Online Appendix to

Cheap Cloth, Dear Bread: Skewed Growth, Trade and the British Living-Standards Paradox

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A Data

A.1 Wages, prices and national accounts

Wages, prices, land rents, the farm share of male employment, national income and population are from Clark (2009), decadal. The share of land rents is computed from the same accounts as farmland rents over net national income less indirect taxes, the definition Clark (2009) uses for factor shares. The workers' food basket is Clark's cost-of-living food index; the price of arable products and of individual farm goods is from Clark's farm-price series; cotton cloth and manufactured iron are from his Appendix Table A1. Calories per head and net imports are from Broadberry et al. (2015, Table 7.06); agricultural output per head uses their real agricultural output for Great Britain divided by their population of Great Britain. The value-added multiplier is from Clark et al. (1995, Table 1). Decadal values are interpolated to annual frequency at mid-decade. Clark's index of manufactured goods, which is made of household items, serves as the price of old manufactures, the numeraire.

A.2 Continental grain prices

The English price of wheat is the Gazette average for England and Wales, the series that Clark (2009) and the Reichsamt compilation both use. For 1770–1814 the continental price is Danzig, from the Parliamentary Papers as reported in Allen and Unger (2019), which quote it in English pence per quarter; for 1815–1870 it is Hamburg, from the compilation of the Statistisches Reichsamt (2008). The Hamburg series cannot be used before 1815 for a reason that is easy to miss: the Reichsamt converted English prices into German currency at a fixed parity, so that during the suspension of cash payments (1797–1821), when the paper pound traded at a discount, the English–Hamburg gap computed in marks or silver overstates the true gap. The Danzig series in English money is free of that problem. For Figure 3 we take the percentage gap between the English and the continental price each year and smooth it with a five-year centred mean. In the model the continental price itself,

in shillings a quarter and smoothed in the same way, is the world price of wheat. The Hamburg price, in marks per tonne, is converted to shillings per quarter at the ratio of the Reichsamt's London series in marks to the Gazette average in shillings, which is constant at 4.83 after 1830. Two gaps in the Danzig series during the war (1807–08 and 1812–13) are filled with the Hamburg price multiplied by 1.10, the average ratio of the two in 1792–1814. The England–Amsterdam gap from Allen and Unger (2019), shown in Figure 3, gives the same chronology at a somewhat lower level. Series with Berlin as the continental market, which the Reichsamt compilation also offers before 1815, give implausibly large pre-war gaps and are not used.

A.3 Irish grain

Mitchell and Deane (1962, Agriculture 9) report, from Parliamentary Papers 1843, vol. LIII, the quantities of wheat and wheaten flour, barley and bere, and oats and oatmeal imported into Great Britain from Ireland each year from 1800 to 1842, and, in Agriculture 10, the imports from foreign countries into the United Kingdom and their re-exports. The "imports" column of their Table A for wheat includes Ireland: in 1834 and 1835, when foreign wheat was nearly excluded, it exceeds the Irish figure only by the small foreign quantities recorded in Agriculture 10. We convert quarters to bushels (eight to the quarter) and bushels to calories with the rates of Broadberry et al. (2015, Table 7.01): 86,667 per bushel of wheat, 71,429 of barley and 63,889 of oats. We apply their losses: 10 per cent in storage for all grains, 20 per cent in milling and baking wheat, 44 per cent in milling oats, and, for barley, 70 per cent for the 80 per cent that was brewed and 22 per cent for the rest. We divide by the population of England and Wales, as the calorie series does. The central case attributes to England and Wales their population share, 84 per cent, of the grain that entered Great Britain and treats half of the oats as horse fodder; the upper rows of Table 2 count all the grain as English food. Robustness checks in Appendix H use the upper figures. The series can be extended to 1848 with the returns used by Bourke (1976).

The net imports in Broadberry et al. (2015, Table 7.06) exclude this grain. They cite Mitchell (1988, 221–5, 233), which contains both kinds of series: the trade of Great Britain, which includes shipments from Ireland (Agriculture 16), and the overseas trade of the United Kingdom, which by construction does not (Agriculture 17 for grain, 19 for meat). Their figures match the second. Converting United Kingdom net imports of wheat, barley and oats from foreign countries into calories at their rates, without deducting losses in storage or milling, and dividing by the population of England and Wales gives 151 kilocalories a day per head in the 1800s and 157 in the 1830s, against their 154 and 139.

Their series is decadal, so we cannot reconcile it year by year; the difference in the 1830s, 18 kilocalories, is a fifth of the baseline Irish correction for that decade and does not change its sign. Adding Irish grain on the same basis would give 215 and 457. Their meat imports (6, 10 and 22 kilocalories in the 1840s, 1850s and 1860s) likewise match the United Kingdom's overseas imports of meat.

Our correction is therefore a lower bound in two respects. First, we deduct losses in storage, milling and brewing from Irish grain, as Broadberry et al. (2015) do for domestic output but not for imports; on their treatment of imports, Irish grain would add about 300 kilocalories a day per head in the 1830s rather than 167. Second, Ireland also sent Britain large numbers of live cattle, pigs and sheep, and provisions such as butter and salted meat, none of which appear in the overseas-trade series and none of which we add. We have not quantified them; they would enlarge the correction.

A.4 Raw cotton

The price of raw cotton for 1801–1870 is the annual average price of Upland (later Middling American) cotton at Liverpool in Mitchell and Deane (1962, Prices 11, part B). For 1782–1800 their part A gives only the highest and lowest price of each year, for West Indian cotton to 1792 and for Bowed Georgia from 1793; we take the midpoint and scale it by 0.73 so that 1790 matches the annual series in Harley (2012). For 1770–1781 we use the price ranges for 1771–75 and 1776–80 that the notes to the same table quote from Ellison, scaled in the same way. The model uses the ratio of this price to Clark's price of consumer manufactures, interpolated to annual frequency.

B The Corn Laws in the model

B.1 Duties

The duty on foreign wheat depended, in every period, on the English price, and the model uses the statutes to find the lowest English price $\bar{p}$ at which importing paid: the smallest p such that $p - d(p) \geq p^* + f$, where p^* is the continental price and f freight and handling, all in shillings per imperial quarter. The duties are:

- *1770–1791*: a nominal duty of 6d. when the English price was 48 shillings or more; below it, duties that we treat as prohibitive.
- *1792*: under the act of 1791, 24s. 3d. below 50 shillings, 2s. 6d. between 50 and 54, and 6d. above 54.

