ORIGINAL ARTICLE

An annual index of Irish industrial production, 1800–1913

Seán Kenny[1,2,3] | **Jason Lennard**[4,5,6] | **Kevin Hjortshøj O'Rourke**[5,7,8]

[1]Department of Economics, University College Cork

[2]Department of Economic History, Lund University

[3]Centre for Economic History, Queen's University Belfast

[4]Department of Economic History, London School of Economics

[5]Centre for Economic Policy Research

[6]Economic Statistics Centre of Excellence

[7]NYU Abu Dhabi

[8]National Bureau of Economic Research

Correspondence
Jason Lennard
Email: J.C.Lennard@lse.ac.uk

Abstract

We assemble the Irish industrial data currently available for the years 1800–1921, the period during which the entire island was in a political union with Great Britain, and construct an annual index of Irish industrial output for 1800–1913. We also construct a new industrial price index. Irish industrial output grew by an average of 1.3 per cent per annum between 1800 and the outbreak of the First World War. Industrial growth was slightly slower than previously thought, especially during the two decades immediately preceding the Great Famine. While Ireland did not experience absolute deindustrialisation either before the Famine or afterwards, its industrial growth was disappointing when considered in a comparative perspective.

KEYWORDS
industrial production, Ireland, historical national accounts

JEL CLASSIFICATIONS
E01, N13, N14

The question of how well the Irish economy fared during the union with Great Britain (1800–1921) has always been politically fraught.[1] On the one hand, Irish nationalists at home and abroad blamed the British connection for Ireland's relative underdevelopment: free trade with Britain had led Ireland, 'with all its natural resources', to 'hurl from its bosom its mechanics, its laborers and its farmers to become toilers and wanderers in strange lands'.[2] To Arthur Griffith, founder of Sinn Féin, manufacturing was essential for prosperity, protection was required for Irish

---

[1] Two Acts of Union (1800 ch. 67 39 and 40 Geo 3) were passed in 1800, bearing the combined title 'An Act for the Union of Great Britain and Ireland'. The legislation came into force in 1801.

[2] Scanlan, *Why Ireland is poor*, p. 24.

manufacturing to develop, and independence was needed to make protection possible.[3] In sharp contrast, in 1911 the *Irish Unionist Pocket Book* argued that 'This country, humiliated by being represented by separatist politicians as a mendicant grovelling in rags and misery, is in reality urging onwards to prosperity'.[4] Ireland, led by Ulster, was on its way to becoming a prosperous industrial society underpinned by the British connection.

The more data we have that can speak to such debates, the better. However, despite many significant advances in recent years, quantifying the nineteenth-century Irish economy remains a work in progress. We lack annual or even decennial national accounts of the sort now available for most western European countries. There have been estimates for individual years: the eve of the Great Famine, 1907, 1911, and 1914.[5] There have also been a series of proxy estimates: O'Rourke uses monetary data and econometrically estimated velocity figures to guesstimate Irish GDP from 1864 to 1913 (but stresses the fragility of the series), Andersson and Lennard use a wide range of economic time series and dynamic factor methods to estimate real GDP between 1842 and 1913, and Geary and Stark use decadal census information on employment by broad sector (agriculture, industry, and services) and sectoral wages (assumed proportional to sectoral productivities) to distribute UK GDP across its constituent regions (including Ireland) for the period 1861–1911.[6] However, none of these contributions span the entire period of the Union, and none of the multi-year estimates are based on the detailed quantification of either output, expenditure, or income that is standard in the literature.

Ongoing efforts to produce more systematic evidence on a par with that produced for other countries have largely focused on the income approach.[7] However, there are good reasons to also focus on output, since from the Famine on, the Irish administration produced official agricultural statistics that were high quality in the context of the time.[8] Indeed, several of the aforementioned point estimates used output data; it also bears mentioning that Broadberry et al. have used output data to push British GDP estimates back far beyond the nineteenth century, into periods much less well documented statistically than nineteenth-century Ireland.[9]

In a series of path-breaking publications, Bielenberg has highlighted the wealth of industrial data available for Ireland under the Union, and he and Geary have used these to calculate long-run manufacturing growth rates during the first two quarters of the nineteenth century.[10] Such estimates are essential in adjudicating long-standing debates about Irish economic performance both

---

[3] Griffith, *The resurrection of Hungary.*

[4] Cited in Strachan and Nally, *Advertising, literature and print culture in Ireland*, p. 139.

[5] Mokyr, *Why Ireland starved;* Bielenberg and O'Mahony, 'An expenditure estimate'; Ó Gráda, *Ireland*. In an appendix, Feinstein, *National income, output and expenditure*, computed real output for Great Britain, thus omitting Ireland from his UK estimates. He noted that, as a by-product of the exercise, it was possible to obtain an output index for Ireland but cautioned that the latter was to be used 'with extreme caution' (p. 212). Cullen therefore probably deserves the accolade of having produced the first national income estimate for Ireland (in 1911) in an unpublished 1974 paper. This estimate was later published by Cullen and Smout, 'Economic growth in Scotland and Ireland'. See Cullen, 'Context and development'.

[6] O'Rourke, 'Monetary data and proxy GDP estimates'; Andersson and Lennard, 'Irish GDP'; Geary and Stark, 'Examining Ireland's post-Famine economic growth'; isdem, 'Regional GDP in the UK'.

[7] Begley et al., 'Estimating Irish GDP'.

[8] Turner, *After the Famine*. But see also Solar, 'The pitfalls of estimating Irish agricultural output'.

[9] Broadberry et al., *British economic growth.*

[10] Bielenberg, 'Industrial growth in Ireland'; idem, 'A survey of Irish flour milling'; idem, 'The Irish distilling industry under the Union'; idem, 'What happened to Irish industry?'; idem, *Ireland and the industrial revolution*; Bielenberg and Johnson, 'The production and consumption of tobacco in Ireland'; Bielenberg and O'Mahony, 'An expenditure estimate'; Bielenberg and Solar, 'The Irish cotton industry'; Bielenberg and Geary, 'Growth in manufacturing output'.

before and after the Famine. How good or bad was it, both before and after the Famine, relative to other periods of Irish history? Relative to Britain? Relative to the experiences of other small, agricultural countries close to Britain, such as Denmark? Does the answer depend on whether you look at growth in absolute, per capita, or per worker terms?

The mainstream nationalist view, associated not just with politicians like Griffith, but also with traditional historians like O'Brien, was that the Act of Union was devastating for Irish economic development because it exposed Irish industry to the full force of British competition, making it impossible for the country to adopt trade or industrial policies that were suited to its particular stage of development.[11] Overall growth was disappointing, and this was driven above all by a poor industrial performance. Cullen took issue with O'Brien: the lack of a national trade policy was not crucial, and in any event, deindustrialisation was not a general phenomenon, but rather limited to textiles.[12] Mokyr disagreed with Cullen, arguing that pre-Famine Ireland did in fact experience deindustrialisation; Ó Gráda agreed that industrial decline across much of the country was a problem, but doubted that trade policy had much to do with this.[13] The question of whether or not Ireland deindustrialised before the Famine has thus taken on considerable analytical, as well as purely factual, significance in the literature.

Irish industrial growth is also important in assessing the country's post-Famine economic performance. There is little doubt that Irish living standards converged on British ones between the Famine and the First World War: as Kennedy et al. noted, this emerges from the per capita GDP point estimates cited earlier, and it emerges even more strongly from the available real wage evidence.[14] The question is why. An obvious candidate is emigration: post-Famine Ireland was unique in seeing a continuous decline in population that lasted until well into the twentieth century. Per capita improvement that was due to a fall in the number of capitas would obviously appear less impressive than growth on the basis of agricultural improvement or industrialisation. On the other hand, the increase in the dependency ratio resulting from persistent emigration could imply that per capita performance understates labour productivity growth in industry. Hatton, O'Rourke, Williamson, and others attribute the bulk of the real wage convergence (as opposed to real wage growth) to migration; Begley et al. dispute the extent of the convergence and downplay the role of emigration in bringing it about.[15] According to them, TFP improvements, capital accumulation, and structural change – the sorts of factors driving growth in other European economies at the time – were more important. This argument would be strengthened if Irish industry had grown rapidly between the Famine and the First World War.

