Erik Buyst

The Causes of Growth during Belgium's Industrial Revolution

The reconstruction of historical regional accounts is a hot topic these days in the economic-history literature. For example, GDP figures on a provincial, departmental, or regional level have recently been published for France, Italy, Spain, the United Kingdom, and Sweden. Most of these studies present estimates from the late nineteenth century onward. This article pushes the research frontier back to the beginning of the nineteenth century.¹

From a Belgian perspective, this exercise has the crucial advantage of taking into account the regional effects of the first Industrial Revolution. The healthy growth rates in the mining and iron sectors during the second half of the eighteenth century had already announced Belgium's Industrial Revolution, but the process really took off during the first decades of the nineteenth century. Hence, the international literature often characterizes Belgium as the second industrialized nation of the world, after Britain. As in the British case, the sectors that mechanized rapidly in Belgium were relatively small compared to the rest of the economy; it took time before real GDP growth per capita started

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1 Pierre-Philippe Combes, Miren Lafourcade, Jacques Thisse, and Jean-Claude Toutain, "The Rise and Fall of Spatial Inequalities in France: A Long-Run Perspective," *Explorations in Economic History*, XLVIII (2011), 243–271; Kerstin Enflo and Joan R. Rosés, "Coping with Regional Inequality in Sweden: Structural Change, Migrations and Policy, 1860–2000," *Economic History Review*, LXVIII (2015), 191–217; Emanuele Felice, "Regional Value Added in Italy, 1891–2001, and the Foundation of a Long-Term Picture," *ibid.*, LXIV (2011), 929–950; Frank Geary and Tom Stark, "Regional GDP in the UK, 1861–1911: New Estimates," *ibid.*, LXVIII (2015), 123–144; Daniel A. Tirado, Alfonso Díez-Minguela, and Julio Martínez-Galarraga, "Regional Inequality and Economic Development in Spain," *Journal of Historical Geography*, LIV (2016), 87–89.

to accelerate. From the late 1820s, the macroeconomic effects of the technological and organizational breakthroughs slowly but surely became visible.²

The Belgian Industrial Revolution was a typical example of unbalanced economic growth. Although the mining, iron, cotton, and woolen industries boasted strong growth rates, the failure of the large export-oriented linen sector to mechanize resulted in a steep decline. Given that these industries were concentrated in certain areas, the question is which provinces benefited from the Industrial Revolution and which ones were left behind? The issue becomes even more intriguing in the context of a linguistically divided country. Although the tensions between speakers of Dutch and of French were less pronounced during most of the nineteenth century than they are today, the relative economic performance of the areas in which Dutch-speaking Flemings and French-speaking Walloons lived influenced the political balance of power between them.³

The Industrial Revolution in Belgium did not generate radical changes in relative GDP per capita at the provincial level. The hierarchy of rich and poor provinces remained relatively stable during the nineteenth century, but the gap between rich and poor increased dramatically. At the same time, people moved from poor to rich areas. Rising regional inequality in tandem with these migration flows provoked a shift in the spatial localization of economic activity. The northwest of the country, for centuries the industrial heartland, fell far behind the provincial axis of Hainaut–Namur–Liège.⁴

2 E. Anthony Wrigley, *Industrial Growth and Population Change* (London, 1961), 37; Sidney Pollard, *Peaceful Conquest: The Industrialization of Europe 1760–1970* (New York, 1981), 87; Stephen Broadberry, Rainer Fremdling, and Peter Solar, “Industry,” in Broadberry, and Kevin H. O’Rourke (eds.), *The Cambridge Economic History of Modern Europe* (New York, 2010), I, 164–186; Nicholas F. R. Crafts, *British Economic Growth during the Industrial Revolution* (New York, 1985), 17–47; Bart Pluymsers, *De Belgische industriële productie, 1811–1846: Reconstructie van een databank van de fysieke productie en de bruto toegevoegde waarde* (Leuven, 1992), 17–42.

3 Buyst, “Economic Aspects of the Nationality Problem in Nineteenth- and Twentieth-Century Belgium,” in Alice Teichova, Herbert Matis, and Jaroslav Pátek (eds.), *Economic Change and the National Question in Twentieth-Century Europe* (New York, 2011), 33–47.

4 Jan Blomme and Herman Van der Wee, “The Belgian Economy in a Long-Term Perspective: Economic Development in Flanders and Brabant, 1500–1812,” in Angus Maddison and Herman van der Wee (eds.), *Economic Growth and Structural Change: Comparative Approaches over the Long Run* (Milan, 1994), 82–91.