- *1793–1814*: the French wars. The band is set by the measured gap between English and Danzig prices, since the duties of 1791 and 1804 rarely bound and war freight and insurance rates are not known.
- *1815–1827*: import prohibited when the English price was below 80 shillings, free above it. The act of 1822 never came into force; the temporary releases from bond of 1825–27 are ignored.
- *1828–1841*: the sliding scale of 1828, from Sharp (2010, Table 1): 1s. at 73 shillings or more, then 2s. 8d., 6s. 8d., 10s. 8d., 13s. 8d., 16s. 8d., 18s. 8d. and 20s. 8d. as the price fell from 72 to 66 shillings, and one shilling more for every shilling below 66.
- *1842–1845*: the scale of 1842, which set the duty in steps: 1s. at 73 shillings or more, rising by about a shilling for every shilling of price below 73, with plateaus (6s. from 66 to 68 shillings, 18s. from 52 to 54), to 20s. below 51. The model uses a linear approximation, rising by one shilling for every shilling below 73 to 20s. at 54 and below; using the steps instead lowers the model's price of 1842–45 by one shilling (Appendix H).
- *1846 and 1848*: the scale of 1846: 4s. at 53 shillings or more, rising by one shilling for every shilling below 53 to 10s. at 47. In 1847 duties were suspended.
- *1849–1868*: a registration duty of 1s.; none from 1869.

The scales were applied weekly to the average of the Gazette prices of the previous six weeks, and importers held grain in bond until the duty was low: Sharp (2010) shows that most wheat released for consumption under the sliding scales paid the lowest duty of the year, so that the average duty actually collected was far below the duty implied by the annual average price. An annual model cannot reproduce that timing. Applied to annual prices, the statutory scale overstates the barrier in years of fluctuating prices and understates the flow of imports within them. Table B.1 summarises the result by legal regime; the text of Section 5 reports decades, which cut across the regimes.

Table B.1: The band under each law, shillings per quarter, period averages

	1770–91	1815–27	1828–41	1842–45	1846–48	1849–68
Continental price	29.3	34.4	30.6	34.2	39.4	45.0
Price at which import pays	48.0	80.0	62.6	58.1	50.2	50.9
English price, model	46.2	75.2	62.6	58.1	50.2	50.9
English price, Gazette	45.1	66.0	56.6	53.5	52.1	50.7

Note. Continental price: Danzig to 1814, Hamburg from 1815, five-year centred means. Model prices are annual values averaged over the period; Gazette prices are five-year centred means averaged over the period.

B.2 Freight

Freight and handling from the Baltic are 7.5 shillings a quarter until 1846, the figure used by Fairlie (1969, Table 3), 6s. for freight and 1s. 6d. for expenses, and by Sharp (2010), and close to the 10 shillings implied by the constant of the regression of Williamson (1990) of English on Prussian prices. After repeal the cost falls linearly to 4.5 shillings in 1856, the gap that remained between English and Hamburg prices once the duty was nominal. With 5 or 7.5 shillings throughout (Table H.1) the results of the protected decades hardly change, because the duty, not freight, set the band.

B.3 Ireland

Irish grain paid no duty, and it cannot be treated as an import at the continental price. The model adds it to English supply as a share of English farm output: Irish grain, in calories after losses (Table 2), over the domestic calories of Broadberry et al. (2015, Table 7.06), interpolated between their benchmark decades and smoothed with a five-year mean. The share rises from 1 per cent in the 1800s to 6 per cent in the 1830s. For 1843–46 we hold it at its 1838–42 average; from the famine we set it to zero, since by then the English price was set by foreign supply and Irish grain only displaced imports. Food from outside England in the model is the sum of Irish grain and foreign imports, to compare with the calorie record corrected for Ireland.

B.4 The rest of the world

The rest of the world has the technologies, factor shares and preferences of England, without modern manufactures and without the processing multiplier of the English food bill. Its sectoral labour shares in 1770 are 62 per cent in agriculture, 21 in old manufactures and 17 in services; its labour force is six times England's and grows at 0.65 per cent a year;

its productivity in old manufactures and services grows at the English rates of 0.26 and 0.57 per cent. Its farm labour share moves towards its flexible level at the English rate $\lambda = 0.05$. In 1770 the world price of grain is set to the observed ratio of the Danzig price to the English one, and the weight of modern goods in its basket of manufactures so that Britain exports 40 per cent of its modern output.

Its agricultural productivity is not given a rate. In the baseline it is solved for, each year, so that the price of grain in the rest of the world equals the observed continental price. The path it takes is a record of everything that moved continental prices other than British demand: it falls during the wars, nearly doubles between the 1800s and the 1820s—the post-war glut—and settles in the 1850s about a quarter above its level of 1770. In every counterfactual that path is held fixed. The baseline therefore changes very little with the size of the rest of the world; what the size changes is how much world prices respond to England in the counterfactuals (Table 7 and Section 7).

B.5 Fairlie's assumption

To reproduce the assumption of Fairlie (1969, Table 3) we use the model with England small in both world markets and let the continental price of grain rise with British imports of foreign grain above their baseline level, $\ln p_t^* = \ln \bar{p}_t^* + \psi\,(m_t - m_t^b)$, where $\bar{p}_t^*$ is the observed price and m_t the share of foreign grain in English consumption. The form follows from a supplying region that consumes C with supply and demand elasticities e_s and e_d: an extra purchase ΔM raises its price by $\Delta \ln p = \Delta M/[(e_s + e_d)C]$, so that with $\Delta M = \Delta m\, C_E$, $\psi = (C_E/C)/(e_s + e_d)$. With $\psi = 0.75$—a supplying region twice the size of England, with elasticities that sum to two-thirds—the rise in the continental price accounts for about half of the narrowing of the (log) gap between English and continental prices in the 1820s and 1830s, as in Fairlie, who assumed that half of the margin net of freight would have been closed by a rise in the Prussian price. The two-region model gives a smaller response, because its rest of the world can move labour into grain more freely than the Baltic of the 1820s could.

C From wheat to the farm basket

The continental prices are prices of wheat, and the model has a single farm good, whose price in the data is Clark's index of arable prices. Wheat and the arable basket moved together until the 1810s; afterwards the basket became dearer relative to wheat, by 7 per cent in the 1830s and 17 per cent in the 1860s, largely because potatoes, hay and oats, which

were not traded, rose in price while wheat, which was, did not. We carry the continental price of wheat over to the farm basket by multiplying it by the English ratio of the arable index to the price of wheat (1770s = 1), decadal and interpolated. The ratio is a relative price within the food basket and says nothing about the level of food prices relative to manufactures. Without it (Table H.1) the model's food becomes cheaper after 1846, food per head in the 1860s is 17 per cent above the 1800s instead of 6, and the wage in food rises by 1.86 instead of 1.69, both close to the record, but imports reach half of consumption: the one-good model would then attribute to the whole farm basket the fall in the price of the one crop that trade cheapened. With the adjustment it does the opposite, attributing to the traded crop the rise in the price of those that were not. A model with a traded grain and a non-traded remainder of the food basket would lie between the two. The counterfactuals compare economies with the same adjustment, so it moves baseline and counterfactual together. Table C.1 shows this in the structural model: each counterfactual, measured against its own baseline, changes by about a point at most when the adjustment is removed (1.2 points for the Ricardian 1830s), although the baseline itself moves a good deal.