In this paper, we build on the pioneering work of Bielenberg, bringing together the series collected by him and other scholars, as well as series collected by ourselves, to create a compendium of industrial data that is, we think, as comprehensive as currently possible for Ireland under the Union.[16] We then discuss these series' coverage and reliability. On the basis of this information, we construct an annual industrial output index for the island of Ireland spanning the period of

---

[11] O'Brien, *The economic history of Ireland.*

[12] Cullen, *An economic history of Ireland.*

[13] Mokyr, *Why Ireland starved;* Ó Gráda, *Ireland.*

[14] Kennedy et al., *The economic development of Ireland*, pp. 17–20; Hatton and Williamson, *Migration and the international labor market*; Williamson, 'Economic convergence'; O'Rourke and Williamson, *Globalization and history.*

[15] Begley et al., 'Convergence in the pre-1914 Atlantic economy'.

[16] Of the 30 output series, 10 are drawn entirely from, and a further four are partially based on, Bielenberg's work. Of the 25 price series, five are fully or partly based on existing research. All of the other price series are either from primary sources or Riordan, *Modern Irish trade and industry.*

1800–1913 (appendix I). We do so in the spirit of Angus Maddison and the Maddison Project that carries on his work and name: the aim is not to provide a definitive series but to produce an index that reflects our current state of knowledge in as systematic and transparent a manner as possible in the hope that this will stimulate future scholars to improve on our work.[17] In the supporting information, we thus present the underlying individual series for all the years they are available in the hope that this will make their task easier.[18] We also believe that making these individual series easily available is a useful contribution in its own right.

We begin by outlining the methodology used to construct our index, before presenting the main results in section II. We then place Ireland's post-Famine industrial performance in a comparative perspective in section III, asking what our results mean for the debate about Irish performance, or underperformance. Section IV concludes.

I | DATA AND METHODOLOGY

We have assembled data on the output of 30 industries. This involved constructing new data, such as the output of biscuits, gas, and newspapers, and collecting existing data, such as the production of grain, railways, and spirits. The series, coverage, sources, and transformations are outlined in appendix II, while the data themselves are presented in appendix V (figure AV.1 and the supporting information).

The series should measure the domestic output of Irish industries. However, in many cases domestic output data were not directly available, as is common when constructing historical industrial production indices. We therefore use a number of indirect measures. First, imports are sometimes used to proxy domestic output when the major input into the industry in question was imported, as in the case of cotton or cocoa.[19] Second, exports are sometimes used as a proxy if the bulk of domestic output was exported, as in the case of mackerel.[20] Third, we use the output of a major firm if it produced a significant fraction of domestic output.[21] For example, we use the output of Jacob's, which was 'by far the largest-biscuit making firm in Ireland'.[22] Where we use a substitute instead of a direct measure of output, we not only make this clear, but also provide supporting evidence to justify our choice. However, we do not resort to wholesale prices, equity prices, other financial variables, or employment figures. Romer, Calomiris and Hanes, and Davis stress the importance of avoiding such series.[23] They argue that physical quantities produced are the ideal measure of output. Davis, for example, 'eliminated annual indicators of general business or financial conditions not explicitly associated with genuine production'.[24]

A handful of series are measured in nominal, as opposed to real, terms: bread and biscuits; canals, docks, etc.; local authorities; tramway/light rail; and water (public). In the case of bread

---

[17] Bolt and van Zanden, 'The Maddison Project'.

[18] Kenny et al., 'Data and code'.

[19] Davis, 'An annual index of U.S. industrial production'; Bielenberg and Solar, 'The Irish cotton industry'.

[20] Department of Agriculture and Technical Instruction for Ireland, *Report on the sea and inland fisheries of Ireland for 1905*.

[21] Davis, 'An annual index of U.S. industrial production'.

[22] Bielenberg, *Ireland and the industrial revolution*, p. 73.

[23] Romer, 'Cyclical behavior'; Calomiris and Hanes, 'Consistent output series'; Davis, 'An annual index of U.S. industrial production'.

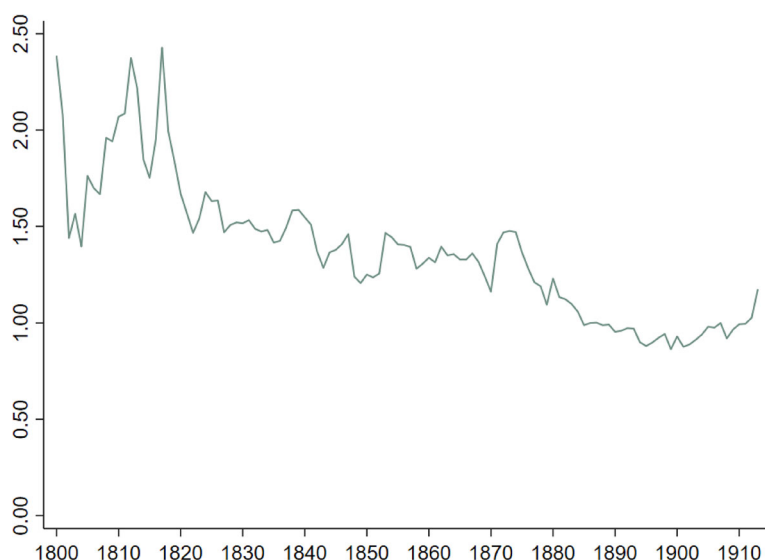[24] Davis, 'An annual index of U.S. industrial production'.

FIGURE 1   New annual index of Irish industrial prices, 1800–1913 (1907 = 1). *Source*: See section I [Colour figure can be viewed at wileyonlinelibrary.com]

and biscuits, we deflated nominal output using a specific bread and biscuits deflator.[25] In the other cases, an industry-specific deflator was not available. We therefore deflated nominal output using a new industrial price index, which is shown (for the years 1800–1913) in figure 1.[26] The index is based on the prices of 25 individual items, which are described in appendix III. These individual items are aggregated into an industrial price index using the same procedures as are applied to the industrial production index (see below).

To construct an index of industrial production, the output of individual industries must be weighted to reflect their relative importance. A number of historical industrial production indices are weighted by employment.[27] However, the best practice is to weight by value added.[28] Our weights are based on Bielenberg's revisions to the *Final report on the first census of production of the United Kingdom*.[29] Among other things, the census recorded the value added in 77 Irish industries in 1907, which is the base year of our index. Table 1 shows the value added in these industries.

An interesting feature of Irish industry is how concentrated in a few major industries it was. The top four industries (jute, hemp, and linen; brewing; clothing, handkerchiefs, and millinery; and shipbuilding/other) accounted for 48.6 per cent of industrial value added in 1907; the equivalent figure in the UK as a whole was just 34.4 per cent. More systematically, using the Herfindahl index we can compute the degree of industrial concentration as the sum of squares of the value-added shares for each of the 77 industries reported in table 1 ($H = \sum_{i=1}^{N} v_{i0}^2$, where v_{i0} is the value-added

---

[25] Mitchell, *British historical statistics*, p. 771.

[26] In figure AIV.6 we explore the robustness of the industrial production index to using industry-specific deflators.

[27] Harley, 'British industrialization before 1841'; Bielenberg and Geary, 'Growth in manufacturing output'.

[28] Davis, 'An annual index of U.S. industrial production'.

[29] *Final report on the first census of production of the United Kingdom*; Bielenberg, 'What happened to Irish industry?'.

