

Industrialization as an Historical Process

by Richard Tilly

This essay offers an historical overview of European industrialization from the perspective of long-run economic growth. Its chronological focus is the period from 1750 to 1914. Starting with Britain's eighteenth-century pioneering role, it then traces the diffusion of industrialization in northwestern Europe during the nineteenth century and relates it to international trade and especially market-friendly institutional changes associated with eighteenth-century proto-industrialization, the delayed spread of industrialization to eastern Europe to the latter's absence. The brief summary of twentieth-century experience also emphasizes international relationships and shows how these determined the contrast between the interwar and post-1945 periods.

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Introduction

From the late eighteenth until well into the second half of the twentieth century, European economic growth has been closely associated with the process of structural change we call "industrialization", i.e., the absolute and relative growth of industrial activity. Indeed, from the perspective of world history, Europe's importance rests largely on the fact that industrialization began here and long remained a European monopoly.¹ It was industrialization, more than anything else, which made the nineteenth century very much a "European Century".

▲ 1

This survey summarizes a vast historiography. Its focus, however, is very largely on the process of long-run economic growth. To interpret industrialization in this light, it considers in addition the role of regional differences and international economic relations. In keeping with the article's title, the text is basically chronological. It distinguishes three periods: early industrialization to 1870, rapid industrialization from 1870 to 1914, and slow further industrialization from 1918 through the 1950s. Since "European Industrialization" cannot be described without reference to regional differences and international relations, their discussion is integrated into the three periods.

▲ 2

In view of the article's stress on the historical, path-dependent character of industrialization, I should at least mention here a cost of that perspective: neglect of what one might call "the correlates of industrialization", i.e. characteristics such as rising income or product per capita, growing capital intensity of production, rising life expectancy, a rising share of the population living in cities (urbanization), the spread of literacy (→ [Media Link #ab](#)), or negative characteristics such as distributional conflict or environmental damage, that have repeated themselves in virtually all known historical cases. Studies that have adopted that perspective doubtless offer a more complete description of industrialization.² Space limitations have dictated its rejection here.

Industrialization and Long-Run Economic Growth in Comparative Perspective

Economic growth is first on the agenda followed here, for industrialization marked the advent of "modern economic growth" (MEG), i.e. of economic change characterized by rising output per capita. In retrospect, it contrasts sharply with the "extensive economic growth" – in which production grew in step with population – that had dominated most of previous world history. Industrialization, after all, embodied the new technologies which delivered the technical progress now widely accepted as the main driving force behind long-term economic growth;³ and it was economic growth, finally, that supplied the basis for Europe's secularly rising living standards. The special place of Europe in the story of modern economic growth is mirrored in Figure 1: (→ Media Link #ac)

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Western Europe did not quite keep pace with the US until 1945, but did remain in the same league, globally speaking. After World War II, moreover, it temporarily enjoyed the benefits of "catching-up growth" and gained on the US.⁴ Note the differences within Europe. It will be argued here that they were largely a product of differential industrialization. Discussion of this point, however, requires cross-country comparison. Table 1 below opens the discussion by following up Figure 1 above with country estimates of gross domestic product (GDP) per capita for a more limited period which covers the years commonly associated with industrialization.⁵

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Table 1. Some Estimates of European GDP per Capita, 1700-1910 (\$ of 1990)

	Year	1700	1760	1820	1870	1913
Country						
Great Britain		1130	1365	1707	3191	4921
Belgium				1319	2697	4220
Netherlands				1821	2753	4049
Denmark				1274	2003	3912
Germany				1058	1821	3648
France				1230	1876	3485
Switzerland				1280	2202	4266
Sweden				1198	1664	3096
Italy				1117	1499	2564
Portugal				963	997	1244
Russia				689	943	1486
Source: Maddison, Monitoring 1995.						

A glance at Table 1 immediately suggests the leading role played by Great Britain – the "First Industrial Nation" – in the history of economic growth. The rough pattern of convergence observed between 1870 and 1913 also brings to mind Karl Marx's (1818–1883) (→ Media Link #ad) famous dictum: "The industrially more developed country only shows to the less developed country a picture of the latter's future."⁶ That dictum, however, became a hypothesis destined to be refuted.⁷ Though by 1870 most West European countries were growing faster and starting to catch up to Britain, their

development did not take the path the latter had taken – for a number of reasons. The first had to do with the role of agriculture: the unique combination of highly concentrated land ownership and relatively large farms in England fostered, from the eighteenth century on, a rapid growth of agricultural productivity and encouraged the early transfer of labor (and capital) to industry and services. As early as 1840 barely a quarter of Britain's labor force was still in agriculture, while even 30 years later agriculture in countries like Germany or France employed roughly double that fraction. Table 2 below generalizes that observation.