ESTIMATING PROVINCIAL GDP FOR THE 1819–1896 PERIOD The Geary–Stark (GS) method has become the standard procedure to estimate historical regional GDP figures. The method requires a labor force and a wage matrix by sector and province. The first benchmark year for which these variables can be reconstructed is 1819. This early date is fortunate because it provides insight into the geographical distribution of economic activity before the Industrial Revolution generated an acceleration of real GDP growth per capita. The other benchmark years are 1846, 1880, and 1896. Following Wolf and Rosés, we consider mining a separate sector along with agriculture, industry, and services. Table 1 gives a general overview of the sources used to nurture the GS method.⁵

The labor force by sector is usually derived from the population censuses (PC). The large group of “undetermined workers” in the PC of 1846 was divided by sector using the procedures developed by Klep. Although no PC was organized in 1819, Goossens estimated the increase in the agricultural labor force per province for the period from 1812 to 1846 by combining information from various local and regional studies.⁶

Employment in mining and industry is taken from the 1819 industrial census (IC). Since the province of Brabant and some sectors across Belgium suffered from under-registration, this article uses a highly detailed fiscal inventory of most industrial firms and their workers in 1833 to remedy the problem. It also uses this inventory for information about commercial firms, as well as data from the 1829 population census and from parliamentary reports, to extrapolate the labor force in services from 1846 to 1819. In 1839, the Dutch recognition of the Belgian secession from the United Kingdom of the Netherlands led to a partitioning of the provinces Limburg and Luxembourg between both countries. The employment data for these provinces obtained from IC of

5 Geary and Stark, “Examining Ireland’s Post-Famine Economic Growth Performance,” *Economic Journal*, CXII (2002), 919–935; Nikolaus Wolf and Rosés (eds.), *The Economic Development of Europe’s Regions: A Quantitative History since 1900* (New York, 2017).

6 Paul Klep, “De Agrarische Beroepsbevolking van de Provincies Antwerpen en Brabant en van het Koninkrijk België, 1846–1910: Nieuwe Evaluaties van het Kwantitatief-Historisch Materiaal,” *Bijdragen tot de Geschiedenis*, LIX (1976), 25–69; Martine Goossens, *The Economic Development of Belgian Agriculture: A Regional Perspective, 1812–1846* (Brussels, 1992).

Table 1 General Overview of Sources, 1819–1896

YEAR	LABOR FORCE	WAGES
1819	Agriculture: Goossens Mining & industry: Brugmans Services: extrapolation	Agriculture: agricultural census (AC) of 1846 Mining & industry: Brugmans
1846	Population census (PC) of 1846	Agriculture: AC of 1846 Mining & industry: industrial census (IC) of 1846
1880	PC of 1880	Agriculture: AC of 1880 Mining & industry: IC of 1880
1896	Interpolation of PC of 1890 and PC of 1900	Agriculture: AC of 1895 Mining & industry: IC of 1896

NOTES AND SOURCES Martine Goossens, *The Economic Development of Belgian Agriculture: A Regional Perspective, 1812–1846* (Brussels, 1992); Ieb J. Brugmans, *Statistieken van de Nederlandse Nijverheid uit de Eerste Helft der 19e Eeuw* (The Hague, 1956). AC (agricultural census) of 1846: Ministère de l'Intérieur, *Agriculture: Recensement général (15 octobre 1846)* (Brussels, 1850–1851), I–IV; of 1880: Ministère de l'Agriculture, *Agriculture: Recensement général de 1880* (Brussels, 1885); of 1895: Ministère de l'Agriculture, *Agriculture: Recensement général de 1895* (Brussels, 1899–1902), I–V. IC (industrial census) of 1846: Ministère de l'Intérieur, *Industrie: Recensement général (15 octobre 1846)* (Brussels, 1851); of 1880: Ministère de l'Intérieur, *Industrie: Recensement de 1880* (Brussels, 1887), I–III; of 1896: Ministère de l'Industrie et du Travail, *Recensement général des Industries et des Métiers (31 octobre 1896)* (Brussels, 1901), I–XVIII. PC (population census) of 1846: Ministère de l'Intérieur, *Population: Recensement général (15 octobre 1846)* (Brussels, 1849); of 1880: Ministère de l'Intérieur, *Population: Recensement générale (31 décembre 1880)* (Brussels, 1884); of 1890: Ministère de l'Intérieur, *Population: Recensement générale de 1890* (Brussels, 1893), I–II; of 1900: Ministère de l'Intérieur, *Population: Recensement générale du 31 décembre 1900* (Brussels, 1903), I–II; *Verslagen der Handelingen van de Staten-Generaal* (The Hague, 1815–1830).

1819 and the 1833 fiscal inventory are adapted to the new borders according to their relative population size.⁷

Wages in agriculture are usually found in the agricultural censuses (AC), with the exception of 1819 when no such census was organized. The AC of 1846, however, recorded regional wage data for 1830. Given Goossens' demonstration that Belgian agricultural production grew slowly between 1819 and 1830, we assume that regional wage differentials remained unchanged.⁸

7 Etablissement Géographique de Bruxelles, *Tableaux statistiques des Patentables de la Belgique en 1833* (Brussels, 1833), 2–31; Adolphe Quetelet and Edmond Smits, *Recherches sur la Reproduction et la Mortalité de l'Homme aux Différents Ages et sur la Population de la Belgique* (Brussels, 1832), 43; Xavier Heuschling, *Essai sur la Statistique de la Belgique* (Brussels, 1841), 27, 54; Sven Vrielinck, *De Territoriale Indeling van België (1795–1963)* (Leuven, 2000), I, 90–92; III, 2079–2080.