TABLE 1 Value-added weights (%)

	Industry group	Industry		Industry group	Industry
Food and drink	29.96		Building and contracting	5.62	
Brewing		15.49	Building and contracting		4.30
Bread and biscuits		4.21	Glass/stone/roof felt/etc.		0.66
Grain milling		3.07	Brick and fireclay trades		0.38
Spirits		2.25	Works/public buildings		0.17
Butter, cheese, marg, etc.		1.56	Other trades		0.09
Aerated waters, etc.		1.08	Naval buildings		0.02
Bacon curing		0.95	Papers, newspapers, etc.	4.51	
Bottling		0.63	Printing/bookbinding		1.99
Cocoa, confectionery, etc.		0.42	Newspapers/periodicals		1.88
Other food and drink		0.22	Paper trade		0.26
Fish curing		0.06	Stationery		0.18
Sugar and glucose		0.00	Cardboard boxes		0.17
Textiles	23.83		Other paper, newspapers, etc.		0.03
Jute, hemp, linen		19.19	Timber trades	2.38	
Bleach, dyeing, printing, etc.		1.80	Timber trades		1.11
Woollen and worsted		1.09	Furniture/furnishing		0.68
Rope, twine, net		0.77	Carriages/carts, etc.		0.35
Cotton trade		0.35	Wooden crates/cases		0.16
Flax scotching		0.32	Other timber trades		0.08
Hosiery		0.14	Chemicals, etc.	1.58	
Silk		0.13	Fertiliser/disinfectants		0.80
Other textiles		0.03	Soap/candles		0.38
Iron, shipbuilding, etc.	11.50		Chemical trades		0.22
Shipbuilding/other		6.01	Other chemicals, etc.		0.18
Railways		2.74	Mining/quarrying	0.83	
Engineering trades		2.20	Limestone quarries, etc.		0.26
Iron and steel		0.18	Other quarries		0.22
Govt yards/lighthouses		0.14	Coal and ironstone		0.18
Cycle/motor trades		0.11	Other mining/quarrying		0.11
Blacksmithing trade		0.08	Slate quarries		0.06
Tools/implements		0.04	Coke works		0.00
Clothing	9.47		Oil shale mines		0.00
Clothing, handkerchiefs, and millinery		7.88	Leather	0.35	
Laundry, cleaning, and dyeing		0.99	Leather		0.13
Boots and shoe trades		0.51	Saddlery/harness		0.13
Hats, caps, and bonnets		0.05	Other leather		0.09
Other clothing		0.05	Other metals	0.22	

(Continues)

TABLE 1 (Continued)

	Industry group	Industry		Industry group	Industry
Utilities	8.36		Miscellaneous	0.12	
Local authorities		4.19	Other miscellaneous		0.09
Gas		2.42	Musical instruments		0.03
Water (public)		0.80	Excluded residual (tobacco)	1.26	
Electricity		0.49			
Tramway/light rail		0.20			
Telephone		0.16			
Water (companies)		0.08			
Canals, docks, etc.		0.02			

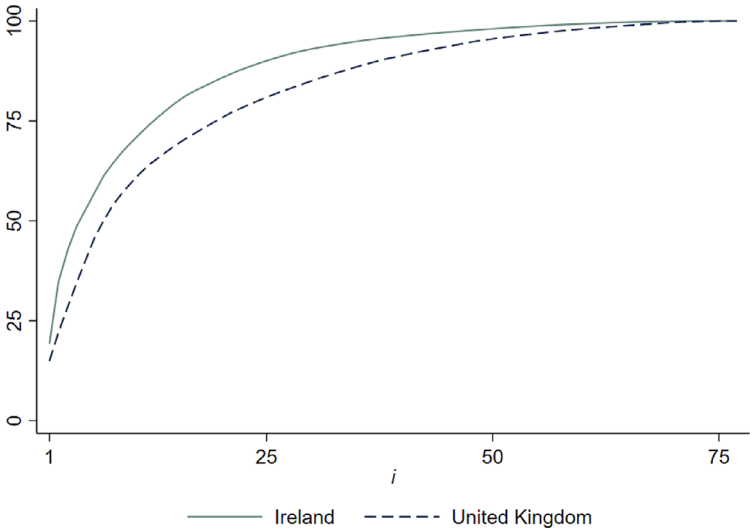*Source*: Bielenberg, 'What happened to Irish industry?'.

FIGURE 2 Cumulative share of value added in Irish and UK industries (%). *Source*: Calculated from Bielenberg, 'What happened to Irish industry' [Colour figure can be viewed at wileyonlinelibrary.com]

share of industry i in 1907). We can also do this for the UK as a whole, since Bielenberg also reports the UK value-added shares for the same industries. The Herfindahl index for Ireland was 0.0819, while for the UK it was 0.0507, implying a much higher degree of concentration in Ireland. Figure 2 shows the cumulative share of value added for the 77 industries in Ireland and the UK. Again, concentration was much higher in Ireland. The practical implication is that a few high value-added industries accounted for a significant share of total industrial output in Ireland. A more diffuse industrial concentration, such as Britain's, requires more series to achieve the same coverage. We do not have output series for all 77 industries.[30] Nevertheless, at 30 series, our index is not light on data, and the 30 series account for 78.5 per cent of industrial value added in 1907.

---

[30] The largest industry for which we do not have data is clothing, handkerchiefs, and millinery.

TABLE 2 Reliability grades

Reliability grade		Margin of error
A	Firm figures	±<5%
B	Good estimates	±5% to 15%
C	Rough estimates	±15% to 25%
D	Conjectures	±>25%

The oft-cited Miron–Romer and Davis indices of US industrial production are based on 13 and 41 series, respectively.[31]

As stated above, our objective was to collect as much data as possible for the period during the union with Great Britain (1800–1921). The question then is to determine how reliable these data are and how good the coverage they provide is. In terms of quantity, panels A and B of figure 3 show the number of series available in each year (the maximum being 30) and their share of 1907 value added. The results suggest that the coverage begins at a decent base, rises steadily from the 1840s, and collapses after 1913, as the First World War and the struggle for independence disrupted the flow of economic statistics. Our series capture an average of 53 per cent of 1907 value added prior to 1840, reaching a peak of 78 per cent between 1904 and 1913, before plunging to 49 per cent in 1921.

In terms of quality, the margins of error associated with the series can be conveyed with reliability grades, which should help to indicate the periods in which the data are strongest and weakest.[32] The classification system, based on Feinstein's classic work, is set out in table 2.[33] The grades run from A (firm figures of less than ±5 per cent) to D (conjectures of more than ±25 per cent). As Feinstein noted, these grades are 'no more than the investigator's "best guess" as to the likely margins of error'.[34]

Figure 3 also plots the share of 1907 value added by grade between 1800 and 1921. The quality of the series improves over time, with a leap in the 1850s, but deteriorates after 1913.[35] As a result, in this paper we have chosen to present an index only for the years prior to 1913. However, in the supporting information we present the original series through to 1921 in the hope that this may aid future scholars wishing to extend our index forwards in time. On balance, figure 3 suggests that our index is less reliable before the Famine than after.[36]

Armed with the output and value added of individual industries, we can calculate a Laspeyres quantity index:

$$IP_t = \sum_{i=1}^{N} ip_{it}v_{i0} \qquad (1)$$

---

[31] Miron and Romer, 'A new monthly index'; Davis, 'An annual index of U.S. industrial production'.

[32] We are grateful to Cormac Ó Gráda for this suggestion.

[33] Feinstein, *National income, output and expenditure*.

[34] Ibid., p. 20.

[35] Unfortunately, there are a few series with the lowest reliability grade. The likely consequence of using these conjectures is to increase the volatility of the index.

[36] In an earlier version of the paper, we therefore only provided an index from 1840 onwards. A referee urged us to extend it back to 1800, and we have taken that advice on board.
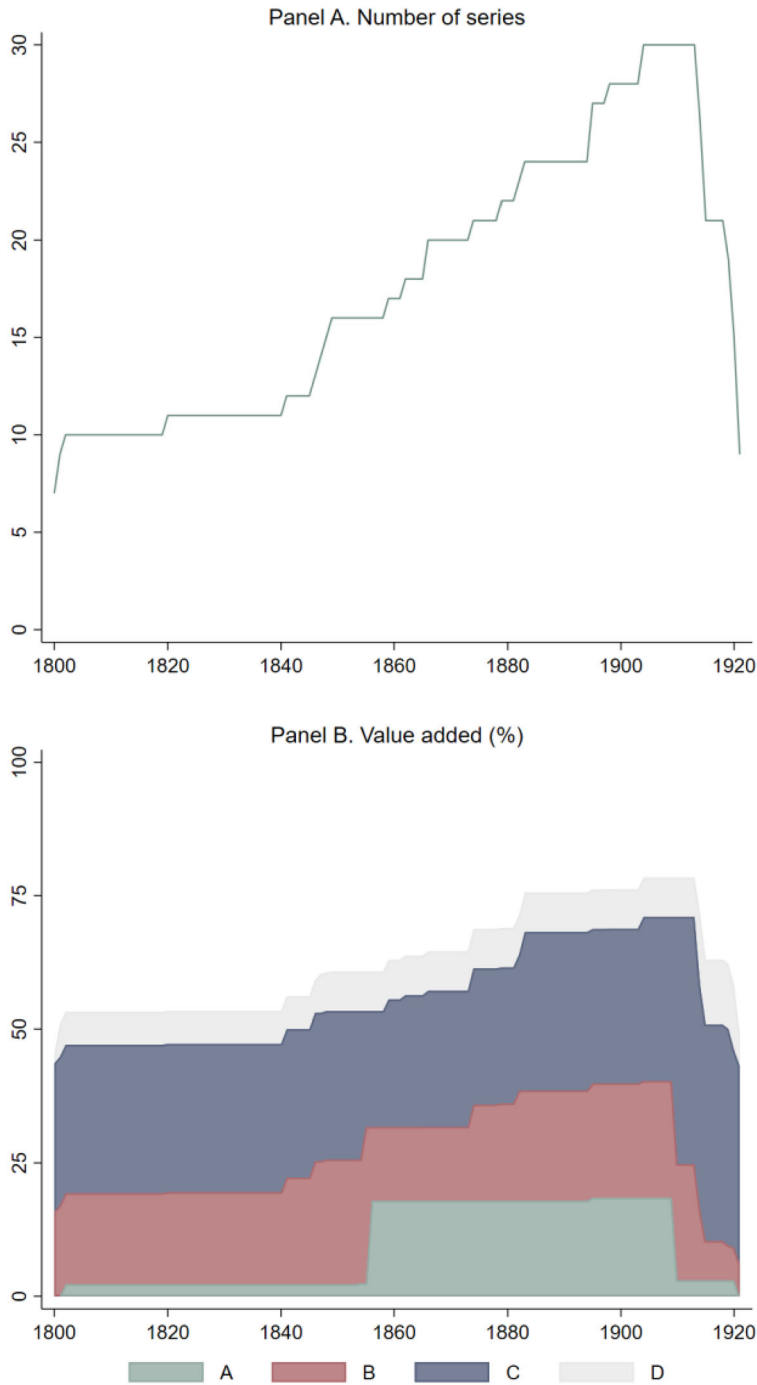
FIGURE 3 The quantity and quality of data, 1800–1921. *Source*: See section I [Colour figure can be viewed at wileyonlinelibrary.com]