▲6

Table 2. Percentage Share of Labor Force in Three Main Sectors, 1850 to 1910/1911

Country and Year	Primary	Secondary	Tertiary
Great Britain			
1851	23	51	26
1911	9	54	37
France			
1856	52	27	21
1911	41	30	29
Germany			
1849	56	24	20
1907	35	40	25
Switzerland			
1850	57	33	10
1910	27	46	27
Sweden			
1870	72	15	13
1910	49	32	19
Source: Fischer, <i>Wirtschaft und Gesellschaft</i> 1985, p. 129.			

Note the negative correlation between the ranking for per capita product and for share of labor force in the primary sector. That offers a rough measure of industrialization.

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A second reason for the uniqueness of Britain's growth path is that its industrial lead – like the technological changes which constituted its "industrial revolution" – was concentrated in cotton (and woolen) textiles and iron to an extent unmatched by the continental "followers". Over the first half of the nineteenth century, for example, cottons, woolens and iron accounted for around one sixth of Britain's total product and 70 per cent of its exports, raw materials and food-stuffs for about 90 per cent of its imports. Third and finally, as Alexander Gerschenkron (1904–1978) (→ Media Link #ae) had argued, British industrialization was a long drawn-out process marked by slow growth, which had begun by the middle of the eighteenth century. When the West European "follower" economies began to industrialize in the nineteenth century, they grew a good deal faster and with higher rates of investment than had Britain during its "industrial revolution" period.⁸ In contrast to Britain earlier, after all, they had a "model" of industrial success to draw on and – where feasible – to emulate.

European Industrialization in Comparative Perspective: Phase 1

The role of Britain as "Workshop of the World" in the early nineteenth century is well known; and that world included the rest of Europe. It was Britain's superior industrial productivity that underlay the great success that her exports enjoyed in Continental Europe during the first half of the nineteenth century. Actually, Great Britain's productivity lead in Europe was not limited to its "leading sectors" but also extended to agriculture. The principle of comparative advantage governing international trade, however, made Britain a net importer of agricultural products.⁹

▲ 9

The features of British industrialization cited above powerfully affected the continental countries. The latter, however, did not constitute a homogeneous bloc; and it is convenient to distinguish between the countries of "Inner Europe" – those that responded to British influence quickly and positively – and the "periphery" – those that did not.¹⁰ The reasons for this differential response had to do with regionally rooted structural differences. This is the place, therefore, to take up the question of regions.

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"Inner Europe" and the Role of Regional Differences

The structural differences just mentioned remind us that the regional character of industrialization is at once one of the most obvious and one of the most frequently forgotten features of European economic history.¹¹ It was not Great Britain as a whole, but parts of it, like Lancashire, parts of Yorkshire, Tyneside, the Midlands and southern Scotland, that first saw industrialization take root. These islands of modernity, in Sidney Pollard's phrase, built on a pre-industrial, "proto-industrial" structure which permitted, just as it dictated, the development of a social class whose existence did not depend on agricultural employment alone and which led to the spread of market-like economic relationships. It was this structure which indirectly stimulated the development of coal technology; and it was at this point – beginning around 1750 – that coal supplies became an independent (and more concentrated) regional base.

▲ 11

By the time industrialization began to accelerate in Western Europe in the nineteenth century most of its countries had already experienced at least a century of "proto-industrialization" – structural change marked by the development of regions with rural industry linked to urban commercial centers responding to an expanding world economy. As in Britain, the Continent's proto-industrial regions usually reflected either adverse agricultural endowment or local availability of raw materials (like flax or wool) which offered supplementary income opportunities. Their spread in the eighteenth century usually developed in proximity to and in tandem with a commercialized agriculture which supplied their food. This growth reflected a degree of freedom from feudal and urban craft guild traditions and obligations in the use of land and labor similar, if not equal, to that which had evolved in much of Great Britain.¹² Not surprisingly, it was in the northwest corner of Continental Europe closest to Britain – "Inner Europe" – that this set of relationships and pockets of "proto-industrialization" most frequently developed, in a broad band stretching across Northern France from about Normandy through what became Belgium and into Holland, then extending down into the Rhine valley of Western Germany and reappearing further east in the Saxon uplands and Lusatia and Silesia. Further south, one can find roughly the same development, in Upper Alsace and in the northeastern corner and along the western border of Switzerland. The Elbe River in the East and the Alps in the South can be taken as the frontiers of "Inner Europe". Beyond those, the pockets of "proto-industrialization" were much rarer and, significantly, feudal traditions and obligations remained much stronger – well into the nineteenth century.¹³