8 Goossens, *Belgian Agriculture*, 160.

Wages in industry are a more complicated matter; the registration procedure differed from one industrial census to the other. Ironically, the IC of 1819 is conceptually the most complete one, registering all the wages in factories, workshops, and domestic industry. The fact that the IC of 1846 and of 1896 processed only wages in factories and workshops, not in domestic industry, is unfortunate for several reasons. First, in such domestic industries as textiles, clothing, leather, and wood, employment was still important, especially in 1846. Moreover, these cottage industries were concentrated in certain provinces. Because wages in domestic industry were considerably lower than those in factories and workshops, the failure to take them into account introduces an upward bias in the average industrial wage of certain provinces. Finally, labor in factories and workshops tended to be male-dominated whereas that in domestic industry was primarily female-dominated. The large wage gap between the sexes aggravates the bias mentioned above. Using the correct weights—by sector, by type of industry, and by gender—is therefore crucial to obtaining meaningful average wages per province.

The IC of 1896 counted employment in factories/workshops and domestic industries separately. The IC of 1846, however, registered only that in factories/workshops. A detailed comparison between the PC of 1846, that counted all industrial workers, and the IC of 1846 provides the necessary building blocks to estimate employment in domestic industry by sub-sector and gender.

Reliable and representative information about nineteenth-century wages in domestic industry is extremely scarce. More solid material about the early twentieth century indicates that these salaries amounted to 70 percent of factory/workshop wages for both males and females. We assume the same ratio for the nineteenth century.⁹

The IC of 1880 is a special case in that it did not cover the whole industrial sector. Domestic industry in general and factory/workshop employment in clothing, wood, and several smaller sub-sectors were not registered. In contrast to the ICs of 1846 and 1896, the IC of 1880 published no separate wages for males and females, only averages for both sexes together. We extrapolate

9 Stef Peeters, Goossens, and Buyst, *Belgian National Income during the Interwar Period: Reconstruction of the Database* (Leuven, 2005), 271.

Fig. 1 σ -Convergence among Belgian Provinces, 1819–1896

SOURCES See Table 2.

the highly detailed (sub)sector and sex ratios of the IC of 1896 to remedy these gaps.

Wages in the services sector present a special problem. Following the Geary–Stark methodology, this study estimates them as the weighted average of salaries in agriculture, mining, and industry. Given the relatively small size of the Belgian tertiary sector in the total economy, this strategy is not an element of serious concern.

LONG-TERM PATTERNS OF REGIONAL INEQUALITY What general picture emerges from this exercise? Figure 1 shows the evolution of the population-weighted coefficient of variation of provincial GDP per capita, which can be considered a proxy of σ -convergence. A sharp increase in spatial inequality, or σ -divergence, followed by a mild correction, occurred between 1819 and 1880. This outcome is not surprising. Late industrializing nations, such as Italy and Spain, experienced similar trends during the late nineteenth and early twentieth centuries. Figure 2 tells a similar story: The provinces that were relatively rich in 1819 grew slightly faster during the nineteenth century than did the poorer ones. In other words, there was a slight tendency toward β -divergence.¹⁰

10 Felice, "Regional Convergence in Italy, 1891–2001: Testing Human and Social Capital," *Cliometica*, VI (2012), 267–306; Martínez-Galarra, Rosés, and Tirado, "The Long-Term Patterns of Regional Income Inequality in Spain, 1860–2000," *Regional Studies*, XLIX (2015), 502–517.

Fig. 2 β -Convergence among Belgian Provinces, 1819–1896

SOURCES See Tables 2 and 3.

Table 2 confirms that the hierarchy among the various provinces remained relatively stable during the nineteenth century. The provinces that benefited most from the Industrial Revolution—Hainaut and Liège—were already the richest ones in 1819. Conversely, the provinces that lagged were mostly the poorer ones at the start of the period under investigation, such as Limburg and West Flanders. Exceptions to the rule were East Flanders and the sparsely populated provinces of Namur and Luxembourg, which lost or gained several positions in the provincial ranking.

More importantly, these findings show that the foundations of the economic geography of Belgium's Industrial Revolution were shaped during the *ancien régime*, not in the first half of the nineteenth century as the traditional literature maintains. From a different angle—that is, structural change in employment—Shaw-Taylor and Wrigley also stress the continuity between the early modern period and the classic era of the Industrial Revolution for the British case.¹¹

The localization of economic activity (Table 3) shows more profound changes as people moved from poorer toward richer

11 Pierre Lebrun, Marinette Bruwier, Jan Dhondt, and Georges Hansotte, *Essai sur la révolution industrielle en Belgique, 1770–1847* (Brussels, 1981), 19–74; Leigh Shaw-Taylor and Wrigley, "Occupational Structure and Population Change," in Roderick Floud, Jane Humphries, and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain* (New York, 2014), I, 53–88.

Table 2 Relative Regional GDP per Head, 1819–1896 (Current Prices, Belgium=1)

	1819	1846	1880	1896
Antwerp	1.03	0.97	0.85	0.87
Brabant	1.00	1.04	1.02	1.05
West Flanders	0.86	0.79	0.74	0.77
East Flanders	1.07	0.95	0.85	0.83
Hainaut	1.10	1.14	1.22	1.21
Liège	1.10	1.17	1.29	1.23
Limburg	0.75	0.80	0.66	0.61
Luxembourg	0.83	0.91	0.99	1.05
Namur	1.00	1.12	1.16	1.14

SOURCE See Table 1.