where ip_{it} is the output of industry i at time t relative to 1907 and v_{i0} is again the value-added share of industry i in 1907.[37]

Constructing a historical industrial production index for any country involves a number of challenges. The first is a lack of data for all industries at all times, as discussed above. One way we address this is by using 'imputed weighting'.[38] This involves reallocating the weight of a missing industry to the other industries in the group. For example, for the industry group 'leather', which includes leather, saddlery/harness, and other leather, we have data for leather but not for saddlery/harness or other leather. We therefore allow our series for leather to stand in for the entire industry group, assigning it the full weight of the latter (0.35 per cent). If data for an industry group is missing, we reallocate its weight to the groups that we have data for.[39] In order to avoid jumps in the series, for each year that the data coverage changes, we splice our index with an alternative index excluding the industry for which there is no data.[40] To explore the robustness of our imputed weighting procedure, in appendix IV we cap the weight of Ireland's leading industries so that, where value added is reallocated, it is not reallocated to industries that are potentially unrepresentative. Another way of addressing missing data is that, for a small number of observations, we log-linearly interpolate to fill the gaps that are listed in appendix II.

A second challenge concerns changes in the composition of output over time. Ideally, this can be overcome by using multiple value-added benchmarks. Unfortunately, the 1907 census was the first to report net output in Irish industries. To gauge the importance of this issue, we use two alternative estimates of value added in appendix IV, one in 1840–5 and another in 1907, for a coarser set of industry groups.[41]

Another challenge is 'survivorship bias', which can occur when the output of a major firm is used to proxy the output of the industry: these firms may suffer idiosyncratic shocks or otherwise not resemble smaller or defunct firms in the industry.[42] Given our relatively light use of such series, it is unlikely that this is a major problem in our index, but appendix IV explores the impact of dropping brewing, for which Guinness is used as a proxy (but only from 1800 to 1805 and 1910 to 1913).

Another potential problem involves the use of exports, such as for linen, butter, and processed meat. Exports, by definition, exclude domestic consumption, and their use can lead to bias.

A final challenge is conceptual: which industries should be included in an index of industrial production? There are two possibilities. The first is to use contemporary classifications so that we include the industries covered by the *Final report on the first census of production of the United Kingdom*.[43] The second is to use modern classifications such as the Standard Industrial Classification (SIC). In this context, the main difference between the two is that local authorities are included in the contemporary definition but excluded from modern classifications. While the provision of government services is not included in an index of industrial production, the

---

[37] Davis, 'An annual index of U.S. industrial production'.

[38] Frickey, *Production in the United States*, p. 25; Davis, 'An annual index of U.S. industrial production'.

[39] This treatment of missing data will distort simple calculations of the distribution of output across industries for years other than 1907 by inflating the share of observed industries. The best that one can do under such circumstances is to assume that unobserved and observed industries grow at the same rate.

[40] Miron and Romer, 'A new monthly index'; Davis, 'An annual index of U.S. industrial production'.

[41] Bielenberg, 'Industrial growth in Ireland', p. 226.

[42] Davis, 'An annual index of U.S. industrial production'.

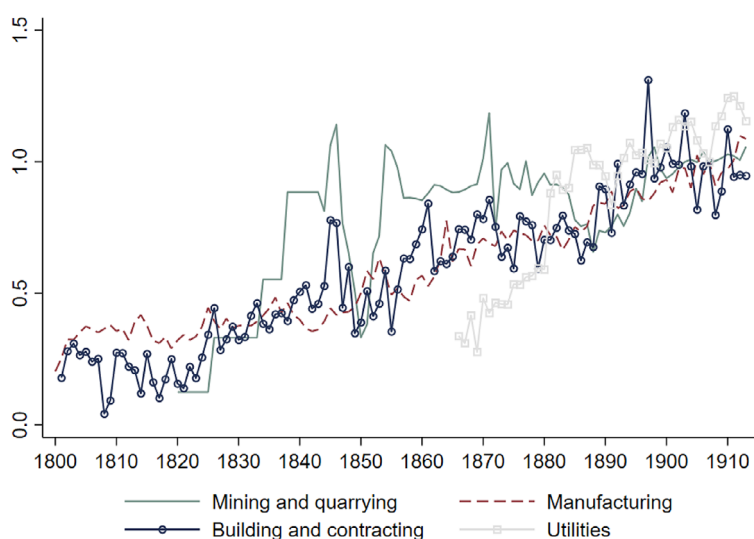[43] *Final report on the first census of production of the United Kingdom*.

FIGURE 4 New annual subindices of Irish industrial production, 1800–1913 (1907 = 1). *Source*: See section I [Colour figure can be viewed at wileyonlinelibrary.com]

category captured by the *Final report on the first census of production of the United Kingdom* focuses on works done on public buildings, highways and bridges, street and road lighting, tunnels and subways, etc. Therefore, it is closer to industry than to services. In addition, this definition is in keeping with the historiography.[44] On balance, we opt to base our index on the contemporary classification. However, in appendix IV we recalculate the index on a modern footing by excluding local authorities.

II | RESULTS

We now turn to the results. Figure AV.1 shows the estimates of output by industry for the entire 1800–1921 period. Figure 4 presents new subindices of industrial production between 1800 and 1913 for four broad categories: mining and quarrying, manufacturing, building and construction, and utilities. Figure 5 plots the new aggregate index, which is reported in table AI.1. Between 1800 and 1913, industrial production grew by 1.3 per cent per year on average.[45] On this basis, output doubled roughly every 54 years. Figure 6 normalises by population.

As previously noted, in appendix IV we gauge the robustness of our index in seven ways: holding constant the value-added weights of Ireland's leading industries rather than adjusting them upwards to account for missing data; using two benchmarks for value added; excluding brewing; using an alternative series for linen; removing local authorities; deflating utilities with an alternative deflator; and excluding the least reliable series. Our index appears to be robust to these methodological alternatives.

---

[44] Bielenberg, 'What happened to Irish industry?'.