Table C.1: Counterfactuals with and without the conversion of wheat to the farm basket

	With conversion	Without
Baseline		
Wage in food, 1860s (1770s = 1)	1.69	1.86
Food per head, 1860s (1800s = 1)	1.06	1.17
Food from outside England, 1860s (%)	37	50
Food per head relative to the baseline (%)		
Across the board, same aggregate rate, 1860s	17	17
Across the board, same real consumption, 1860s	12	12
Corn Laws kept (Malthus), statutory duty, 1860s	−11	−12
Corn Laws kept (Malthus), duty collected, 1860s	−9	−10
No Corn Law from 1815 (Ricardo), 1830s	38	39

Note. Structural model, rest of the world six times England's size, all other parameters as in the baseline; agricultural productivity is not recalibrated, so imports are a result in the second column.

D Solution

For each year the model solves a system of non-linear equations in the allocation of labour and capital across sectors in each region, the prices of services in each region, the price of modern manufactures, the world price of grain (or, in the baseline, the agricultural productivity of the rest of the world) and an auxiliary variable for food trade. The food-trade condition is written as a complementarity: with v unrestricted and

$\rho = \min\{\max\{v, \ln[(p_A^* - f)/p_A^*]\}, \ln(\bar{p}_A/p_A^*)\}$, the English price of food is $p_A^* e^{\rho}$ and the equation $M - \frac{1}{2}(v - \rho) = 0$ forces net imports M to be positive only at the upper bound of the band, negative only at the lower bound and zero inside it; the upper bound is computed from the statutes as a function of the continental price in shillings. The world market for grain clears with the rest of the world's exports equal to England's imports grossed up by the wedge, which is treated as a real cost, and the market for old manufactures clears by Walras's law. Each year is solved twice: first with labour free to move in both regions subject to the English wage differential μ, which gives the flexible farm shares; then with the farm shares fixed by the partial-adjustment rule. The capital stocks are then updated. In 1770 all English relative prices equal one, the English price of wheat, 44 shillings, lies inside the band, and food trade is zero. The counterfactuals use the agricultural productivity of the rest of the world solved for in both steps of the baseline, so that the baseline is reproduced exactly when run as a counterfactual. Residuals are below 10^{-11} in every year of every scenario reported.

E Difficult decisions on productivity

How productivity growth is divided among sectors is the choice on which our results depend most, and each step of it involves judgement. This appendix sets out the steps, what we chose at each, and what the alternatives would have done.

E.1 The level: primal

The model is asked to explain relative prices and real wages. The dual measure of productivity is computed from those same prices and wages, and a model driven by it would reproduce them by construction. We therefore take the level of productivity growth in manufacturing and services from quantities (agriculture is discussed below): our own primal accounts for 1800–1870, on the output series of Broadberry et al. (2015), the capital stock of Feinstein (1988), labour by sector and the factor shares of Clark (2009), give 0.43 per cent a year for agriculture, 0.66 for industry and 0.58 for services. For the economy as a whole Crafts (2021, Table 5) reports 0.51 per cent by the primal method and 0.61 by the dual. The primal total for industry, like that of Broadberry and his predecessors, is a rate for value added: output of each branch is measured by a volume indicator of gross output and the branches are weighted by their shares of value added, so that value added is assumed to grow with gross output.

Industry in these accounts includes mining and building, which the model does not

have as such: there are no mines in it, and buildings are produced by the service sector. We therefore measure manufacturing alone. Output is Broadberry's industrial index less coal and construction, his indicators for the two sub-sectors, with the weights they receive in his industrial price index (12.4 and 11.4 per cent; Broadberry et al., 2015, Table A5.2.3): it grows at 2.64 per cent a year between the 1800s and the 1860s, against 2.70 for industry as a whole. Capital is the manufacturing stock of Feinstein (1988), without mining and utilities. Labour is industrial employment less mining and building, which were 9 per cent of the British labour force in the census of 1851 and 11.5 in that of 1871; before 1851 we project them with their own output, assuming no growth in their output per worker; with output per worker in mining and building growing at 0.5 per cent a year, which puts more of their labour back in the early decades, manufacturing would grow at 0.73 rather than 0.78, still faster than industry as a whole. With the factor shares at which our accounts give 0.66 for industry, manufacturing grows at 0.78 per cent a year, 0.75 to 0.81 as mining and building take 10.5 to 12.5 per cent of the labour force in 1871; with a higher capital share both rates fall, but manufacturing stays about a fifth faster than industry. Manufacturing grows faster than industry as a whole because mining and building took a growing share of industrial employment. Adding building to services lowers their rate from 0.58 to 0.57. The same accounts give manufacturing 0.13 per cent a year between the 1770s and 1800 and 0.57 between the 1770s and the 1860s; the model applies the rates of 1800–1870 from 1770, and Appendix H reports it with those of 1770–1860.

E.2 The division of industry

There are no primal estimates for individual branches. The branch rates in the literature, those of McCloskey (1981), Harley (1999, Table 3.6), Crafts (2021, Table 5) and Clark (2007, Table 12.1), are dual, or dual in origin, and in all of them the rest of industry is a residual. With the value-added weights of Crafts (2021, Table 5) for 1820 (cotton 7 per cent of national income, iron 2, woollens 5 and the rest of industry about 16, in an industrial sector of about 30), the rates of Harley (1999) as updated by Crafts (2021) for cotton, iron and woollens (1.9, 0.9 and 0.95) are enough by themselves to exhaust the primal total for industry:

$$\frac{7 \times 1.9 + 2 \times 0.9 + 5 \times 0.95 + 16 \times x}{30} = 0.66 \quad \Rightarrow \quad x \approx 0.$$

For manufacturing alone, with mining and building taken out of the weight of the rest (below) and the primal total of 0.78, they more than exhaust it, and $x \approx -0.2$. The zero for the rest of industry is therefore a consequence of combining a low primal total with high

dual rates for a few branches, not a measurement. The historical record points both ways. Construction, clothing, footwear, leather, milling and coal, which employed most of the industrial labour force, changed little before 1850. But the rest of industry also includes the paper machine, the steam press, the great porter breweries, Wedgwood's potteries, cylinder glass, Leblanc soda and the stamped and pressed hardware of Birmingham, and Berg and Hudson (1992) argue that the output indices on which the primal totals rest understate precisely the growth of such trades. Adam Smith's examples of the division of labour, pins and nails, belong to this residual.

E.3 Our own dual estimates

To divide industry with a single method we estimate dual productivity growth ourselves, good by good, between the 1780s and the 1850s; we stop in the 1850s to avoid the cotton famine. For each good the rate of productivity growth in gross output is the growth of its unit cost, weighted by cost shares, minus the growth of its price:

$$\hat{A}_j = s_j^L \hat{w} + s_j^K \hat{r}_K + \textstyle\sum_m s_j^m \hat{p}_m - \hat{p}_j.$$

Prices of goods are Clark's decadal series (Clark, 2009, Table A1), the same ones that enter the industrial price index of Broadberry et al. (2015). The wage is the average of Clark's building labourers and craftsmen. The rental of capital is $(r + \delta)p_K$, with Clark's rate of return, $\delta = 0.05$ and the price of capital goods the geometric mean of the prices of bricks, timber and bar iron; it hardly moves. The pithead price of coal is Clark's value of output over tonnage. Materials are raw cotton (Mitchell and Deane, 1962, Prices 11), tallow (Clark's index of fats), barley, timber, bar iron, coal, and, for imported materials without a series of their own (raw silk, flax, hemp, copper, tin, wool, alkali), Clark's price index of imports; domestic materials without a series (rags, hides) follow his index of domestic expenditure prices. The cost shares are ours, set good by good from the structure of each trade (Table E.1).