Table 3 The Share of Belgian GDP by Province, 1819–1896

	1819 %	1846 %	1880 %	1896 %
Antwerp	9.7	9.1	8.9	10.6
Brabant	14.5	16.6	18.1	19.8
West Flanders	13.8	11.8	9.2	9.3
East Flanders	21.1	17.4	13.6	12.8
Hainaut	17.5	18.8	21.6	20.7
Liège	10.9	12.2	15.5	15.2
Limburg	3.3	3.4	2.5	2.2
Luxembourg	3.6	3.9	3.8	3.4
Namur	5.5	6.8	6.8	5.9

SOURCE See Table 1.

provinces. East Flanders lost its leading role, falling back to the fourth position. Its share of Belgian GDP fell dramatically from 21 percent in 1819 to barely 13 percent by the end of the nineteenth century. In 1846, Hainaut became the new leader. In general, the northwestern part of the country, for centuries the industrial heartland, lost its economic primacy to the axis Hainaut–Namur–Liège. But after 1880, the heyday of the Walloon industrial belt had ended. Other provinces started to catch up in a process that continued until deep into the twentieth century.¹²

12 Blomme and Van der Wee, "Belgian Economy," 82–91; Buyst, "Continuity and Change in Regional Disparities in Belgium during the Twentieth Century," *Journal of Historical Geography*, XXVII, 329–337.

Brabant, which is next to the Sambre and Meuse valleys, boasted a strong performance as well, nurtured by the impressive growth of the capital city of Brussels, which provided a lucrative market for luxury industries and services. At this time, the spatial concentration of economic activity intensified to some extent. In 1819, the three provinces with the largest share accounted for 53 percent of the Belgian GDP; by 1896, it had risen to 56 percent.

START OF THE BELGIAN INDUSTRIAL REVOLUTION As was often the case in nineteenth-century Europe, the localization of coal mines largely determined where modern economic growth would take root. Figure 3 and Table 1 demonstrate that Belgium was certainly no exception to this trend. The provinces with the highest per-capita GDP in 1819—Hainaut and Liège—were two of the areas with the richest coal deposits. But the abundance of relatively cheap energy and minerals was not a sufficient condition. Human capital

Fig. 3 Relative Regional GDP Per Capita in 1819 (Belgium=1, Current Prices)

SOURCE Table 2.

was a necessary pre-condition for the adoption of the mining and manufacturing techniques often pioneered in Britain. Moreover, a small country is able to grow in a sustained way only if entrepreneurs can export their products on a large scale. From that perspective, the proximity of Belgium to Britain was as much a curse as a blessing. Belgian exporters in an early phase had to cope with fierce British competition. Finally, the Belgian Industrial Revolution was built not only on coal and iron but also on cotton and wool.¹³

In 1794, French troops conquered the Belgian provinces and later annexed them to the French Republic. The first years of French rule were chaotic due to confiscations, arbitrary taxation, the brutal imposition of completely new political and legal systems, and the demotion of Brussels from a capital city to a provincial town. But by the turn of the century, Belgian manufacturing started to reap the fruits of easy access to the large French market and protection from British competition. This favorable environment created the right conditions to experiment with new technologies.

In 1799, William Cockerill, an English emigrant technician, produced the first water-driven carding and spinning machines in Verviers for the local export-oriented woolen industry. It proved to be such a success that a completely new sector emerged, modern machine building. By 1812, the province of Liège could count twenty-one machine makers producing 3,600 spinning machines and hundreds of other mechanical devices per year. The introduction of machinery in the Verviers wool industry increased output and profoundly transformed the industry's structure. In 1812, a handful of manufacturers controlled half of the production.¹⁴

In contrast with wool manufacturing, the iron industry enjoyed no major technological breakthroughs during the French period (1795 to 1814). The two innovations that revolutionized the British iron industry, the use of coke for smelting and Cort's puddling and rolling process, remained unknown in Belgium. Well protected behind high French tariff barriers and later the continental blockade, Walloon iron producers were not threatened

13 Pollard, *Peaceful Conquest*, 87–94; Wrigley, *Energy and the English Industrial Revolution* (New York, 2010).

14 Pierre Lebrun, *L'industrie de la Laine à Verviers Pendant le XVIIIe siècle et le Début du XIXe siècle: Contribution à l'Etude des Origines de la Révolution industrielle* (Liège, 1948), 348.

by Britain's substantial cost advantage. In fact, output grew considerably due to the introduction of larger blast furnaces.¹⁵

Another spectacular development, but outside the Hainaut-Liège axis, was the sudden rise of modern cotton manufacturing in Ghent. Before the French annexation, a cotton industry barely existed in East Flanders, except for some calico printing. Lieven Bauwens, a local entrepreneur, played a decisive role in the breakthrough by smuggling a prototype of a mule, or cotton-spinning machine, out of Britain. In 1801, he set up a mechanized factory based on this technology, an example that other business people soon followed. A decade later, Ghent had approximately 10,000 factory workers and 115,000 spindles. The rapid expansion of cotton spinning stimulated other branches of cotton processing. In weaving and calico printing, for instance, Bauwens introduced John Kay's flying shuttle and Patrick Bell's copper cylinder system. As a result, production in these sub-sectors also increased quickly, both quantitatively and qualitatively.¹⁶