[45] The growth rates reported in the text are compound averages, where the start and end observations are 5-year centred averages, unless otherwise stated.
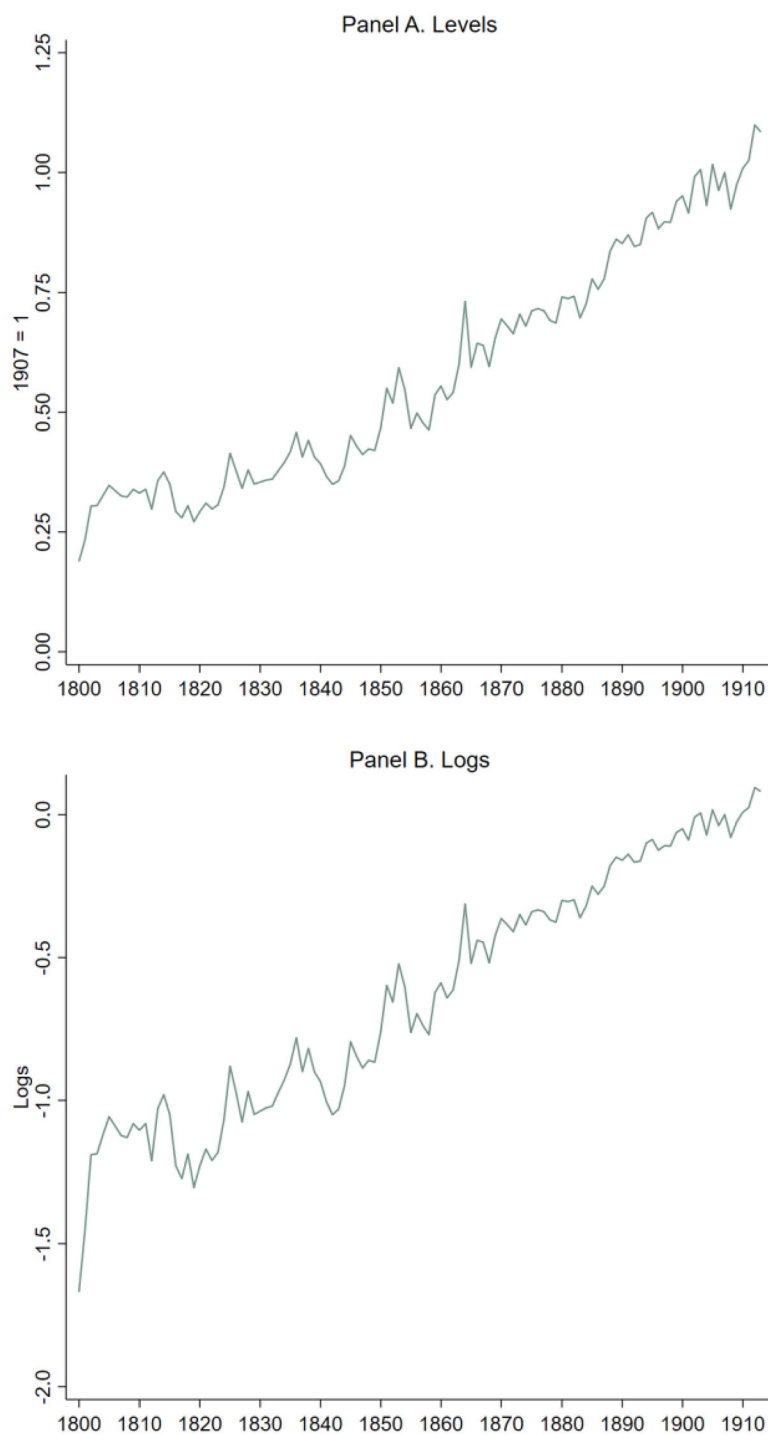
FIGURE 5 New annual index of Irish industrial production, 1800–1913. *Source*: See section I [Colour figure can be viewed at wileyonlinelibrary.com]

FIGURE 6   New annual index of Irish industrial production per capita, 1800–1913. *Source*: Industrial production: see section I. Population: Mitchell, *British historical statistics*, pp. 11–3 [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 3   Comparison of average industrial production growth (%)

Period	Bielenberg and Geary	Bielenberg	New index	Population
1802–25	1.4		1.2	1.3
1825–45	1.4–1.5		0.7	0.7
1845–1907		1.5–1.7	1.4	−1.0

Sources: Mitchell, *British historical statistics*, pp. 11–3; Bielenberg, 'Industrial growth in Ireland', p. 254; and Bielenberg and Geary, 'Growth in manufacturing output'.

How does our index compare with previous estimates of Irish industrial growth? Bielenberg and Bielenberg and Geary estimated growth rates between pairs of benchmark years; table 3 compares their estimates with those obtained for the same years using our index.[46] As can be seen, our new index gives the same impression of modest but sustained growth. However, our estimates are slightly more pessimistic, especially for the two decades immediately preceding the Famine.

For the two sub-periods 1802–25 and 1825–45, Bielenberg and Geary estimate growth rates of 1.4 per cent and 1.4 per cent to 1.5 per cent, respectively, whereas we calculate lower figures of 1.2 per cent and 0.7 per cent for the same periods.[47] Between 1802 and 1845, we find that Irish industry grew by 0.9 per cent per annum. In absolute terms, there was no deindustrialisation in pre-Famine Ireland. On the other hand, between 1802 and 1845, population grew by 1.0 per cent.[48] Per capita growth was therefore close to zero over the period.[49]

For the years between 1845 and 1907, Bielenberg reports average growth of 1.5 per cent to 1.7 per cent, while once again we find a slightly lower rate of 1.4 per cent.[50] Industrial growth between the Famine and the First World War (1851–1913) averaged 1.2 per cent per annum. Since population was falling during the period, at an average rate of 0.7 per cent per annum, this translated into a significantly faster per capita growth rate of 1.9 per cent per annum.

Figure 7 plots our index against several other recently computed nineteenth-century Irish macroeconomic indices: agricultural output, real GDP, broad money supply, and share prices.[51] As can be seen, industrial output grew more rapidly than either agricultural output or total GDP, but at a roughly similar rate to the financial variables.[52]

What accounted for the growth of Irish industry? While it is not possible to compile a full set of growth accounts without information on the capital stock, from 1841 on we can decompose industrial production (IP_t) into a term that measures industrial labour productivity (IP_t/L_t), a term that captures industrial labour force participation (L_t/N_t) and a term that accounts for population (N_t) using the following identity:

$$IP_t = \frac{IP_t}{L_t} \frac{L_t}{N_t} N_t \qquad (2)$$

[46] Bielenberg, 'Industrial growth in Ireland'; Bielenberg and Geary, 'Growth in manufacturing output'.

[47] Bielenberg and Geary, 'Growth in manufacturing output'.

[48] Mitchell, *British historical statistics*.

[49] Furthermore, aggregate growth does not rule out the possibility that certain sectors or regions declined.

[50] Bielenberg, 'Industrial growth in Ireland', p. 254.

[51] Turner, *After the Famine*; Andersson and Lennard, 'Irish GDP'; Kenny and Lennard, 'Monetary aggregates'; Hickson and Turner, 'Pre- and post-Famine indices'; Grossman et al., 'A monthly stock exchange index'.

[52] Kennedy et al., *The economic development of Ireland*, p. 18, provide estimates of GDP growth (per capita) between 1830 and 1913 of 0.7 per cent (1.6 per cent) per annum. Consistent with figure 7, our industrial output series displays faster growth over this period also, in both aggregate (1.3 per cent) and per capita (2 per cent) terms.
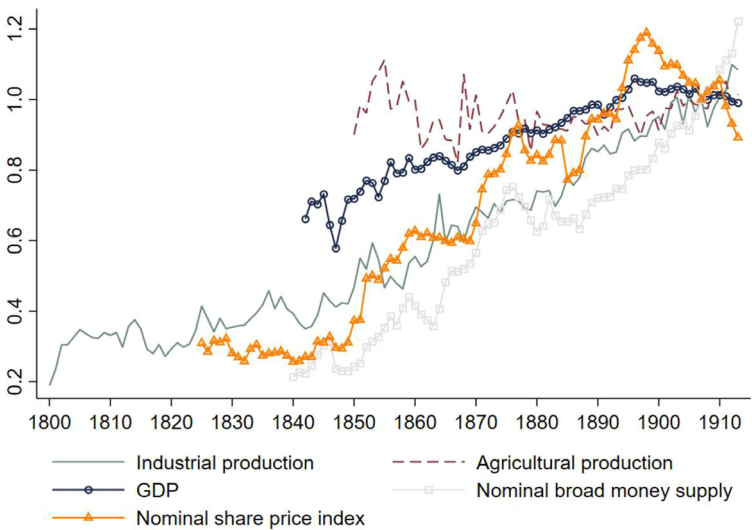
FIGURE 7 Macroeconomic indicators, 1800–1913. *Sources*: See section I and Turner, *After the Famine*; Andersson and Lennard, 'Irish GDP'; Kenny and Lennard, 'Monetary aggregates'; Hickson and Turner, 'Pre- and post-Famine indices'; and Grossman et al., 'A monthly stock exchange index' [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 4 Growth accounting (1841 = 1)