Table E.1: Dual productivity growth by good, 1780s–1850s, per cent a year

	Price	Cost shares		Materials	Productivity growth	
		Labour	Materials		Gross output	Value added
Cotton cloth	-2.22	0.50	0.30	coal, raw cotton	2.32	3.31
Bar iron	-0.59	0.35	0.45	coal	1.27	2.30
Woollen cloth	-0.07	0.40	0.45	imports	0.34	0.62
Silk thread	-0.56	0.25	0.65	imports	0.64	1.82
Linen cloth	-0.51	0.40	0.45	imports	0.78	1.42
Tallow candles[a]	-0.26	0.20	0.70	tallow	0.88	2.95
Soap[a]	-0.57	0.20	0.70	imports, tallow	1.02	3.39
Paper	0.27	0.45	0.40	domestic prices	0.28	0.47
Books[b]	0.40	0.45	0.40	paper	0.18	0.31
Woodwares	0.79	0.50	0.40	timber	-0.34	-0.57
Pottery	0.88	0.60	0.25	coal	-0.31	-0.42
Window glass[a]	-0.72	0.45	0.35	coal, imports	1.10	1.68
Brass goods[b]	-0.11	0.30	0.60	imports	0.27	0.67
Pewter	0.31	0.30	0.60	imports	-0.18	-0.44
Rope	0.00	0.30	0.60	imports	0.14	0.34
Shoes	0.48	0.45	0.45	domestic prices	0.09	0.16
Suit of clothes	0.32	0.50	0.45	wool cloth	0.13	0.23
Bricks	0.51	0.55	0.25	coal	0.01	0.01
Nails	-0.25	0.40	0.50	bar iron	0.33	0.67
Spades and shovels	-0.28	0.45	0.40	bar iron	0.48	0.79
Screws	-0.24	0.55	0.30	bar iron	0.58	0.83
Cutlery	0.62	0.55	0.30	bar iron	-0.27	-0.39
Beer[a]	0.59	0.15	0.70	barley, domestic prices	-0.11	-0.36
Coal at the pithead	0.78	0.55	0.20	coal rents, timber	-0.23	-0.29

Note. Prices from Clark (2009, Table A1); growth between the decadal averages of the 1780s and the 1850s (1790s–1850s where marked [b]). Capital takes the remaining share of cost. "Imports": Clark's import price index, standing for raw silk, flax, hemp, copper, tin, wool and alkali. "Domestic prices": Clark's domestic expenditure price index. For coal the royalty is treated as an input. Value added: the gross-output rate divided by one minus the share of materials. [a] Prices affected by the repeal of excise duties within the period (beer 1830, candles 1831, glass 1845, soap 1853).

The method passes one check: it reproduces Clark's own dual rates for the modern branches, 2.3 per cent a year for cotton cloth and 1.3 for bar iron, against his 2.4 and 1.4. It departs from Crafts's update of Harley for woollens, which grow at 0.3 per cent rather than 0.95; the price of woollen cloth hardly fell while wages doubled. For the twenty-one goods of the rest of industry the rates range from -0.3 to 1.1 per cent a year in gross output, with a median of 0.18 and a mean of 0.26. The highest rates, in candles, soap and window glass, are inflated by the repeal of excise duties, which lowered prices without any change in productivity; the lowest, in woodwares, pottery and cutlery, may reflect changes in quality in the institutional purchases on which Clark's series rest. With the wage series of Feinstein (1998), which rises 9 per cent less than Clark's between the 1770s and the 1860s, the rates fall by about 0.05 points. This is also our answer to Stephenson (2018): his critique of the

institutional building wages concerns their level more than their growth, and a wage that grew more slowly would lower every dual rate in about the same proportion, leaving the division of manufacturing, which is what we take from the dual, nearly unchanged. With a share of materials in cotton of 0.25 or 0.35 instead of 0.30, old manufactures grow at 0.28 or 0.25 per cent a year and modern manufactures at 1.56 or 1.59 in value added, which by Figure 7 moves the gain from balanced growth by less than a point. The rest of industry did not stand still, but it grew slowly.

E.4 Gross output and value added

A primal total for value added can only be divided with branch rates for value added, or, equivalently, with gross-output rates weighted by gross output over value added (Crafts, 2004). We convert each gross-output rate to value added by dividing it by the share of value added in the value of output. The conversion multiplies the error of goods in which value added is small: candles and soap, where tallow is seven-tenths of cost and the repeal of excise duties lowered prices, reach 3 per cent a year.

E.5 The rest of manufacturing

The twenty-one goods of the rest of industry have to be combined into one rate. Their median in value added is 0.34 per cent a year and their unweighted mean 0.63, pulled up by candles and soap. Neither reflects the structure of industry: clothing and hardware employed far more people than candle-making or glass. We therefore weight the manufacturing trades with the sub-sector weights of the industrial price index of Broadberry et al. (2015, Table A5.2.3) for 1770–1870: textiles other than cotton and wool (silk and linen) 7.4, non-ferrous metals (brass and pewter) 2.0 and other manufactures (paper, books, woodwares, pottery, rope) 12.5. Hardware (nails, spades, screws, cutlery) receives 6.9, Broadberry's weight for iron and steel less the iron industry's share in the weights of Crafts (2021), and clothing and footwear, which the index omits, an assumed 10. We leave out the goods whose prices were lowered by the repeal of excise duties within the period: candles, soap, window glass and beer. Coal and bricks stand for mining and building, which are no longer part of the sector. The weighted rate for the rest of manufacturing is 0.46 per cent a year in value added. Its weight in the weights of Crafts (2021) is the 16 per cent of national income of the rest of industry less mining and building, 3.7 and 3.4 per cent if they bear the same proportion to industry as in Broadberry's price index, which leaves 8.9.

The value-added rates then imply productivity growth in manufacturing of

$$\frac{7 \times 3.31 + 2 \times 2.30 + 5 \times 0.62 + 8.9 \times 0.46}{22.9} = 1.53$$

per cent a year, nearly twice the primal 0.78. The gap between primal and dual, which the literature places mainly outside modern industry, is also inside it. Scaling every branch by the same factor, 0.51, until the total equals the primal gives cotton 1.69, iron 1.18, woollens 0.32 and the rest of manufacturing 0.23. Modern manufactures then grow at 1.58 per cent a year in value added and old manufactures at 0.26. In the model modern manufactures use raw cotton, 22 per cent of their cost, so the rate that applies to their gross output is $1.58 \times 0.78 = 1.23$. The division hardly differs from the one obtained with industry as a whole: taking out mining and building raises the primal total and the weighted dual in about the same proportion.