In 1814, the Belgian provinces separated from France, merging with the northern Low Countries to form the United Kingdom of the Netherlands. For many Belgian manufacturers, the collapse of the Napoleonic Empire was a serious setback. As the French tariff wall shifted southward, the large French market abruptly was closed off. Moreover, when the continental blockade lifted, the Belgian cotton, iron, and wool industries suddenly confronted fierce British competition, based on superior technology. Many factories went bankrupt, but others responded to the challenge by embracing technological innovation.¹⁷

In the early 1820s, the cotton and wool industries used the profits of the past to introduce power looms and shearing machines, respectively, on a large scale. Again, British mechanics initially played a key role, but Belgian entrepreneurs soon managed to produce their own textile machinery. Steam power also became more widespread during this period. On the organizational front, mechanical cotton spinning and weaving became concentrated under one roof. Only Manchester preceded Ghent in the adoption of vertically integrated cotton factories.

15 Joel Mokyr, *The Industrialization of the Low Countries, 1795-1850* (New Haven, 1976), 51-54.

16 Odilon Périer, *Lieven Bauwens en de Opkomst der Katoennijverheid in Vlaanderen* (Ghent, 1885).

17 Lebrun, Bruwier, Dhondt, and Hansotte, *Essai*, 128-138.

Despite the success of the Ghent cotton industry, the economic prospects of East Flanders looked rather bleak. A major setback for both East and West Flanders were the structural problems in the large, traditionally export-oriented rural linen industry, which suffered from the growing popularity, as well as the cheapness, of cotton. Consequently, prices for linen fell continuously. Linen's stagnant technology depressed the sector's wages and profits.¹⁸

UNBALANCED ECONOMIC DEVELOPMENT The most spectacular developments of the 1820s occurred in metal processing. John Cockerill, William's youngest son, played a pivotal role in the changes that revolutionized the sector throughout the European continent. As soon as John took control of his father's business in Verviers, he began to diversify output. By 1816, he had produced—in addition to textile equipment—hydraulic presses, pumps, and steam engines. His factory in the Liège area along the river Meuse expanded at a dazzling rate, complementing facilities for machine construction with one of the largest foundries in Europe. In 1822, he was the first to introduce the puddling process, converting pig iron to wrought iron, to the European continent.

A year later, Cockerill began construction of the first blast furnace operating on coke in continental Europe. Because the chemical composition of Walloon iron ore differed substantially from the British variant for which the furnace originated, the British mechanics engaged in the construction struggled to adapt their technology to local circumstances. As a result, the coke furnace did not become fully operational until 1826. Cockerill's subsequent acquisition of coal and iron-ore mines ensured that he had the raw materials necessary to build the steamship engines that were now in demand. Ultimately, he controlled all stages of production—from the exploitation of raw materials for the creation of cast iron to machine building. The first fully integrated firm in the United Kingdom of the Netherlands became a reality.¹⁹

18 Chris Vandenbroeke, "Sociale en Conjuncturele Facetten van de Linnennijverheid in Vlaanderen (late 14de-midden 19de eeuw)," *Handelingen der Maatschappij voor Geschiedenis en Oudheidkunde te Gent*, XXIII (1979), 117–174.

19 Karel Veraghtert, "Ambacht en Nijverheid in de Zuidelijke Nederlanden, 1790–1844," *Algemene Geschiedenis der Nederlanden* (Haarlem, 1981), X, 253–360.

Besides the Liège area, another center for metallurgy emerged around Charleroi (province of Hainaut) during the 1820s. In the crisis that hit the local nail industry when Belgium was severed from its important French market, a number of entrepreneurs concluded that a major restructuring of the local economy toward iron production was the only way forward. They took the opportunity to introduce the latest British techniques, such as the puddling process and the use of coke furnaces.²⁰

The Belgian secession in 1830 created serious problems for the Ghent cotton industry. During the previous decade, the Dutch East Indies had become a crucial market for the sector. To punish the rebellious provinces, and to support the expansion of a Dutch cotton industry, the Dutch government imposed high tariffs on Belgian imports into their colonies. Furthermore, fierce British competition on international markets made it difficult for the Belgians to penetrate new outlets in Europe. As a result, the Ghent cotton industry seriously stalled in the early 1830s. The high profits of the late 1820s, however, allowed it to respond to the economic difficulties in creative ways—on the one hand, accelerating the mechanization process and, on the other, by reducing wages and shifting from male to cheaper female workers. Despite all these efforts, however, the number of spindles remained below the level of the late 1820s until the 1850s.²¹

The attempts of the Ghent cotton barons to cut the wage bill were helped by the deteriorating conditions in the rural linen industry. In addition to suffering the structural problems identified earlier, the linen sector could not withstand the quick mechanization of British flax spinning during the 1820s. Intensified competition on international markets drove linen prices further downward. Although mechanical flax-spinning mills were eventually established in Belgium during the late 1830s, the Flemish rural spinners clung to traditional production methods. By accepting continuously longer working days and wage cuts, they hoped to remain competitive, but in vain. Between 1845 and 1847, the potato blight and other harvest failures coincided with a deep crisis in the rural linen industry. Famine and widespread unemployment

20 Lebrun, Bruwier, Dhondt, and Hansotte, *Essai*, 424–433.

21 Peter Scholliers, *Wages, Manufacturers and Workers in the Nineteenth-Century Factory: The Voortman Cotton Mill in Ghent* (New York, 1996), 54–65.