	Industrial production	Industrial labour productivity	Industrial labour force participation	Population
1841	1.00	1.00	1.00	1.00
1851	1.50	2.07	0.91	0.79
1861	1.44	2.40	0.85	0.71
1871	1.86	3.53	0.80	0.66
1881	2.01	4.59	0.70	0.63
1891	2.38	5.49	0.76	0.57
1901	2.50	6.10	0.76	0.54
1911	2.80	7.67	0.68	0.53

Sources: Industrial production: see section I. Industrial employees: Geary, 'Deindustrialization in Ireland to 1851', and Geary and Stark, 'Examining Ireland's post-Famine economic growth'. Population: Mitchell, *British historical statistics*, pp. 11–3.

where IP_t is industrial production, L_t is the number of industrial employees, and N_t is population at time t. The results are reported in table 4 for the census years between 1841 and 1911, indexing industrial production, industrial labour productivity, and population to be equal to 1 in 1841.[53] The growth in industrial production, which increased by a factor of 2.8 over 70 years, was due to remarkable labour productivity growth, which rose by 3.0 per cent per year on average.[54] This

---

[53] Although we use existing estimates of industrial employment, it should be noted that allocating employees across censuses, even into broad sectors such as agriculture, industry, and services, is a challenging task.

[54] Table AV.1 shows that labour productivity growth was faster in Ireland than in the United Kingdom.

growth could be due to improvements *within* industries, involving capital accumulation, technical progress, or lower misallocation, or because of shifts *between* industries, with workers moving from low- to high-productivity industries.[55] The strong productivity growth in industry does not depend on the new data. If we relied on the growth rates from Bielenberg, we would find that productivity improved by 3 per cent to 3.2 per cent a year in this period.[56] Weighing against this, though, were two factors: first, a decline in industrial labour force participation, as the share of the population working in industry declined from 13.4 per cent in 1841 to 9.2 per cent in 1911, a fall of almost a third, and second, a decrease in population, which fell by 47 per cent.

These results have important implications for the debate on deindustrialisation. On one hand, focusing on employment suggests that industry was dwindling. On the other hand, studying industrial production leads to the conclusion that industry was flourishing. Table 4 reconciles these views. The output of Irish industry expanded despite a shrinking industrial labour force owing to the productivity growth of those that remained. However, the fact that the *share* of the labour force employed in industry declined means that higher Irish living standards growth, relative to growth in Britain, the United States, and elsewhere, was unlikely to have been due to the structural transformation associated with industrialisation that was driving catch-up growth in other countries during this and subsequent periods.[57]

An interesting question is whether the strong labour productivity growth was simply due to a declining labour force, or rather to total factor productivity growth (TFP) and/or capital deepening. To answer this question, we first decompose the labour productivity term, IP_t/L_t, into:

$$\frac{IP_t}{L_t} = A_t \, K_t^{\alpha} L_t^{-\alpha} \tag{3}$$

where A_t is industrial TFP, K_t is industrial capital, L_t is industrial employees, and α is the elasticity of industrial production with respect to industrial capital. We then rewrite equation (3) in terms of the rate of growth of labour productivity:

$$\Delta \ln \left(\frac{IP_t}{L_t} \right) = \Delta \ln A_t + \alpha \Delta \ln K_t - \alpha \Delta \ln L_t \tag{4}$$

Despite not observing TFP or capital, we can explore the counterfactual of what would have happened to labour productivity if the industrial labour force had fallen at its actual rate but TFP and capital had remained fixed by setting $\Delta \ln A_t$ and $\Delta \ln K_t$ to 0 in equation (4). We take the difference between the actual and counterfactual outcomes as being due to efficiency gains and/or capital deepening. Table 5 reports the results for three values of the elasticity: a medium value of $\alpha = 0.4$ that is standard in the literature, a low value of $\alpha = 0.3$, and a high value of $\alpha = 0.5$.[58]

The results suggest that there was a boost to labour productivity as a result of the fall in the industrial labour force during and after the Famine. However, this was only a small part of the productivity boom. The decline in the industrial labour force explains between 15 per cent and 25 per cent of the growth in labour productivity, whereas efficiency gains and capital accumulation

[55] McMillan et al., 'Globalization, structural change, and productivity growth'.

[56] Bielenberg, 'Industrial growth in Ireland'.

[57] See Broadberry, 'United States and Germany' and Temin, 'The golden age', among many others.

[58] Broadberry and de Pleijt, 'Capital and economic growth in Britain'.

TABLE 5 Decomposing labour productivity growth, 1841–1911

	Actual change in log labour productivity	Counterfactual change in log labour productivity	Due to change in employees (%)	Due to total factor productivity growth and capital deepening (%)
$\alpha = 0.3$	2.04	0.30	14.83	85.17
$\alpha = 0.4$	2.04	0.40	19.78	80.22
$\alpha = 0.5$	2.04	0.50	24.72	75.28

Source: See authors' calculations.

explain 75 per cent to 85 per cent. Even at the limits, with $\alpha = 1$ or $\alpha = 0$, the latter factors account for between 50 per cent and 100 per cent of the productivity gains.[59] Geary and Stark also find that TFP growth and capital deepening were major sources of productivity growth in Ireland.[60]

III | POST-FAMINE IRISH INDUSTRIAL GROWTH IN COMPARATIVE PERSPECTIVE

Irish industry grew substantially after the Famine, albeit at a slower pace than was previously thought. It grew even more rapidly in per capita terms as a result of emigration. Industrial growth clearly played a role in driving overall Irish growth during this period, but did it also help to explain that (modest) fraction of Ireland's per capita growth that *exceeded* growth in richer countries? This seems less likely.

Figure 8 compares Irish industrial growth with growth in Britain, the United States, and Denmark, another small, largely agricultural economy of the time. As can be seen, industry grew less rapidly in Ireland than in any of the other three economies. Between 1818 and 1913, when data are available for each country, Irish industrial growth of 1.4 per cent per annum was slow compared with growth of 3.5 per cent in Denmark, 2.8 per cent in Britain, and 5.3 per cent in the United States.[61]

Table 6 broadens the comparison, giving average manufacturing growth rates over two sub-periods, 1870–96 and 1896–1913, for a wide range of European countries as well as the United States. We include both manufacturing and industrial growth rates for Ireland.[62] Standard convergence logic suggests that manufacturing growth should have been more rapid across the European periphery than in rich countries such as the United States or Belgium, and by and large those expectations are borne out by the evidence. Irish industry stands out, however, as having grown

---

[59] This simulation does not account for human capital.

[60] Geary and Stark, 'Examining Ireland's post-Famine economic growth'; idem, "growth"; idem, "Regional", 'Regional GDP in the UK'.

[61] As figure AV.2 shows, slower growth in Ireland relative to Great Britain implies that the Irish share of industrial production in the United Kingdom declined. Irish industrial output growth does not even stand out in per capita terms (figure AV.3), except vis-à-vis Britain. Between 1851 and 1913, the average per capita growth rates are: Ireland 1.9 per cent, Denmark 2.3 per cent, the United States 2.3 per cent, and Britain 1.3 per cent.