Dividing industry instead with Harley's rates and applying the resulting 1.7 per cent to the gross output of modern manufactures, as is natural if one reads those rates as gross-output rates, would make modern manufactures grow at about 2.2 per cent a year in value added and manufacturing at about 1.0 rather than 0.78. The model would then come closer to the wage in modern manufactures (5.7 against 6.3) and to the price of food relative to them in the 1840s (4.2 against 4.3), but overshoot that price by about a quarter in the 1860s (4.2 against 3.3; Table E.2).

E.6 Why this division

The weighted rate is one of several defensible ways of dividing manufacturing, and we compare it with four others: the same weighted rate with the goods affected by the excise included; the median good for the rest of manufacturing; the unweighted mean; and, instead of scaling every branch in the same proportion, attributing the whole gap between primal and dual to modern industry, so that woollens and the rest of manufacturing keep their unscaled dual rates. The opposite attribution, the whole gap to the rest, leaves old manufactures with negative productivity growth and we do not consider it. We also report what the model gives if old manufactures are taken to be the whole of industry outside cotton and iron, mines and building included: the primal total for industry, Crafts's weight of 16 for the rest, coal and bricks among its trades, and modern goods at 29 per cent of industrial value added in the 1860s. Each alternative is run with its own elasticity of substitution, calibrated as in the baseline, and its own agricultural rate, set, as in the baseline, so that food imports in the 1860s are 37 per cent.

We prefer the weighted rate of the manufacturing trades for three reasons. It reflects the composition of manufacturing; it leaves out prices that fell for fiscal rather than technical reasons; and, with the primal total for manufacturing, it measures what the model calls old manufactures from end to end, leaving out mines and building, which the model does not have or places in services. A fourth consideration supports it: the agricultural rate that then reproduces food imports, 0.29 per cent a year, is close to Clark's dual, 0.3, whereas treating old manufactures as all of industry requires 0.22, below every estimate. We do not choose by fit: the measure that would favour divisions reproducing the first gap is mechanically tied to the prices of cloth and iron used to divide manufacturing. On that measure the reference with Harley's rates would win, since with the cotton–iron weights of Table 1 it comes closer than the baseline to the record of the 1840s and to the wage in modern manufactures of the 1860s (4.21 and 5.69 against 4.34 and 6.26, where the baseline gives 2.98 and 3.73); the choice of the baseline rests on its consistency with a primal total for value added and on the side of food, not on the first gap.

The alternatives trade one side of the record against the other. Treating old manufactures as all of industry lowers their rate to 0.19 per cent a year and improves the first gap, at the cost of the food side and of an agricultural rate below the published range. Attributing the whole gap to modern industry raises old manufactures to 0.52 per cent a year, and with it the wage in food (1.98) and food per head (17 per cent), both above the record; the agricultural rate that then reproduces imports, 0.51, lies between our own primal estimate and Crafts's older one. But modern manufactures grow at only 1.2 per cent a year in value added, less than any estimate in the literature, the elasticity that reproduces their share of manufacturing is 3.8, and the model misses the first gap badly: the price of food relative to modern manufactures rises to 1.7 by the 1860s, against 3.3 in the data and 2.7 in the baseline. The median, the mean and the weighted rate with the excise goods lie between. We report all of them, and note that the across-the-board counterfactual, the central result of the paper, is smaller the more productivity growth the baseline gives old manufactures: at the same real consumption, 12 per cent with the median and in the baseline, 11 with the excise goods, 10 with the mean, 12 with old manufactures as all of industry, and 4 when the whole gap goes to modern industry (Figure 7). The assumed weight of clothing and footwear does not matter: doubling or halving it changes the rate of old manufactures by less than 0.01 points.

E.7 Agriculture

For agriculture the estimates range from Clark's dual, 0.3 per cent a year, to 0.7 (Crafts's older estimates, which Harley, 1999 adopts), with our own primal at 0.43, while Crafts (2021) gives 0.25 for the whole economy outside the modernised sectors; Clark (1999) argues that much of what looks like productivity growth was costly investment in soil fertility. We let the model choose: given the other rates, the agricultural rate determines food imports and the farm share of employment in the 1860s. A rate of 0.29 per cent brings imports to the record and farm employment within a point of it, while 0.43 leaves England importing 19 per cent of its food and keeping 29 per cent of its labour on the land. The cost is that imports cease to be a test of the model.

E.8 What each choice costs

Table E.2 sets the baseline against the alternatives. Besides the divisions of industry discussed above, it reports two variants that are not candidates but references: Harley's rates applied to gross output, which is inconsistent with a primal total for value added, and faster rates in agriculture and old manufactures (0.43 and 0.38), which bring the economy-wide total close to the dual rather than the primal. The second comes closest to the record on the side of food, which is another way of saying that the dual describes the period's wages better than the primal; we do not adopt it because the model would then be reproducing prices with productivity recovered from prices.

Table E.2: Productivity choices and what they cost

	Economy TFP (%)	Food / modern 1840s	Food / modern 1860s	Wage in modern	Wage in food	Food per head (%)	Imports (%)	Farm labour (%)	Across the board (%) same rate	Across the board (%) same cons.
Divisions of manufacturing (agriculture set to reproduce imports)										
Weighted manufacturing trades (baseline)	0.51	2.98	2.66	3.73	1.69	6	37	25	17	12
Weighted, with the excise goods	0.52	2.86	2.53	3.64	1.72	7	37	24	16	11
Median good of the rest	0.50	3.11	2.81	3.83	1.65	4	37	25	18	12
Unweighted mean of the rest	0.53	2.81	2.46	3.60	1.73	7	37	24	15	10
Primal–dual gap in modern industry	0.61	2.10	1.70	3.00	1.98	17	37	23	7	4
Old manufactures as all of industry	0.46	3.45	3.21	4.19	1.61	3	37	25	18	12
References										
Harley's rates as gross output	0.55	4.21	4.16	5.69	1.66	4	38	24	23	16
Agriculture 0.43, old manufactures 0.38	0.59	2.76	2.46	3.85	1.81	9	32	25	14	9
Agriculture 0.43 (own primal), baseline division	–	2.73	2.68	3.76	1.67	1	19	29	–	–
Data	0.51–0.61	4.34	3.30	6.26	1.88	12–13	37	24		

Note. Economy TFP: value-added-weighted average of the sectoral rates, 1780–1860. Food / modern: price of food relative to modern manufactures, 1770s = 1. Wages in the 1860s, 1770s = 1. Food per head: growth between the 1800s and the 1860s. Imports and farm labour: 1860s. Across the board: food per head in the 1860s, relative to the row's own baseline, when every sector grows at the economy rate of the row (same rate) or at the rate that leaves real consumption per head in the 1860s as in the baseline (same consumption). Each row recalibrates σ and, except the references, agricultural productivity. Agricultural productivity is 0.29 per cent a year in the baseline, 0.31 with the excise goods, 0.26 with the median, 0.33 with the mean, 0.51 with the gap in modern industry and 0.22 with old manufactures as all of industry; 0.25 in the reference with Harley's rates. Old manufactures as all of industry: primal total 0.66, services 0.58, modern goods 29 per cent of industrial value added in 1866–70, building labour in industry. Data for economy TFP: primal and dual totals of Crafts (2021, Table 5).