Fig. 4 Relative Regional GDP per Capita in 1846 (Belgium=1, Current Prices)

SOURCE Table 2.

were the dire consequences. The poor shape of the economy in East and West Flanders in 1846 is not fully reflected in Figure 4 and in Tables 1 and 2. Because unemployed people were often registered under their previous occupation, the population census of 1846 overestimated employment.²²

As spectacular as the rural linen industry's decline was the breath-taking expansion of Wallonia's iron output. The growth of cast-iron production in the 1830s and 1840s followed the shift from traditional charcoal blast furnaces to the far more productive coke blast furnaces. Moreover, the substitution of coke for charcoal dramatically changed the iron industry's organization. First, it relocated the center of production. For centuries the availability of wood had determined the iron industry's location, mainly in the

22 Eliane Gubin and Peter Scholliers, "La Crise linière des Flandres: Ouvriers à domicile et Prolétariat urbain (1840-1900)," *Revue belge de Philologie et d'Histoire*, LXXIV (1996), 365-401.

timber-intensive provinces of Luxembourg and Namur. With the introduction of coke furnaces, the presence of coal mines became the decisive geographical factor. The iron-making center of gravity moved rapidly to the rich coal-mining areas of Hainaut and Liège. In Table 2, the effects of Luxembourg's de-industrialization on relative per-capita income are clearly visible. In Namur's case, the decline in iron production was compensated by an increase in coal mining and quarrying.²³

THE SECOND HALF OF THE NINETEENTH CENTURY From about 1850 until the early 1870s, the railway boom in Belgium and in neighboring countries gave a strong boost to the heavy industries concentrated in Hainaut and Liège. Coal production tripled, and the number of mine workers passed the magic figure of 100,000. The innovation of powerful pumps, improved ventilation systems, and new coal-treatment processes brought the Walloon coal mines to the forefront of European technology. In the iron and machine-building industries, the days when British mechanics were in sole possession of state-of-the-art technologies were gone as well. Walloon's ever-larger blast furnaces and more powerful steam engines and locomotives also pushed the technological frontier, presenting Belgian heavy industry with a strong position on foreign markets and triggering mergers and acquisitions sufficient to generate economies of scale. Integrated firms encompassing most stages of production became the norm. In this favorable context, Hainaut and Liège pulled ahead of the rest of Belgium in per-capita income (see Figure 5).²⁴

Meanwhile, East and West Flanders had to deal with the death throes of rural flax spinning. After having employed about 150,000 workers in 1843, flax spinning literally vanished from the economic scene during the 1850s and 1860s. A decade later, rural flax weaving also went into decline. Some of the displaced workers returned to agriculture or found employment in lace production, shoemaking, and other low value-added activities. Others emigrated or commuted to northern France, especially the triangle

23 Paul Michotte, "Localisation de la Grosse Sidérurgie belgo-luxembourgeoise, avant et après 1830," *Bulletin de la Société belge d'Etudes géographiques*, V (1932), 42-73.

24 Jean-Marie Wauteler, *Structures industrielles et Reproduction élargie du Capital en Belgique (1850-1914)* (Louvain-la-Neuve, 1995), 188-193.

Fig. 5 Relative Regional GDP per Capita in 1880 (Belgium=1, Current Prices)

SOURCE Table 2.

Lille–Roubaix–Tourcoing, or to the Walloon industrial belt as an escape from poverty. A last survival strategy was to supplement poorly paid local work with seasonal labor in northern France or Wallonia.²⁵

The agricultural invasion dealt another blow to East and West Flanders after 1880. In this area with few other employment opportunities, agriculture started to shed labor when arable farming lost ground to less labor-intensive animal husbandry. During the first half of the nineteenth century, the Ghent cotton industry's expansion counterbalanced the adverse economic developments in other parts of East Flanders to some extent but not after the 1860s. In a free-trade environment, the Ghent cotton industry

²⁵ *Moniteur Belge*, 13 May 1846, 1208; Benoît Verhaegen, *Contribution à l'Histoire économique des Flandres* (Leuven-Paris, 1961), I, 218–313.

Fig. 6 Relative Regional GDP Per Capita in 1896 (Belgium=1, Current Prices)

SOURCE Table 2.

struggled to survive the onslaught of British competition. Figures 5 and 6 illustrate the deterioration of East Flanders' relative per-capita income.²⁶

The railway boom in Belgium lost steam during the second half of the 1870s, at a time when France and Germany were rapidly increasing production of locomotives and railway equipment. Consequently, the iron and machine-building industries shifted to a lower gear. But a slowdown in domestic and international demand was just one problem. The transition from iron to steel production proved difficult for Belgian metallurgists; Bessemer converters produced good steel only when fed high-quality iron ore. Because the local iron ore or that from nearby Lorraine contained too much phosphor, imports from North Africa, Spain, or

²⁶ Scholliers, *Wages*, 66-76.