▲ 12

"Proto-industry" affected many branches of industry, but it was in textiles and metal-working that its influence was most widespread. Its importance for the process of industrialization does not lie in the productivity gains it achieved. Its decentralized, cottage-based and labor-intensive structure set narrow transaction and production cost limits that only the mechanized factory would overcome. Its importance lay in its long-run effects on the economic and social structure of the regions in which it developed: it freed part of the rural, agrarian population from total dependence on land and agri-

cultural employment, opened up market opportunities for entrepreneurs, and encouraged capital accumulation based on expanding export markets and a growing labor force willing to work for low wages. Proto-industrial production, finally, meant competition for the other two main forms of industrial organization, the tradition-bound urban craft guilds and the state-sponsored centralized manufactures. These factors, taken together with reforms which came in the wake of the French Revolution (→ Media Link #ag), paved the way in "Inner Europe" for the rapid adoption of the new techniques and organization forms of industrialization. It follows that in Europe's "periphery", where these forces proved much weaker, industrialization had to come later and haltingly.

▲ 13

Broadly speaking, the industrializing regions of Europe were coterminous with the "proto-industrialized" regions described above, beginning in Northern France and what would be Belgium and then spreading eastward and southward. Like their predecessors, these regions were initially just industrial islands, which gradually "colonized" the surrounding territory. Exceptions were regions such as Southern Flanders, Eastern Westphalia and Lower Silesia, where rural industry collapsed and the population either reverted to agriculture or emigrated. Some new regions also emerged, such as the "Ruhr", where coal supplies rapidly transformed an agrarian setting into Europe's most important center of heavy industry.

▲ 14

The Role of International Economic Relations in Phase 1

Industrialization spread outward from Britain in the nineteenth century by means of international economic relations. The German states, from 1834 onwards as a trading bloc, the *Zollverein*, offer an instructive example of the response to Britain's industrial lead from "Inner Europe". Prussian/Zollverein imports of British cotton, woolen and iron products rose from ca. two thirds of total imports in 1815 to more than 80 percent in the early 1830s. Their exports of raw materials and foodstuffs, symmetrically, accounted for about 90 per cent of total exports to Britain in the early 1830s; and even as late as 1860 well over two thirds. Such figures, however, conceal the dynamism of the relationship. First, British exports showed German entrepreneurs that a domestic market existed for such new products and induced them to imitate. Second, relatively cheap and high-quality yarn from Britain formed the basis for domestic manufacture of finished goods and, once those entrepreneurs had mastered the new machine-based technology, for a shift of imports away from finished products to intermediate ones. This also led to the development of German export markets in Eastern Europe and overseas, where Germany's lower wage levels gave its producers a price advantage over British competitors. Anglo-German differences also reflected a shift in comparative cost advantages related to technological change. Railroads, for example, represented a new technology innovated in Britain but one that offered the German economy – thanks to its less developed industry and its topography – greater relative advantages. Recruitment of British engineers and imports of British locomotives and iron rails, characteristic in the 1830s, had mutated, by the 1850s, into pig iron imports for domestic rail production. Ongoing railroad building thus became one of the key bases of the growth of German heavy industry and the growth of the economy as a whole.¹⁴ Similar changes took place elsewhere in "Inner Europe" at roughly the same time (e.g., in Belgium, France, and Switzerland), though the industrial structures in each of these countries developed differently.