[62] The non-Irish data are taken from Bénétrix et al., 'The spread of manufacturing to the poor periphery', updated using the annual growth rates in isdem, 'Measuring the spread of modern manufacturing to the poor periphery'. They calculate average growth rates over these sub-periods by regressing the log of output on a time trend, and we do the same for Ireland in this table. While Bénétrix et al. tried to collect manufacturing data wherever possible, in some cases they were obliged to use industrial output.
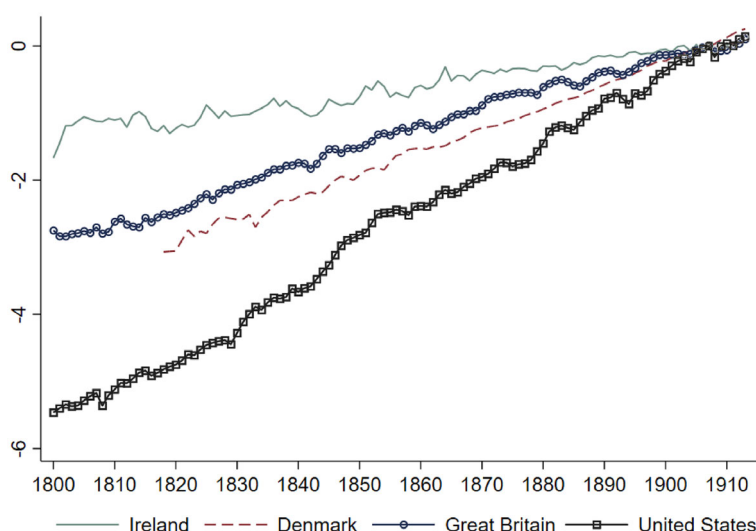
FIGURE 8 Industrial production in four economies, 1800–1913 (log scale). *Sources*: See section I and Hansen, *Økonomisk Vækst i Danmark*; Feinstein, *National income, output, and expenditure*; Broadberry et al., *British economic growth*; and Davis, 'An annual index of U.S. industrial production' [Colour figure can be viewed at wileyonlinelibrary.com]

unusually slowly during the late nineteenth century. Not only were Irish growth rates slower than anywhere else in the European periphery, but they were also slower than anywhere in the core as well. Since Ireland's population was shrinking during this period, in per capita terms its underperformance is not so stark. Even so, Irish per capita growth remains unimpressive in a comparative perspective, particularly from 1896 onwards when it was slower than in any other country listed in table 6, with the exceptions of Spain and the UK.[63] To that extent, it seems hard to argue that Ireland's relatively slow industrial growth helped the country's per capita GDP to converge on that of richer economies like Britain or the United States. On the other hand, the evidence in table 5 supports authors like Begley et al., who emphasise that absolute Irish per capita growth during this period was, for the most part, due to capital accumulation and technological change.[64]

---

[63] Persistent emigration resulted in a relatively high share of young and old in the remaining Irish population. By 1926, 38 per cent of the Irish Free State were dependants: Saorstát Éireann, *Census of Population 1926*. Relative per capita growth may therefore understate relative productivity growth. Indeed, Irish industrial output per worker seems to have grown at an internationally respectable rate between 1881 and 1911: at 1.7 per cent per annum the Irish industrial productivity growth rate was somewhat slower than in other peripheral European economies such as Austria, Denmark, Germany, Italy, and Sweden (2 per cent to 2.1 per cent), but it was substantially higher than in rich countries such as Belgium, France, the Netherlands, the UK, and the United States. The figures are as follows: Belgium (0.2 per cent), France (1896–1911) (1.7 per cent), Germany (2.1 per cent), Netherlands (1889–1909) (0.3 per cent), the UK (0.7 per cent), the United States (1.5 per cent), Denmark (2.0 per cent), Sweden (2.1 per cent), Austria (2.1 per cent), Italy (2.2 per cent), and Spain (0.6 per cent). Sources: Mitchell, *International historical statistics*, for France, Austria and Germany; Broadberry and Irwin, 'Labor productivity', for the UK and the United States; Fenoaltea, 'The growth of the Italian economy', and Malanima and Zamagni, '150 years of the Italian economy', for Italy; de la Escosura, *Spanish economic growth*, for Spain; Enflo and Roses, 'Coping with regional inequality in Sweden', for Sweden; Hansen, *Økonomisk Vækst i Danmark*, Danmarks Statistik, *Befolkningsforholdene,* and idem, *Folkemængden*, for Denmark; Mitchell, *International historical statistics*, and Smits et al., 'A dataset on comparative historical national accounts', for Belgium and the Netherlands.

[64] Begley et al., 'Convergence in the pre-1914 Atlantic economy'.

TABLE 6   Manufacturing growth, 1870–1913 (per cent per annum)

Groups	Country	Aggregate		Per capita	
		1870–96	1896–1913	1870–96	1896–1913
Rich core	Belgium	1.6	2.7	0.7	1.7
	France	2.4	2.0	2.1	1.8
	Germany	3.1	3.6	2.1	2.2
	Netherlands	2.9	2.9	1.7	1.5
	Switzerland	2.6	4.5	2.0	3.3
	The United Kingdom	1.9	1.5	1.0	0.6
	The United States	4.6	4.9	2.4	3.0
Scandinavia	Denmark	4.7	4.5	3.7	3.3
	Norway	2.3	3.4	1.6	2.6
	Sweden	3.8	5.4	3.2	4.7
European	Austria	5.0	3.8	4.1	2.8
Periphery	Bosnia and Herzegovina	12.4	8.0		
	Bulgaria	2.9	4.8	1.5	3.6
	Finland	4.4	4.2	3.0	3.1
	Hungary	5.0	3.8	4.5	3.0
	Ireland (industry)	**1.2**	**1.0**	**1.9**	**1.3**
	Ireland (manufacturing)	**1.0**	**1.2**	**1.7**	**1.4**
	Italy	2.1	4.0	1.4	3.2
	Portugal	2.1	2.5	1.3	1.7
	Romania	3.9	4.5	9.3	6.7
	Russia	5.5	3.9		1.8
	Serbia and Montenegro		7.0		
	Spain	2.7	1.7	2.2	1.1

Source: See section I and Bénétrix et al., 'The spread of manufacturing to the poor periphery', and isdem, 'Measuring the spread of modern manufacturing to the poor periphery'.

That seems to have been true of industry, at any rate. The fact that industrial output grew more rapidly than GDP (figure 7), despite a decline in industry's share of employment, suggests that productivity growth was higher in Irish industry than in the rest of the economy.

IV | CONCLUSION

Conclusions based on a new index such as the one presented in this paper need to be tempered with caution, given the problems of data availability highlighted above. This is particularly true of the pre-Famine period. That having been said, the data currently available to us suggest that, while Ireland did not experience aggregate deindustrialisation either before or after the Famine, its industrial performance was relatively disappointing when viewed in a comparative perspective. We find slightly less growth than previous estimates, particularly during the two decades immediately preceding the Famine. According to the numbers presented here, there was little, if any, per capita industrial growth before the Famine. Aggregate Irish industrial growth picked

up slightly after the Famine, and per capita growth even more so, but it remained relatively slow when compared with the experiences of other European economies at the time.

We hope that we have convinced the reader that there are abundant data available for Irish industry during the Union. While in this paper we have only presented aggregate indices for the 1800–1913 sub-period, the data for individual industries available in the supporting information are useful in their own right in assessing performance. We hope that this paper will advance the quantification of the nineteenth-century Irish economy, and that future research will not only improve and extend our industrial indices forwards (and maybe even backwards) in time, but also combine these with other output indicators so as to obtain a more accurate overview of trends in Irish GDP during a tumultuous period in the country's history.

REFERENCES

Andersson, F. N. G. and Lennard, J., 'Irish GDP between the Famine and the First World War: estimates based on a dynamic factor model', *European Review of Economic History*, 23 (2019), pp. 50–71.

Begley, J., Bielenberg, A., and Cullen, L. M., 'Estimating Irish GDP from the mid-nineteenth century to the First World War', *Irish Economic and Social History*, 37 (2010), pp. 75–104.

Begley, J., Geary, F., and Stark, T., 'Convergence in the pre-1914 Atlantic economy: what really happened to wages in Ireland between 1881 and 1911?', *Cambridge Journal of Economics*, 40 (2016), pp. 43–67.

Bénétrix, A. S., O'Rourke, K. H., and Williamson, J. G., 'The spread of manufacturing to the poor periphery 1870–2007', *Open Economies Review*, 26 (2015), pp. 1–37.

Bénétrix, A. S., O'Rourke, K. H., and Williamson, J. G., 'Measuring the spread of modern manufacturing to the poor periphery', in K. H. O'Rourke and J. G. Williamson, eds., *The spread of modern industry to the periphery since 1871* (Oxford, 2017), pp. 13–29.

Bielenberg, A., 'Industrial growth in Ireland; *c*. 1790–1910', unpub. PhD thesis, London School of Economics (1994).

Bielenberg, A., 'A survey of Irish flour milling, 1801–1922', in A. Bielenberg, ed., *Irish flour milling: a history 600–2000* (Dublin, 2003), pp. 59–87.

Bielenberg, A., 'The Irish distilling industry under the Union', in D. Dickson and C. Ó Gráda, eds., *Refiguring Ireland: essays in honour of L. M. Cullen* (Dublin, 2003), pp. 290–315.