F English old manufactures as a variety of their own

In the baseline, old manufactures are a homogeneous good, so that English productivity growth in them raises English output without lowering their world price. The natural objection is that English woollens and hardware were varieties of their own, which faced a demand for the English product rather than a world market for the good, as cotton did. We test it by giving English old manufactures a price of their own, $p_{E,t}$, and letting every country buy old manufactures as a CES composite of the English and the foreign variety with elasticity η:

$$P_{O,i,t} = \left[\beta_i \, p_{E,t}^{1-\eta} + (1-\beta_i)\right]^{\frac{1}{1-\eta}}, \qquad i = \text{England, rest of the world,}$$

where the foreign variety remains the numeraire, $P_{O,i,t}$ replaces its price in the composite of manufactures, and $p_{E,t}$ clears the market for English old manufactures. England spends 90 per cent of its outlay on old manufactures on its own variety in 1770, and the weight of the English variety abroad is set so that the market clears at $p_E = 1$ in that year. We run three elasticities, 10, 5 and 2, with two divisions of manufacturing: the baseline and the one that places the whole gap between primal and dual in modern industry (Appendix E). The clean comparison (panel A of Table F.1) changes only the market for old manufactures:

agricultural productivity stays as in the homogeneous case, σ is recalibrated to the modern share of manufacturing, and food imports become a result. Panel B also recalibrates agriculture to reproduce food imports, as the baseline does; it mixes the Armington assumption with a different agriculture, and we report it for completeness.

Table F.1: English old manufactures as a variety of their own

	η	Agric. TFP (%)	σ	Wage in food	Food per head (%)	Imports (%)	Food / modern	Wage in modern	Price of English old goods	Across the board (%) from 1770	from 1800
A. Agriculture as in the homogeneous case											
Baseline division of manufacturing											
Homogeneous old manufactures	∞	0.29	2.48	1.69	6	37	2.66	3.73	1	17	11
Variety of their own	10	0.29	2.25	1.56	−3	23	2.90	3.66	0.90	13	8
	5	0.29	2.17	1.51	−5	18	2.98	3.64	0.86	11	7
	2	0.29	2.11	1.48	−8	14	3.06	3.62	0.83	10	6
Whole primal–dual gap in modern industry											
Homogeneous old manufactures	∞	0.51	3.82	1.98	17	37	1.70	3.00	1	7	5
Variety of their own	10	0.51	3.42	1.85	8	26	1.83	2.95	0.91	4	3
	5	0.51	3.29	1.80	6	22	1.88	2.94	0.88	3	2
	2	0.51	3.16	1.76	3	17	1.93	2.92	0.85	2	1
B. Agriculture set to reproduce food imports											
Baseline division of manufacturing											
Variety of their own	10	0.14	2.31	1.52	−3	37	2.99	3.59	0.85	14	9
	5	0.00	2.15	1.38	−9	37	3.32	3.48	0.73	18	11
	2	−0.36	1.78	1.08	−23	37	4.40	3.20	0.50	36	21
Whole primal–dual gap in modern industry											
Variety of their own	10	0.39	3.45	1.82	9	37	1.87	2.91	0.88	5	3
	5	0.29	3.17	1.70	4	37	2.02	2.85	0.79	7	4
	2	0.07	2.59	1.46	−6	37	2.40	2.70	0.62	16	9
Data				1.88	12–13	37	3.30	6.26			

Note. Wages and the price of food relative to modern manufactures in the 1860s, 1770s = 1. Food per head: growth between the 1800s and the 1860s. Imports: 1860s. Price of English old goods: relative to the foreign variety, 1860s. Across the board: food per head in the 1860s relative to the baseline of the row, with every English sector growing at the economy-wide rate of that baseline from 1770 or from 1800. In panel B, with $\eta = 2$ and the baseline division, reproducing food imports requires agricultural productivity to fall by 0.36 per cent a year.

With agriculture held fixed, a lower elasticity lowers the gain from balanced growth steadily, as the objection supposes: from 17 per cent with homogeneous old manufactures to 13, 11 and 10 per cent with elasticities of 10, 5 and 2 in the baseline division, and from 7 to 4, 3 and 2 per cent when the whole gap is placed in modern industry. English old manufactures become 9 to 17 per cent cheaper than the foreign variety by the 1860s, and faster growth in them passes part of its gain abroad, as faster growth in cotton did. The effect is moderate because the rest of the world makes most of the old manufactures it buys, and because the same fall in price also afflicts the baseline, in which English old manufactures grow slowly.

In panel B the gain moves the other way, rising as the elasticity falls (14 per cent with $\eta = 10$, 18 with $\eta = 5$ and 36 with $\eta = 2$ in the baseline division). The reason is the recalibration of agriculture: a lower elasticity worsens England's terms of trade, and reproducing the food imports of the 1860s then requires slower, at the limit negative, agricultural productivity growth, which changes the baseline against which the counterfactual

is measured. For the same reason the worse fit of panel B on the side of food (a wage in food of 1.08 to 1.82 against 1.69 to 1.98 with homogeneous goods) cannot be attributed to the Armington assumption alone. It is also evidence on the structure of the market: with agriculture as in the homogeneous case and the baseline division, the variety model makes food per head fall between the 1800s and the 1860s and imports reach only 14 to 23 per cent of consumption, against a rise of an eighth and 37 per cent in the record, and reproducing the imports requires agricultural productivity to slow down sharply or fall. On the side of food, the record fits English old manufactures that competed in a world market better than a variety of their own.

The conclusion we draw is that the objection is right in direction and moderate in size in the baseline division, where treating English old manufactures as a variety of their own lowers the gain from balanced growth by a quarter to two-fifths, to 10–13 per cent at the same aggregate rate and 7–9 per cent at the same real consumption (Table 7). When the whole gap between primal and dual is placed in modern industry it is large: the gain, already 7 per cent with homogeneous goods, falls to between 2 and 4. The faster productivity grew in English old manufactures, the less a balanced revolution would have added, and the more of what it added would have gone abroad.

G The structure of the economy

Table G.1 compares the model with the two readings of British agriculture that Clark (1999, Table 4.7) sets side by side: the older estimates of Crafts, in which agriculture was a small share of output and its output per worker well below the rest of the economy, and Clark's own, in which it was a larger share and nearly as productive. The model, which was not calibrated on either, is closer to Clark's than to Crafts's, although its farm sector is larger than Clark's in 1801 and relatively less productive in 1861. Its farm share of employment matches Clark's later series of men in farming in the 1800s and 1860s and falls more slowly in between, when it is up to seven points above it.