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Industrialization: Phase 2 (1870–1914)

In the last third of the nineteenth century a subtle shift in the character of European industrialization began to make itself felt: it reflected the systematic application of science to technology, marked the advent of close ties between science and industry and encouraged the growth of large-scale enterprise. This "Second Industrial Revolution" (Landes) began in "Inner Europe", but altered the relationship between Britain and the Western European countries.¹⁵ Once again, German experience is used here as representative of the latter, even if the Anglo-German comparison offers the starkest contrast. Germany's post-1870 experience diverged sharply from that of Great Britain in two important respects. The first reflected differences in the role of government. In Germany, thanks in part to government support, secondary and higher education – especially its vocational schools, technical colleges and natural science departments of the universities – became a "growth industry", its "output" consisting of highly trained engineers and technicians and of research results in the form of technical knowledge ripe for industrial application. In terms of number of graduates from institutions of higher education, scientific articles listed or patent statistics, Britain remained far behind, relying much more on the

family network and time-honored apprenticeship system. This was most obvious in such science-intensive branches as chemicals or electrical engineering; but it also became apparent in the educational qualifications of top management – as in the steel industry.

▲ 16

The second difference was only indirectly related to government intervention. The Anglo-German science-orientation gap manifested itself in the way large-scale enterprises were organized. An obvious example is the creation of research and development departments (R&D), not only in electrical engineering and chemicals, but in steel and machinery making as well. The contrast went beyond that, however. German heavy industrial enterprises, for example, were vertically integrated and better able to realize energy-saving economies than their British rivals; and in most branches their production had a much higher degree of diversification.¹⁶ The contrast reflects to some extent path-dependence and possibly disadvantages of the pioneer Britain, which remained in a sense "over-committed" to its traditional leading industries. Table 3 suggests one implication of this point.

▲ 17

Table 3. Weights and Growth Rates of Selected Branches of Industry in Great Britain and Germany, 1880–1913 (in %)

Branch	Great Britain		Germany	
	Weight*	Growth Rate+	Weight*	Growth Rate+
Chemicals	2.0	4.86	5.0	6.39
Electric. Equip.	0.8	6.00	1.5	8.00
Coal & Textiles	30.00	1.92	14.00	2.58
*Period average of share of branch in total value added in manufacturing ("Industrie und Handwerk") +Average annual growth of value added, 1880–1913 in %				
Source: Author's calculations, based on Hoffmann et al., <i>Wachstum</i> 1965; and Kennedy, <i>Industrial Structure</i> 1987.				

The growth of large-scale enterprise in this period also benefited from strong financial institutions. With its London-centered capital market, Britain led the world in this respect. By 1870, however, that market and its institutions had come to focus largely on foreign investment, mostly overseas – to the Americas and throughout the British Empire. This outward flow of financial capital, though it reflected comparative advantage and proved profitable, may have encouraged a neglect of domestic industry and the potential of the "Second Industrial Revolution".¹⁷ The contrast to the development of the "great banks" in Germany with their capital market operations and close ties to large-scale industrial enterprise which marked this same period is a strong one. Thus finance may be another reason for the differential growth of large-scale enterprise and industrial output in the two countries.

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Industrialization and International Economic Relations in Phase 2

A number of different processes characterized European international economic relations in this period. The first of these involved trade between the more industrialized countries of "Inner Europe" (including Britain). Intra-European trade increasingly meant the exchange of finished industrial goods, each country specializing in particular branches, for example, with British services (finance and shipping) being exchanged for Swiss clocks and watches, for German optical instruments, or for French luxury clothing, etc. This emerging pattern reflected changing comparative advantage, a shift which included a switch of Britain's industrial exports away from Europe into the Empire and the emergence of Britain (London) as the world's principal money and capital market. Britain was not yet de-industrializing, but its economic center of gravity was clearly moving into services. It paid for its growing import surplus with the rest of Europe by supplying the latter with financial and shipping services.¹⁸ This complementary relationship further stimulated the ongoing industrialization of the Continental countries.

A second process had to do with countries on the European "periphery" such as Greece, Portugal, Russia or Sweden. They entered intra-European trade with exports of primary products such as olives, timber, grain or furs, though only a handful of these countries proved able to undertake structural change and draw lasting benefits from the linkage. This important point may be illustrated with the help of a table which compares performance in a number of the "periphery" countries.

Table 4. Rate of Growth of Exports and Product per Capita in Selected European Countries, 1860–1910 (in 1960 \$ and Percent per Year)

Country	Pc Income 1820	Pc Income 1910	ROG Exports	ROG Pc Income
Portugal	275	290	2.0	.1
Sweden	280	593	4.0	2.2
Balkans*	210	286	4.0	.7
Hungary	230	372	2.7	1.2

*Serbia, Bulgaria and Rumania.
Source: Berend / Ránki, Foreign Trade 1980.

