to the coal mines and better access to water power in Montjoie and Eupen had created diverging patterns of industrial development. In the 1820s and 1830s cloth production in Aachen/Burtscheid moved towards centralised production and machinery driven by steam engines. In Montjoie relatively far away from the mines (and to a certain level also in Eupen that was in a medium position), water wheels continued to be the main driving power (with implications for the possibility to operated throughout the year and to expand production with new machinery). The direct access to the railway further increased the relative costs of coal supply to Montjoie and Eupen, which resulted in a worsened competitive position. Thus, the woollen cloth industry in Montjoie lost its previous importance and collapsed in the second half of the 19<sup>th</sup> century.

Furthermore the railway and other improvements of infrastructure created new business opportunities. It is however difficult to establish a causality that allows for a separation between the industrial agglomeration effect and the increase in labour supply on the one hand and the infrastructure on the other hand. The tobacco manufactures that soon employed more than 1,000 people (see table 2, above) is the best example, local artisan workshops, food production, and services might also serve as indicators for this process. In the case of tobacco, which means cigar production, the decision to set up the manufactures in Aachen was (probably)

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<sup>107</sup> HSAD BAD 69: Annual report on the Wurm mines, 1853, F. .114.

<sup>108</sup> Fremdling, 1975;

labour related. Normally the cigar manufactures in German states been setup in agricultural regions, close to local tobacco fields or with access to intercontinental shipping (e.g. in the hinterland of Bremen). It is exceptional that cigar production went to an industrial centre; but in Aachen many children and women worked in the cloth and in the needle industry suffering from heavy, unhealthy, and low paid work. – There is however no proof that such considerations were crucial for the location of the cigar manufactures in the 1840s and 1850s.

#### *(4.) Legal and social institutions*

The institutional environment of the district had been supportive to economic development. Much of it can be attributed to the French commercial law and resulting institutions that continued to govern the regional economic actors and transactions despite falling to the Prussian State (see above). The substitution of the French regulatory system for new Prussian laws was a slow process; and in general new Prussian laws were inspired by the French civil and commercial law (Railway Act 1838, Joint Stock Company Act 1843, General German Trade Law 1861). The French regulatory system was e.g. a little bit more supportive to JSC than the Prussian law before 1843. Some of the implications have been discussed in this paper.

But there were also other institutions from the French period that supported economic development like Chambers of Commerce of Aachen (1804) or the Commercial Court (1805) and the Trade Court (1808). These self-regulating institutions have been important in different ways. The Chamber of Commerce<sup>109</sup> had administrative functions in the Prussian state (especially providing information on regional industry, trade, and commerce to the Prussian ministries – and providing ministerial information to the local industry), but it was composed by industrialists who were elected by industry representatives. Unfortunately the documentation for the period before 1850 is rather limited, but from the existing archival material it can be concluded that the Chamber had a double function<sup>110</sup> in the sense that it fulfilled its administrative tasks and, at the same time, acted as the political representation of the industrial interests towards the local Royal Government and towards the ministries in Berlin. This was not the idea of Chambers of Commerce, but the institution was used for such purposes as can be shown for example in regard to the project of the Rhenish railway or in regard to tariffs (the position was however far from being ideological, depending on the industry the chamber demanded free-trade or protectionist tariffs).<sup>111</sup> With the Chamber of commerce lobbying for Aachen was much more successful than lobbying for e.g. Düren, Eupen, or Montjoie where this institution was not established.

The judges in the specialised commercial court (Handelsgericht, existing until 1879)<sup>112</sup> and the trade court (Gewerbegericht, Conseils de prud'hommes)<sup>113</sup> were elected representatives from commerce and, respectively, trade and industry); both were beneficial to economic develop-

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<sup>109</sup> *Chambre consultatives de manufacture, fabriques, arts et métiers*, see: Thomes, 2004, 20-33, Zeyss, 1907.

<sup>110</sup> Reckendrees, 2010a: 56-58.

<sup>111</sup> For further examples see Reckendrees, 2010a.