Sweden became necessary. For the landlocked provinces of Hainaut and Liège, however, this solution proved too costly. Therefore, Belgian metallurgists continued to produce mainly iron, contrary to the international trend.²⁷

The first signs of exhaustion in coal mining were a slowdown in output growth and an increase in production costs. Under these circumstances, competition from coal fields in northern France and the Ruhr area became a real threat. Starting in the mid-1870s, imports of coal showed a continuous upward trend. The Verviers wool industry fared even worse, never recovering from the crisis of the 1870s and 1880s; exports of woolen cloth suffered from relatively high wage costs and technological sclerosis.²⁸

Brabant, located in the middle of the country, benefited from the presence of Brussels. The expanding capital city provided a solid market for horticulture, luxury industries (paper and printing, haute couture, and specialized food processing), and tertiary, or service, activities. Table 1 shows that Brabant's relative GDP per capita remained roughly stable from 1819 to 1896. Immigration caused a continuous rise in Brabant's share of the Belgian GDP (Table 2).²⁹

Surprisingly, the province of Antwerp fell back in the second half of the nineteenth century (Table 1). Nevertheless, the port of Antwerp flourished because of the city's excellent railway connections with the rapidly growing Ruhr area in Germany. The employment of dock workers grew together with that of workers in port-related industries—food processing and ship repair—and in services such as logistics, wholesale, and finance. But favorable conditions in the city of Antwerp contrasted sharply with severe problems in the countryside. As in adjacent Limburg, sandy soils and poor communications there held back economic development. Small-scale farming in combination with population

27 Jean Gadisseur, "De Industriële Doorbraak," in Guido L. De Brabander (ed.), *De Industrie in België: Twee Eeuwen Ontwikkeling 1780–1980* (Ghent, 1981), 50–87.

28 Daniel Degreve, *Le Commerce extérieur de la Belgique, 1830–1913–1939: Présentation critique des Données Statistiques* (Brussels, 1982), II, 632; Albert Thonnar, "L'Industrie du Tissage de la Laine dans le Pays de Verviers et dans le Brabant Wallon," in Office du travail de Belgique, *Les Industries à Domicile en Belgique* (Brussels, 1904), VI, 109–114, 118–120; François-Xavier van Houtte, *L'Évolution de l'Industrie Textile en Belgique et dans le Monde de 1800 à 1939* (Leuven, 1949), 51–52, 186–190, 266.

29 Anne-Marie Bogaert-Damin and Luc Maréchal, *Bruxelles, développement de l'ensemble urbain, 1846–1961* (Namur, 1978), 37–52.

growth led to a deterioration of relative per-capita income in the countryside.³⁰

After the difficult 1870s and 1880s, the economic sky cleared again. The introduction of what became known as the Thomas–Gilchrist process (invented by Sydney Gilchrist and Percy Gilchrist Thomas) made it possible to turn phosphorous iron ore from nearby Lorraine into good-quality steel. As a result, the metallurgists of Hainaut and Liège could finally join the international steel bonanza of the late nineteenth and early twentieth centuries. The machine-building industry benefited from the emergence of the first global economy. New markets for steam locomotives and rolling stock were established in China and Latin America. Innovative products, such as electric trams and electrical engineering, found promising outlets on the world market as well.

Notwithstanding these successes, the golden age of the Walloon industrial belt had begun to lose some of its shine before the nineteenth century ended. Even though Tables 1 and 2 and Figure 5 illustrate that the area remained the powerhouse of the Belgian economy, its lead in GDP per capita over the other provinces diminished. The growing structural difficulties in the coal-mining sector were crucial. The exhaustion mentioned earlier intensified over time, and from the early 1890s onward, coal production stagnated. The sheer weight of coal mining in the economies of Hainaut, Liège, and Namur acted as a drag on the growth performance of these provinces.³¹

The stagnation of coal output in a period when the steel sector and other energy-intensive industries were booming provoked a steep rise in coal imports from overseas. The Belgian ports, located in the north of the country, were not the only beneficiaries. New coke smelting plants were built along Belgium's internal waterway system. The by-products of these facilities—gas, tar ammonium, benzene, etc.—in their turn attracted chemical industries and others. The canal connecting the river Scheldt with Brussels and Charleroi, in particular, started to become a highly diversified manufacturing axis.³²

30 Reginald Loyer, Buyst, and Greta Devos (eds.), *Struggling for Leadership: Antwerp–Rotterdam Port Competition between 1870–2000* (Heidelberg, 2003), 29–45.

31 Ginette Kurgan-Van Hentenrijk, "Industriële Ontwikkeling," in *Algemene Geschiedenis der Nederlanden* (Haarlem, 1978), XIII, 18–24, 228–236.

32 Paul Olyslager, *De Localisering der Belgische Nijverheid* (Antwerpen, 1947), 211–222.

MIGRATION AND REGIONAL DISPARITIES The share of a province in national GDP is determined not only by relative GDP per capita but also by the direction of population displacement. Usually migrants, whether internal or international, move from relatively poor areas toward richer ones. Permanent, working immigrants who contribute to the GDP of a receiving province also raise the share of the receiving area in national GDP; provinces characterized by net-emigration undergo the opposite effect. In the case of temporary migration, the situation is different. Seasonal workers employed in a province where they do not live contribute part-time to the GDP of the province where they work. Hence, both GDP and GDP per capita rise in provinces that hire seasonal workers; the opposite holds for areas that send seasonal labor.