The resultant income growth pattern stemmed from differences in country response to the opportunities of European export markets.¹⁹ Portugal's exports (mainly wine and olives) lagged behind the European average, but – more importantly – they remained unchanged; and the country's per capita income fell still further behind the rest of Europe. Sweden's exports did extraordinarily well; but they were also transformed – from mainly iron ore and timber into iron and steel products, celluloid, and paper – as the country industrialized. The difference between Hungary and the Balkan countries reflects the same story. Hungary experienced just average export success, but its grain exports turned into flour and machinery exports, as Budapest, the capital, became the world's second largest milling center. The Balkans, in contrast, realized export growth far above the European average, but their agrarian character (grain, horses, oil) remained untouched by industrial innovation, and their per capita income levels lagged far behind. What we then have is a contingency table like Table 5, which includes in parentheses the country's per capita income in 1910 as a percentage of the European average.

Table 5. Exports and Role of Structural Change in 4 Countries, 1860–1910

Export Performance	With Structural Change	Without Structural Change
High Growth Rate	Sweden (120%)	Balkan Countries (57%)
Low Growth Rate	Hungary (81 %)	Portugal (58%)

Source: Berend / Ránki, Foreign Trade 1980.

In general, the "periphery" as a whole did fall behind, but the reasons had less to do with conditions of "unequal exchange" imposed by "Inner Europe" – an argument often made – than with the failure of most of these countries to undertake the structural change that is industrialization. That failure may have had several causes, but none was as important, we suggest here, as the heritage of strong feudal traditions which meant the virtual absence of a proto-industrial pre-history coupled to the absence of the development of towns and cities dependent on commerce, rather than the political and administrative functions of government.

Industrialization in the Twentieth Century

From 1914 to 1945 European industrialization slowed down – for both obvious and not so obvious reasons. Two world wars and a world depression obviously wreaked enormous direct economic damage in Europe; and there were indirect effects, especially on international economic relations. Indeed, such was the weight of political events in this period that it is seldom described in terms of the process of industrialization. Nevertheless, most of the main European economies did enjoy industrial growth over the period, at least until 1939. Table 6 below conveys a rough idea of that growth by means of a comparative yardstick.²⁰

▲ 23

Table 6. Index of Manufacturing Growth and Income per Capita in Five Industrial Countries (1913=100)

Country	Manufacturing			Income p.c.
	1913	1928/1929	1937/1938	1937/1938
United Kingdom	100	106	139	120
Germany	100	118	144	114
France	100	139	119	110
Sweden	100	143	231	169
United States	100	172	164	123

Source: Sventnilson, p. 28 (cited in Landes, Prometheus 1969).

Industrial growth of the period was increasingly based on further development of the "new industries" of the late pre-1914 era: the spread of electrical power and the development of electrical appliances and equipment, chemicals, automobiles, aviation, radio, and the telephone. The older industries, such as textiles, steel, or machine tools, also grew, albeit much more slowly. Nazi Germany's industrial advance of the 1930s, of course, resulted largely from war preparations. On the whole, despite some bright spots and a few striking country differences (notably neutrals like Sweden), European industrialization slowed markedly compared with the pre-1914 era.

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How different were the post-1945 years! Recovery was not only more rapid but sustained over a much longer period. Maddison's estimates of per capita product (Table 7) reflect developments well into the postwar period to 1973. Table 7 also includes the US, to suggest the "catching-up" character of the post-1945 era.

▲ 25

Table 7. Estimates of European GDP per capita, 1913–1973 (\$ of 1990)

Country	Year	1913	1950	1973
United States		5301	9561	16689
United Kingdom		4921	6907	12022

*USSR
Source: Maddison, Angus: Monitoring the World Economy, 1820–1992, Paris 1995.

Belgium		4220	5462	12170
Germany		3648	3881	11906
France		3485	3270	12123
Sweden		3096	6738	13493
Switzerland		4266	8939	17953
Italy		2554	3502	10643
Russia*		1486	2834	6058
*USSR Source: Maddison, Angus: Monitoring the World Economy, 1820–1992, Paris 1995.				