H Robustness

Table H.1 reports the baseline and variations, most of which change one assumption at a time; the last row combines several. The size of the rest of the world does not appear, because it changes the baseline very little: the agricultural productivity abroad is recalibrated to the continental price in each case; its effect on the counterfactuals is

Table G.1: Agriculture in the economy: model and two readings of the record

	1760/1770	1801	1831	1861
Agriculture's share of national output (%)				
Crafts, in Clark (1999)	37	26	23	18
Clark (1999)	49	32	29	18
Model	44	40	33	22
Agriculture's share of employment (%)				
Clark (1999)	48	36	32	19
Model	45	40	36	26
Output per worker, agriculture relative to the rest				
Crafts, in Clark (1999)	0.64	0.62	0.63	0.93
Clark (1999)	1.04	0.84	0.87	0.93
Model	0.96	0.99	0.85	0.79
Land rents in national income (%)				
Clark (2009)	19	16	10	7
Model	16	14	12	8

Note. The first column is 1760 for Clark's estimates and 1770 for the model and for Clark's land share. Model values are for single years; Clark's land share is for decades (1770s, 1800s, 1830s, 1860s), computed from his decadal accounts as farmland rents, including tithes, over net national income less indirect taxes, his own definition. In the model, relative output per worker follows from the wage gap and the factor shares; it is not a parameter. The farm share of employment in Clark (1999) for 1861 (19 per cent) is lower than in his later series (Clark, 2009), 24 per cent in the 1860s, which Figure 5 uses.

reported in Table 7 and Section 7.

The main results survive. The agricultural rate is pinned down by trade and employment: at our own primal estimate of 0.43 per cent England imports only 19 per cent of its food by the 1860s and keeps 29 per cent of its labour on the land. With agriculture and old manufactures at 0.43 and 0.38 per cent, which put the economy-wide total close to the dual, the wage in food rises by 1.81 and food per head by 9 per cent, closer to the record; this is the variation that matters most for the food wage, and it is the one on which the literature on primal and dual productivity is divided. The alternative divisions of manufacturing are discussed in Appendix E: the more productivity growth they give old manufactures, the better the model does on the side of food and the worse on the first gap. Measuring the productivity rates over 1770–1860 rather than 1800–1870 lowers them, because manufacturing grew only about 0.1 per cent a year before 1800: the wage in food then rises by 1.60, the price of food relative to modern manufactures by 2.5 in the 1840s, and the gain from balanced growth is 10 per cent at the same real consumption. We keep the rates of 1800–1870 because the output index on which the earlier rate rests gives the new trades least weight before 1800 (Berg and Hudson, 1992), and because Crafts (2021, Table 3), with the same output data, finds economy-wide productivity growing no more slowly in 1780–1800 than in 1800–1830.

Capital matters for the wage. A saving rate rising from 0.08 in 1770 to 0.14 in 1840, closer to the estimates of Feinstein (1988) than our constant 0.16, lowers the wage in food to 1.59 and food per head to 1 per cent above the 1800s; a depreciation rate of 0.035 lowers them to 1.51 and 1 per cent. Both move the model away from the record, and neither changes the relative prices that define the first gap. The demand side is the source of the second gap: with a unit income elasticity of food expenditure food per head would rise 28 per cent between the 1800s and the 1860s, and with the processing share of the food bill held at its level of 1770, 18 per cent; with a unit price elasticity it would fall 1 per cent.

The market for grain matters mostly for timing. Freight matters only after repeal, and a cost of freight falling from 1820 (Harley, 1988; North, 1958) changes little, because the duty, not freight, set the band before 1846. Applying to the sliding scales the average ratio of the duty collected to the statutory duty, as Sharp (2010) measures it, would lower the price of wheat in the 1830s to 48 shillings, against 55 in the data, and raise imports in that decade to a third of consumption, against an eighth in the record. The statutory and the effective duties therefore bracket the barrier, and we report both for the Malthusian counterfactual (Section 7). The ratio is low because importers released grain from bond when the duty was low, that is, when the English price was high; the statutory scale applied to the English price already captures that timing, and the average ratio, applied in every year, overstates

Table H.1: Robustness

	Wage in food 1860s	Wage in modern 1860s	Food / modern 1840s	Wheat (s./qr) 1830s	Food per head 1830s	Food per head 1860s	Imports (%) 1830s	Imports (%) 1860s	Farm labour 1860s (%)
Baseline	1.69	3.73	2.98	62	0.97	1.06	12	37	25
Agricultural productivity 0.43% (own primal)	1.67	3.76	2.73	57	0.98	1.01	6	19	29
Agriculture 0.43%, old manufactures 0.38% ($\sigma = 2.54$)[a]	1.81	3.85	2.76	62	0.98	1.09	9	32	25
Rest of manufacturing: weighted, with the excise goods[b]	1.72	3.64	2.86	62	0.98	1.07	12	37	24
Rest of manufacturing: median good[b]	1.65	3.83	3.11	62	0.97	1.04	12	37	25
Rest of manufacturing: unweighted mean[b]	1.73	3.60	2.81	62	0.98	1.07	12	37	24
Primal–dual gap attributed to modern industry[b]	1.98	3.00	2.10	62	1.02	1.17	12	37	23
Old manufactures as all of industry[b]	1.61	4.19	3.45	62	0.96	1.03	13	37	25
Harley's branch rates as gross output[c]	1.66	5.69	4.21	62	0.97	1.04	13	38	24
Productivity rates measured over 1770–1860[d]	1.60	2.71	2.45	62	0.96	1.03	13	37	25
Saving rate rising from 0.08 (1770) to 0.14 (1840)	1.59	3.58	2.89	61	0.93	1.01	7	31	26
Depreciation 0.035	1.51	3.40	2.93	62	0.94	1.01	8	32	27
Unit price elasticity of food ($\gamma = 0$)	1.69	3.72	2.85	61	0.92	0.99	8	33	24
Unit income elasticity of food expenditure	1.70	3.75	2.91	62	1.09	1.28	23	50	25
Processing share of the food bill constant at 1770	1.64	3.74	2.95	62	1.05	1.18	19	44	25
$\sigma = 1.9$	1.68	3.72	2.98	62	0.97	1.06	12	37	25
$\sigma = 3.1$	1.69	3.75	2.98	62	0.97	1.05	12	37	25
No raw cotton input	1.67	3.56	2.37	62	0.98	1.06	13	37	25
Flexible farm labour ($\lambda = 1$)	1.78	3.69	2.89	62	0.99	1.08	23	52	16
Farm/non-farm wage differential $\mu = 0.20$	1.63	3.78	2.98	62	0.96	1.03	12	36	24
Freight 5s. throughout	1.68	3.73	2.90	61	0.98	1.05	14	37	24
Freight 7.5s. throughout	1.63	3.74	2.99	62	0.97	1.02	12	32	26
Freight falling from 7.5s. in 1820 to 4.5s. in 1856	1.69	3.73	2.92	61	0.98	1.06	13	38	24
Duties at the rate collected, 1828–48[e]	1.71	3.70	2.77	48	1.13	1.06	33	41	22
Foreign imports attributed to England by population share[f]	1.68	3.74	2.95	62	0.96	1.04	9	32	26
No Irish grain	1.69	3.73	2.98	62	0.98	1.06	11	37	25
Irish grain: all oats as food, all to England	1.69	3.73	2.95	62	0.97	1.05	13	37	24
Wheat, no adjustment to the farm basket[g]	1.86	3.70	2.75	62	1.01	1.17	18	50	21
England small in both world markets	1.69	3.73	2.98	62	0.97	1.06	12	37	25
Measured gap as the band, faster rates, small economy[h]	1.87	5.93	3.73	55	1.07	1.12	24	36	23
Data	1.88	6.26	4.34	55	0.90–0.93	1.12–1.13	7–12	37	24