Table 4 provides an overview of implied net (permanent) migration per province from 1847 to 1900, calculated by subtracting the natural increase from the total change in population between two censuses. Not surprisingly, a relatively rich province like Liège recorded mostly positive implied net-migration rates, whereas poor or declining provinces, such as East and West Flanders or Limburg, recorded consistently negative figures. An exception to the rule is Hainaut. Although it was the second-richest province, it did not generate net-immigration. The rapidly growing employment opportunities in the French coal mines located near the border probably played a role. Yet, middle-income provinces, such as Antwerp and Brabant, managed to attract immigrants thanks to a

Table 4 Implied Net-Migration per Province, 1847–1900

	1847–1856 (%)	1857–1866 (%)	1867–1880 (%)	1881–1890 (%)	1891–1900 (%)
Antwerp	0.1	−0.5	5.5	5.6	1.6
Brabant	−3.7	0.4	5.3	1.5	3.7
West Flanders	−3.2	−4.0	−4.3	−2.8	−3.1
East Flanders	−3.9	−3.7	−3.5	−2.2	−3.5
Hainaut	−0.2	−0.8	0.2	−1.1	1.1
Liège	3.4	2.1	3.0	3.6	−0.1
Limburg	−1.6	−4.3	−5.0	−4.7	−5.1
Luxembourg	−4.8	−5.1	−7.5	−6.3	−3.7
Namur	−2.7	−5.8	−7.8	−3.3	−3.6

SOURCE Population censuses and Ministère de l'Intérieur, *Statistique du Mouvement de la Population et de l'Etat Civil* (Brussels, 1847–1900).

successful port town and capital city. Conversely, the absence of large cities made Luxembourg and Namur unattractive.

Although the provincial implied net-migration rates were not particularly large, they made a difference in the long run. They help to explain, for instance, why Brabant, despite its relatively stagnant per capita GDP, managed to increase its share in national GDP during the nineteenth century (see Table 3).

From a statistical point of view, information about the flows of seasonal labor is scarce. The census of 1897, the only source available, counted about 57,000 seasonal workers, 85 percent of them residing in East and West Flanders or Hainaut. Oddly, the relatively rich province of Hainaut held second position. The northwestern part of Hainaut, however, suffered from the same difficulties as adjacent East and West Flanders. Most of the seasonal workers in these three provinces went to France, where wages were higher than in Belgium, thus contributing to the French GDP. The negative impact on GDP or GDP per capita of the provinces where the seasonal workers resided should not be exaggerated. Even in East Flanders, the area where most of them lived, seasonal labor accounted for only 5 percent of the total labor force.³³

What do we learn from this examination? From a methodological point of view, the construction of representative average wages per province proved hard. Most accounts involve only wages in factories and/or workshops, but in an (early) nineteenth-century context, domestic industry must be included, too. Home workers often concentrated in certain areas and in certain sectors, such as textiles and clothing. Moreover, the gender composition of this group was substantially different from that of factory workers. Ignoring these elements can lead to highly misleading average wages on a provincial level. It is surprising that the international literature devotes so little attention to the issue.

Secondly, the Belgian Industrial Revolution did not lead to radical changes in relative GDP per capita. To the contrary, the hierarchy of rich and poor provinces remained remarkably stable

33 Jean-Pierre Delhay, *Les Ouvriers saisonniers du Hainaut occidental* (Brussels, 1986), 1-68; Firmin Lentacker, *La Frontière franco-belge: Etude Géographique des Effets d'une Frontière Internationale sur la Vie des Relations* (Lille, 1974), 191-212; Edmond Ronse, *L'Emigration saisonnière belge en France* (Ghent, 1933), 70-71.

during the nineteenth century, although the gap between the two sets increased (β -divergence). In relative terms, the Industrial Revolution generated clear winners and areas that were not so fortunate. More importantly, these findings suggest that the foundations of the economic geography of Belgium's Industrial Revolution were shaped during the *ancien régime*, not during the first half of the nineteenth century as the traditional literature maintains. They support the revisionist view, recently advanced in British historiography, of substantial continuity between the eighteenth century and the era of the Industrial Revolution.

As people moved from poor to rich provinces, the localization of economic activity changed dramatically. East and West Flanders lost ground as their large export-oriented domestic industries collapsed. Hainaut and Liège, the coal-mining areas, forged ahead as the abundant supply of relatively cheap energy lured iron making, machine building, and the production of railway equipment. But Brabant also managed to increase its share in Belgian GDP, even without the benefit of "black gold." Brussels, its capital city, was a significant factor that would become even more of one in the next century.³⁴

For the purposes of Belgian historiography, it is important to point out that Hainaut and Liège had already passed their peak in relative GDP per capita by 1880 or so, sooner than anticipated. A slowdown of growth in coal production after the early 1870s turned into stagnation two decades later. The deteriorating fortunes of coal mining had an increasingly negative impact on the growth performance of Wallonia's entire industrial belt. Coal, a blessing during the classical Industrial Revolution era, would become a curse during the twentieth century.

More generally, the debate about the Industrial Revolution focuses too much on the successful sectors and technologies, leaving the declining industries and the regions where they were located largely left in the dark. Industrialization and de-industrialization are closely intertwined, but the historical dynamics between them are still poorly understood because of their heavy influence on regional inequality and migration flows.

34 Buyst, "Continuity and Change," 33–47.