It is likely that industrial growth underlay the postwar expansion, though the data are woefully incomplete. Statistics on employment for Western European countries (Table 8 below) show a slowdown in the interwar period, followed by resurgence after 1945. For the United Kingdom the employment figures appear to show first signs of de-industrialization; but for this country, as well as for a few others for which estimates exist, industry's estimated share in production was a good deal higher.²¹ In this period also, industrialization increasingly affected countries of the "periphery", like Hungary, though the European East-West gap remained substantial.

▲ 26

Table 8. Share of Industry in Total Employment (%)

	Year	1910/1913	1930/1931	1960/1961
Country				
United Kingdom		54	46	37
Belgium		45	50	47
Germany		40	40	47
France		30	31	38
Sweden		32	32	45
Switzerland		45	44	50
Hungary		20	24	35
Source: Mitchell, Statistischer Anhang 1985.				

A close look at Western Europe's industrial growth after 1945 shows that the "leading sectors" were almost identical with those of the interwar period: coal, iron and steel, electrical power and equipment, automobiles, machine tools, chemicals, etc. Thus it was not innovation and technological change that made the difference. The explanation favored here returns attention to the role of international economic relations.

▲ 27

former enemy countries; but international cooperation in the interwar period faltered generally, even between the former allies, replaced by what has been called "economic nationalism": International currency instability replaced the stability of the pre-1914 gold and sterling standard, international capital flows shrank and became linked to political conditions, and import restrictions replaced the liberal trade agreements of the pre-war era. The most important casualty of this development was international trade, which shrank. Table 9 below compares the three periods in this respect.

▲ 28

Table 9. Annual Rate of Change in Volume of Exports (in %)

	Year	1890–1913	1913–1950	1950–1960
Country/Region				
United Kingdom		2.1	0.2	1.9
Germany		5.1	-2.5	15.8
France		2.8	1.1	7.2
Western Europe		3.2	0.1	7.0
United States		3.8	2.3	5.0
World		3.5	1.3	6.4
Source: Maddison, Economic Growth 1964.				

The correlation between economic growth and trade in these three periods (obtained by comparing Tables 1, 5 and 7) is striking. This was important because industrialization and economic growth generally depended on the international division of labor and specialization that liberal trade arrangements encouraged. It may be argued that the disastrous economic and political results associated with the economic nationalism and failure of international cooperation of the interwar period led to "learning from history" and a change in the priorities of political leaders in the industrial countries favoring international cooperation. This applied above all to the U.S., which played a much more constructive role after 1945 than it had after 1918. Its crowning achievement, from the point of view of Western Europe, was surely the "Marshall Plan" and its support of intra-European economic cooperation; but European political leaders also interacted more constructively than they had in the aftermath of World War One. It was their cooperation that brought about the EEC, perhaps the most important institutional change of the entire postwar period.²² To some extent, no doubt, cooperation reflected Cold War worries. Whatever the causal mix, however, both international trade and economic growth benefited; and it was the growth of trade (especially of imports), finally, that also magnified the transfer of knowledge about new industrial products and production possibilities and enhanced the "catching-up growth" that marked Western Europe's history in this period.²³

▲ 29

Conclusion

European industrialization began in Great Britain around the middle of the eighteenth century. Political stability, labor-saving innovations in cotton spinning and in ironmaking coupled to cheap and abundant coal put and kept Britain ahead of the rest of Western Europe for over a century. Britain's industrialization made her a Great Power, but it had not been intended. It simply evolved out of Britain's unique history. For the Continental countries of Western Europe conscious imitation of British achievements became a national political goal and a determinant of industrialization. Nevertheless, what enabled those countries to catch up to Britain was that broad similarities in their social and economic institutions had existed and that they were not far behind in the first place. Further to the East and the South of Europe, such similarities were fewer and weaker; and the ability to industrialize proved much more limited – and came much later.

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Focusing on countries as national entities is a necessary simplification for a survey such as this, but it should not ob-

secure the important observation made earlier that industrialization was a regional phenomenon. "Europe", we need to remind ourselves, was not a collection of countries with spatially homogeneous economies. For finer analyses of industrialization than that intended here, the regional perspective is indispensable.

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Finally, international economic relations were seen to have played an important role as a determinant of industrialization. Britain's early specialization in industry depended on its ability to trade industrial exports against agricultural products exported from less industrialized countries. At the same time, this exchange stimulated emulation and industrialization in the latter. The export of capital and emigration of labor overseas were additional features of international relations that probably furthered both the spread and deepening of European industrialization.