Bielenberg, A., 'What happened to Irish industry after the British industrial revolution? Some evidence from the first UK Census of Production in 1907', *Economic History Review*, 61 (2008), pp. 820–41.

Bielenberg, A., *Ireland and the industrial revolution: the impact of the industrial revolution on Irish industry, 1801–1922* (Abingdon, 2009).

Bielenberg, A. and Geary, F., 'Growth in manufacturing output in Ireland between the Union and the Famine: some evidence', *Explorations in Economic History*, 43 (2006), pp. 119–52.

Bielenberg, A. and Johnson, D., 'The production and consumption of tobacco in Ireland, 1800–1921', *Irish Economic and Social History*, 25 (1998), pp. 1–21.

Bielenberg, A., and O'Mahony, P., 'An expenditure estimate of Irish national income in 1907', *Economic and Social Review*, 29 (1998), pp. 107–32.

Bielenberg, A. and Solar, P. M., 'The Irish cotton industry from the industrial revolution to partition', *Irish Economic and Social History*, 34 (2007), pp. 1–28.

Bolt, J. and van Zanden, J. L., 'The Maddison Project: collaborative research on historical national accounts', *Economic History Review*, 67 (2014), pp. 627–51.

Broadberry, S. N., 'How did the United States and Germany overtake Britain? A sectoral analysis of comparative productivity levels, 1870–1990', *Journal of Economic History*, 58 (1998), pp. 375–407.

Broadberry, S. N., Campbell, B. M. S., Klein, A., Overton, M., and van Leeuwen, B., *British economic growth, 1270–1870* (Cambridge, 2015).

Broadberry, S. N. and de Pleijt, A., 'Capital and economic growth in Britain, 1270–1870: preliminary findings', Centre for Economic Policy Research discussion paper no. 15889 (2021).

Broadberry, S. N. and Irwin, D., 'Labor productivity in the United States and the United Kingdom during the nineteenth century', National Bureau of Economic Research working paper no. 10364 (2004).

Calomiris, C. W. and Hanes, C., 'Consistent output series for the antebellum and postbellum periods: issues and preliminary results', *Journal of Economic History*, 54 (1994), pp. 409–22.

Cullen, L. M., *An economic history of Ireland since 1660* (London, 1972).

Cullen, L. M., 'Irish national income in 1911 and its context', Economic and Social Research Institute working paper no. 63 (1995).

Cullen, L. M., 'The context and development of historical national accounts in Ireland', *Irish Economic and Social History*, 37 (2010), pp. 75–84.

Cullen, L. M. and Smout, T. C., 'Economic growth in Scotland and Ireland', in L. M. Cullen and T. C. Smout, eds., *Comparative aspects of Scottish & Irish economic and social history 1600–1900* (Edinburgh, 1977), pp. 3–18.

Davis, J. H., 'An annual index of U.S. industrial production, 1790–1915', *Quarterly Journal of Economics*, 119 (2004), pp. 1177–215.

Enflo, K. and Rosés, J. R., 'Coping with regional inequality in Sweden: structural change, migrations, and policy, 1860–2000', *Economic History Review*, 68 (2015), pp. 191–217.

de la Escosura, L. P., *Spanish economic growth, 1850–2015* (Cham, 2017).

Feinstein, C. H., *National income, output and expenditure of the United Kingdom 1855–1965* (Cambridge, 1972).

Fenoaltea, S., 'The growth of the Italian economy, 1861–1913: revised second-generation production-side estimates', Munich Personal RePEc Archive paper no. 83508 (2017).

Frickey, E., *Production in the United States, 1860–1914* (Cambridge, Mass, 1947).

Geary, F., 'Deindustrialization in Ireland to 1851: some evidence from the census', *Economic History Review*, LI (1998), pp. 512–41.

Geary, F. and Stark, T., 'Examining Ireland's post-Famine economic growth performance', *Economic Journal*, 112 (2002), pp. 919–35.

Geary, F. and Stark, T., 'Regional GDP in the UK, 1861–1911: new estimates', *Economic History Review*, 68 (2015), pp. 123–44.

Griffith, A., *The resurrection of Hungary: a parallel for Ireland* (Dublin, 1918).

Grossman, R. S., Lyons, R. C., O'Rourke, K. H., and Ursu, M. A., 'A monthly stock exchange index for Ireland, 1864–1930', *European Review of Economic History*, 18 (2014), pp. 248–76.

Hansen, S. Å., *Økonomisk Vækst i Danmark* (Copenhagen, 1974).

Harley, C. K., 'British industrialization before 1841: evidence of slower growth during the industrial revolution', *Journal of Economic History*, 42 (1982), pp. 267–89.

Hatton, T. J. and Williamson, J. G., eds., *Migration and the international labor market, 1850–1939* (London and New York, 1994).

Hickson, C. R. and Turner, J. D., 'Pre- and post-Famine indices of Irish equity prices', *European Review of Economic History*, 12 (2008), pp. 3–38.

Kennedy, K. A., Giblin, T. and McHugh, D., *The economic development of Ireland in the twentieth century* (London and New York, 1988).

Kenny, S. and Lennard, J., 'Monetary aggregates for Ireland, 1840–1921', *Economic History Review*, 71 (2018), pp. 1249–69.

Kenny, S., Lennard, J., and O'Rourke, K. H., 'Data and code for: an annual index of Irish industrial production, 1800–1913', Inter-university Consortium for Political and Social Research (Ann Arbor, Mich., 2022).

Malanima, P. and Zamagni, V., '150 years of the Italian economy, 1861–2010', *Journal of Modern Italian Studies*, 15 (2010), pp. 1–20.

McMillan, M., Rodrik, D., and Verduzco-Gallo, Í., 'Globalization, structural change, and productivity growth, with an update on Africa', *World Development*, 63 (2014), pp. 11–32.

Miron, J. A. and Romer, C. D., 'A new monthly index of industrial production, 1884–1940', *Journal of Economic History*, 50 (1990), pp. 321–37.

Mitchell, B. R., *British historical statistics* (Cambridge, 1988).

Mitchell, B. R., *International historical statistics: Europe 1750–1993* (London, 1998).

Mokyr, J., *Why Ireland starved: a quantitative and analytical history of the Irish economy, 1800–* (London, 1985).

O'Brien, G., *The economic history of Ireland from the Union to the Famine* (1921).

Ó Gráda, C., *Ireland: a new economic history 1780–1939* (Oxford, 1994).

O'Rourke, K. H., 'Monetary data and proxy GDP estimates: Ireland 1840–1921', *Irish Economic and Social History*, 25 (1998), pp. 22–51.

O'Rourke, K. H. and Williamson, J. G., *Globalization and history: the evolution of a nineteenth-century Atlantic economy* (Cambridge, Mass, 1999).

Riordan, E. J., *Modern Irish trade and industry* (New York, 1920).

Romer, C. D., 'The cyclical behavior of individual production series, 1889–1984', *Quarterly Journal of Economics*, 106 (1991), pp. 1–31.

Scanlan, J. F., *Why Ireland is poor: ripe fruit from the tree of British free trade* (Chicago, 1880).

Smits, J-P., Woltjer, P., and Ma, D., 'A dataset on comparative historical national accounts, *ca.* 1870–1950: A time-series perspective', Groningen Growth and Development Centre research memorandum no. GD-107 (2009).

Solar, P. M., 'The pitfalls of estimating Irish agricultural output for post-Famine Ireland', *Irish Economic and Social History*, 25 (1998), pp. 152–6.

Strachan, J. and Nally, C., *Advertising, literature and print culture in Ireland, 1891–1922* (London, 2012).

Temin, P., 'The golden age of European growth reconsidered', *European Review of Economic History*, 6 (2002), pp. 3–22.

Turner, M., *After the Famine: Irish agriculture, 1850–1914* (Cambridge, 1996).

Williamson, J. G., 'Economic convergence: placing post-Famine Ireland in comparative perspective', *Irish Economic and Social History*, 21 (1994), pp. 1–27.

OFFICIAL PUBLICATIONS

Danmarks Statistik, *Befolkningsforholdene i Danmark* (1905).

Danmarks Statistik, *Folkemængden* (1911).

Department of Agriculture and Technical Instruction for Ireland. Report on the sea and inland fisheries of Ireland for 1905 vol. 17 (P.P., 1906).

Final report on the first census of production of the United Kingdom (1907), vol. 109 (P.P., 1912).

Saorstát Éireann, *Census of population 1926* (Dublin, 1928).

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.