Note. Wages and the price of food relative to modern manufactures indexed to the 1770s; food per head to the 1800s. Imports include Irish grain. Data: Clark's wage over his food basket and over the cotton–iron composite; Clark's arable price over the cotton–iron composite; the Gazette price of wheat; calories per head without and with Irish grain; Broadberry et al.'s import share, without and with Irish grain; Clark's farm share of male employment. [a] Economy-wide total close to the dual of Crafts (2021); σ recalibrated. [b] Alternative divisions of manufacturing and definition of old manufactures (Appendix E), each with its own σ and with agricultural productivity set to reproduce imports. [c] Industry divided with the branch rates of Harley (1999) and Crafts (2021, Table 5), and the resulting modern rate applied to gross output; agriculture 0.25. [d] Manufacturing 0.57 per cent a year (modern 1.15 in value added, old 0.19) and services 0.56, the primal rates between the 1770s and the 1860s; σ and agricultural productivity (0.23) recalibrated. [e] The statutory duty multiplied by the ratio of the duty collected to the statutory duty on the wheat released from bond in each regime, 0.28 in 1828–41, 0.68 in 1842–45 and 0.52 in 1846–48 (Sharp, 2010, Table 2). [f] The United Kingdom's foreign imports, which the baseline attributes wholly to England as Broadberry et al. (2015) do, are shared by population, so that England imports 32 per cent of its food in the 1860s; agricultural productivity recalibrated to 0.33 per cent a year. [g] The continental price of wheat is not converted to the farm basket (Appendix C); other parameters as in the baseline. [h] The band is the measured gap between English and continental prices; productivity grows at 0.43, 0.38, 0.58 and 1.7 per cent a year in agriculture, old manufactures, services and the gross output of modern manufactures; $\sigma = 2.29$; England small in both markets.

it. The Act of 1842 set its scale in steps rather than in shillings: using its steps lowers the model's price of 1842–45 by one shilling and changes the Malthusian counterfactual by less than a point. Attributing to England only its population share of the United Kingdom's foreign imports lowers the import target to 32 per cent and raises the agricultural rate that reproduces it to 0.33, and changes the other results by a point or two. Counting all Irish oats as food and all Irish grain as English changes the model by less than a point. The Irish correction is a finding about the data; the model's dip in the 1830s is set by the band. Removing Irish grain altogether leaves food per head in the 1830s at 0.98 of the 1800s, against 0.97 with it. The level in the 1830s is the same in both: the English price was at the ceiling of the band, and Irish grain displaced foreign grain one for one. The ratio differs because Irish grain adds a little to food per head in the 1800s, the base. The adjustment from wheat to the farm basket matters for food per head after 1846 (Appendix C). A smaller permanent differential between non-farm and farm wages, 20 per cent instead of Clark's 52, lowers the wage in food a little (1.63) and leaves imports and farm employment where they were; what it cannot do is reproduce the widening of the wage gap. A model with the measured gap between English and continental prices as the band, faster rates outside modern industry and England small in world markets reproduces the English price of food by construction and comes close to the food wage (1.87), but with productivity outside modern industry growing faster than the primal accounts of Section 3 allow.

I Paths of the Corn Law counterfactuals

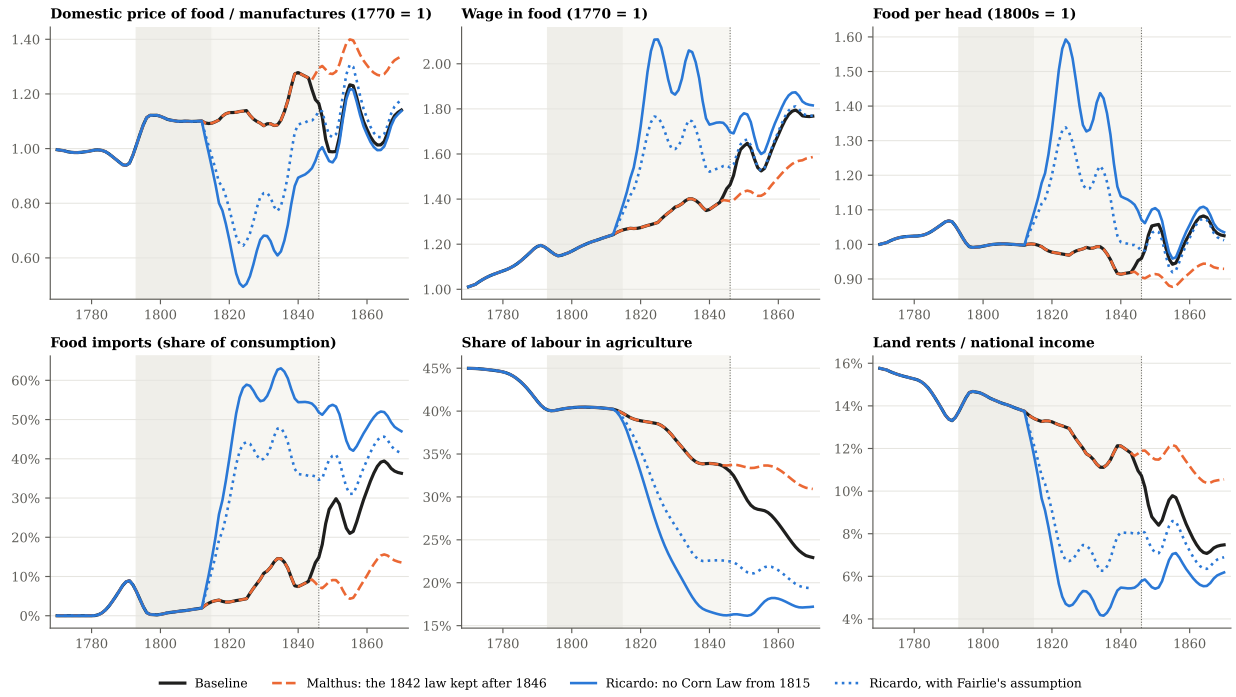


Figure I.1: The baseline, the Corn Laws kept after 1846 (Malthus) no Corn Law from 1815 (Ricardo), and Ricardo with Fairlie's assumption about continental prices. Five-year centred means of annual model output.

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