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Appendix

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Notes

- ¹ The USA, Canada and Australia must be seen as European transplants.
- ² See, for example Klatt, *Theorie* 1959; and for German industrialization see Tilly, *Zollverein* 1990, esp. pp. 70–73.
- ³ Maddison, *Capitalist Development* 1982, pp. 56–59. There is controversy concerning the determinants of technical progress, see North, *Structure* 1981, pp. 162–186.
- ⁴ For this concept and its application see Abramovitz, *Catching up* 1986.
- ⁵ Note the use here of the "measuring rod" of U.S. dollars of 1990. Some such measure is essential for very long-run comparisons, but it may overstate the nineteenth-century country differences.
- ⁶ Marx was referring here to Britain. Karl Marx, *Das Kapital* (1st ed.), preface. Cited in Gerschenkron, *Economic Backwardness* 1962, p. 6.
- ⁷ Gerschenkron used the Marx quote as an anti-thesis for his own work. This paragraph draws on the contributions in Sylla / Toniolo, *Patterns* 1991, as well as on Crafts, *British Economic growth* 1985, especially chapters 7 and 8.
- ⁸ See on this *ibid.* See also Table 1 (Great Britain from 1760, the "followers" from 1820).
- ⁹ This "principle" goes back to David Ricardo (1772–1823). For its application here see Crafts, *British Economic*

Growth 1985, pp. 145–147; and Pollard, *Peaceful Conquest* 1981, pp. 164–184.

10. ^ The following draws on Pollard, *Peaceful Conquest* 1981.
11. ^ See Kiesewetter, *Industrialisierung* 1996; and Kiesewetter, *Region und Industrie* 2000, esp. pp. 106–144.
12. ^ As North and others have argued, transaction cost savings related to better specified (and better protected) property rights underlay the growth of international markets and inter-local market relations on which proto-industrialization was based. See North, *Structure* 1981, esp. pp. 166–170; also Pfister, *Wachstum* 1998, esp. pp. 40–46.
13. ^ In addition to Pollard, *Peaceful Conquest* 1981; see also Buchheim, *Industrielle Revolutionen* 1993, pp. 84–90; Kriedte / Medick / Schlumbohm, *Industrialisierung* 1977 and idem: *Sozialgeschichte* 1992; and Pfister, *Wachstum* 1998.
14. ^ The best book on this subject is Fremdling, *Eisenbahnen* 1985. It has an English language summary, pp. 221–236.
15. ^ Landes, *Prometheus* 1969, p. 196. The economic historian Douglass North called this the "Second Economic Revolution" and regarded it as equivalent in importance to the "First Economic Revolution" of 8,000 B.C. which created agriculture and "civilization". North, *Structure* 1981, p. 171.
16. ^ On education see Erickson, *British Industrialists* 1959; and Pierenkemper, *Schwerindustriellen* 1979 (for steel); also Kocka, *Unternehmer* 1975. A summary of this contrast is in Kindleberger, *Overtaking* 1973; and Tilly, *Zollverein* 1990.
17. ^ See Edelstein, *Overseas Investment* 1982, for a positive assessment; Kennedy, *Industrial Structure* 1987, for a negative one.
18. ^ And indirectly via its Empire, which registered export surpluses with other industrial countries. See on this Saul, *Studies* 1960; and Imlah, *Economic Elements* 1958.
19. ^ The table uses the older per capita income estimates of Bairoch, *Gross National Product* 1976. These estimates, however, show the same ranking of European countries as in Table 1.
20. ^ Manufacturing production is roughly equivalent to industrial production, while the UK adds Scotland and Northern Ireland to "Great Britain".
21. ^ For Britain in 1955 over 53 percent (Deane / Cole, *Economic Growth* 1962, p. 178), for West Germany in 1959 60 percent (Hoffmann et al., *Wachstum* 1965, p. 451).
22. ^ See especially Milward, *European Rescue* 1992; also Tilly in Tilly / Welfens / Heise, *50 Years* 2007.
23. ^ See Abramovitz, *Catching up* 1986; also Crafts / Toniolo, *Economic Growth* 1996.

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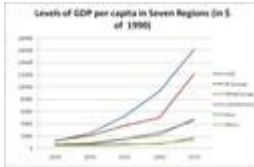
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