<sup>112</sup> Zeyss, 1907: 1-18; Bernert, 1982: 126-128; 144.

<sup>113</sup> Bernert, 1982. From 1846 onwards Königliches Gewerbegericht; there are some differences between the Trade Court in Aachen and the Prussian Factory Courts established in the 1840s, Bernert, 1982, 147. These courts fulfilled however similar functions: Willoweit, 1982; Schöttler, 1985; Mieck, 1997.



ment in slightly different way. The commercial court smoothed or decided on conflicts between firms and between merchants; the trade court decided in regard to labour related conflicts. These institutions were a relatively flexible instrument within the only slowly changing civil law system, in a certain way supporting the legal-origins hypothesis in the economics of law literature which claims that in market economies common law systems were more supportive to economic change and thus to economic growth than civil law systems.<sup>114</sup> Usually, both the French and the Prussian law system are correctly regarded as civil law systems; but interestingly enough, in the early period of industrial development, more case oriented decision process were part of the judicial practice in trade and commerce. In 1815, the judges of commercial court explained their perspective in a letter to the Royal Government in which they argued in favour of maintaining the court in the new Prussian Rhineprovince:

*'In a region so full of commerce and factories [...] the normal courts were not sufficiently prepared to arbitrate the thousands of conflicts of merchants as there is in many cases no written law on the details, or to decide them according to the civil law.'* Economic development would always be ahead of the legal and the regional economy would thus need a legal system *'which is as simple as merchant contracts and as effective and quick as the permanently active speculators are.'*<sup>115</sup>

These institutions shaped an environment and created a framework that allowed for the articulation of different and diverging interests, which could be negotiated but perhaps not always be mitigated. Anyway, this framework supported the emergence of more trust-based relationships and thus a more stable institutional environment.<sup>116</sup>

The formal institutions were further supported by bourgeois societies like the Club Aachener Casino, an exclusive club for industrialists, merchants, member of the local administration, and their families. It was founded in 1805 and not only a social meeting point in which marriages were organized but also a forum of economic and political information exchange (the club had for example an own library with national and international newspapers).<sup>117</sup>

I am not able to show any causality between the briefly mentioned institutions and, for example, the establishment of JSC, but it seems to be very plausible to at least assume that the developed social and communicative structures had a positive impact on the observed economic cooperation in the case of industrial projects. Of course, these projects can be explained by economic self-interest and profit expectations, which are probably crucial. My argument is, however, that the specific institutional environment in the industrial district of Aachen encouraged cooperative approaches to reach the respective individual economic aims.

<sup>114</sup> See Reckendrees, 2010a; Mahoney, 2001; Glaeser and 2002, A. Shleifer; La Porta et al., 2007.

<sup>115</sup> *'In einem so Fabrikreichen und Handelsbefliessenem Lande [...], würde das gewöhnliche Gericht nicht hinreichen, die tausenderlei vorkommenden Differenzen und Kommerzialstreitigkeiten der Kaufleute, in vielen Fällen, worauf kein geschriebenes Gesetz anwendbar zu finden wäre, ausmittelnd zu schlichten, und nach Civil-Gesetzen es zu sprechen'*. Die ökonomische Entwicklung eile der gesetzlichen immer weit voraus, daher benötige die regionale Wirtschaft eine *'Gerechtigkeit-Pflege [...], welche [...] so schlicht und einfach ist, als der Kaufmanns-Verträge es sind; aber so wirksam und schnell, als dessen stets regsamer Spekulationsgeist.'* HSAD Reg. Aachen 1606: Letter of the local judges to President von Reiman, Aachen, 19.4.1816. The Chamber of Commerce supported the judges, letter 18.5.1816, *ibid*.

<sup>116</sup> On the importance of networks for trust in institutions see e.g.: Granovetter, 1985. More generally see also the literature on business ethics and the values of the bourgeoisie in the 18th and 19th century, e.g. McCloskey, 2006

<sup>117</sup> On the club: Arens and Janssen, 1937 u. Sobania, 1991.

#### IV. Summary and outlook on the decline of the industrial district

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