DISCUSSION PAPER SERIES

No. 3394

FROM MALTHUS TO OHLIN: TRADE, GROWTH AND DISTRIBUTION SINCE 1500

Kevin H O'Rourke and Jeffrey G Williamson

INTERNATIONAL MACROECONOMICS and INTERNATIONAL TRADE

Centre for Economic Policy Research

www.cepr.org

Available online at: **www.cepr.org/pubs/dps/DP3394.asp**

ISSN 0265-8003

FROM MALTHUS TO OHLIN: TRADE, GROWTH AND DISTRIBUTION SINCE 1500

Kevin H O'Rourke, IIES, Trinity College Dublin and CEPR
Jeffrey G Williamson, Harvard University

Discussion Paper No. 3394
May 2002

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 3394

May 2002

ABSTRACT

From Malthus to Ohlin: Trade, Growth and Distribution Since 1500*

A recent endogenous growth literature has focused on the transition from a Malthusian world where real wages were linked to factor endowments, to one where modern growth has broken that link. In this Paper we present evidence on another, related phenomenon: the dramatic reversal in distributional trends – from a steep secular fall to a steep secular rise in wage-land rent ratios – which occurred some time early in the 19th century. What explains this reversal? While it may seem logical to locate the causes in the Industrial Revolutionary forces emphasized by endogenous growth theorists, we provide evidence that something else mattered just as much: the opening up of the European economy to international trade.

JEL Classification: F10 and N10
Keywords: distribution, growth, Malthus and trade

Kevin H O'Rourke
Department of Economics and IIIS
Trinity College
Dublin 2
IRELAND
Tel: (353 1) 608 3594
Fax: (353 1) 677 2503
Email: kevin.orourke@tcd.ie

Jeffrey G Williamson
Department of Economics
Harvard University
Cambridge MA 02138
USA
Tel: (1 617) 495 2438
Fax: (1 617) 496 7352
Email: jwilliam@harvard.edu

* We have been helped with the wage-rent data by Greg Clark, Phil Hoffman, Herman van der Wee and Jan Luiten van Zanden, as well as by the excellent research assistance of Darya Zhuck. In addition, the comments of Louis Cullen are gratefully acknowledged, as are those of participants at the Ohlin Conference (Stockholm, October 14-16, 1999), the Sound Conference (Copenhagen, March 1, 2002) and seminar participants at Gotenborg, Harvard, Illinois, London School of Economics, Stockholm School of Economics and the Economic and Social Research Institute, all of whom heard early and preliminary versions of this Paper. Finally, Williamson acknowledges with pleasure financial support from the National Science Foundation SES-0001362. The usual disclaimer applies.

Submitted 07 May 2002

1. Introduction

Over the course of the last decade, a literature has emerged in which economic theorists have attempted to model the dramatic structural break in European living standards which occurred at some point between 1750 and 1850. This literature has relied on a long tradition in economic history which documents real wage indices over the long run (e.g. Phelps-Brown and Hopkins 1956), and on more recent and speculative guesstimates of GDP and GDP per capita (notably Maddison 1982, recently updated in Maddison 1995, 2001). The basic question which this literature seeks to address is based on two stylized facts. First, prior to the structural break real wages and output per capita seem to have been relatively stagnant, increasing only at a very slow pace. This regime seems to have been consistent with the famous model offered by Thomas Malthus (1826), in which living standards depend positively on land-labor ratios, and fertility depends positively on living standards. In the Malthusian regime, any technological shock or resource discovery leading to higher real wages would induce rising populations and falling real wages, until long run equilibrium was reestablished (Lee 1973). Second, there has been a sustained and impressive rise in living standards since the structural break. This has occurred despite a large increase in population, suggesting that the classical Malthusian link between living standards and land-labor ratios in England was broken sometime during the century after 1750.

The key question which modern theorists address is: How did Europe make the transition from a Malthusian economy, in which living standards were largely determined by land-labor ratios, to a modern economy, in which living standards were decoupled from land scarcity and

coupled to capital accumulation and technical change? Thus, Marvin Goodfriend and John McDermott (1995), Gary Hansen and Edward Prescott (1998), Robert Lucas (1999), Oded Galor and David Weil (2000), Charles Jones (2001), and others explore the interactions between population, technology and living standards over the long run. Indeed, Galor and Weil (2000: 806) have asserted that a unified model of the evolution from pre-industrial Malthusian stagnation to the demographic transition and modern economic growth is "one of the most significant challenges facing economists interested in growth and development."

Economic historians have continued to produce information on long run living standards which can better inform these modern theoretical debates. Thus, the voluminous price and wage information collected by pioneers like Thorold Rogers (1866-1892), William Beveridge (1939), Earl Hamilton (1934, 1936, 1947), Nicholas Posthumus (1946, 1964) and Herman van der Wee (1963) have been used to calculate comparable, PPP-adjusted real wages for several cities across Europe and the Mediterranean over centuries (Reher and Ballesteros 1993; Pamuk 2000; Allen 2001). Meanwhile, scholars such as Gregory Clark (2001a) and Jan Luiten van Zanden (2001) have provided GDP estimates for individual European countries going back as far as the Middle Ages. This focus on living standards and other macroeconomic aggregates is understandable, since such aggregate indicators can help identify when the great divergence between advanced and backward nations took place (Pritchett 1997; Pomeranz 2000). But relative factor prices, and thus income distribution, deserve equal attention. After all, significant changes in income distribution influence economic growth in many plausible models (e.g. Stokey 1991; Alesina and Perotti 1994, 1996; Aghion and Howitt 1998; Aghion, Caroli and Garcia-Penalosa 1999). Inequality changes can also matter for the political reactions they often provoke in the form of

dramatic switches in policy (O'Rourke and Williamson 1999). More important for the questions posed in this paper, relative factor prices may also inform us as to the sources of economic growth.

This paper exploits recently-collected data on relative factor prices over the very long run, and points out that there was another, equally radical structural break which occurred in north-west Europe at about the same time as the break in living standards: a dramatic reversal of long run trends in the ratio of wages to land rents. Prior to the 19th century, there had been a long period during which the wage-land rent ratio declined, implying a rise in inequality (since land owners were far closer to the top of the income distribution than were landless workers). This trend was consistent with a Malthusian world in which an increasing population pressed on a quasi-fixed land endowment, to the benefit of landlords (Hanson and Prescott 1998). At some point in the 19th century this pattern reversed, and wages started to rise relative to land rents, implying a decline in inequality. This more modern trend is inconsistent with a Malthusian world in which wage-rent ratios were determined by the land endowment per worker, since the land-labor ratio continued to decline into the 19th century and beyond. It appears, therefore, that there is more evidence that the traditional link between factor prices and factor endowments was broken some time in the 19th century.

What explains the structural break in wage-rent ratio behavior? An obvious explanation is that it was caused by the same industrial revolutionary forces underlying the break in living standards behavior. Some scholars date the first industrial revolution from 1760, some from 1780, and some don't use the word at all, but everyone agrees that the rate of technological advance accelerated in English industry about this time (Mokyr 1990; Crafts 1994; Temin 1997).

In a specific factors world in which two commodities are produced – agricultural products (using land and labor) and manufactured goods (using capital and labor) -- productivity advance in English industry should have drawn workers out of agriculture and into the cities, raising wages, lowering rents, and inflating the ratio of wages to rents.

But this paper does not just draw attention to another stylized fact for recent growth models to explain. Rather, it suggests that these models are often incomplete in one crucial respect: as with many classic growth models, they assume that economies are closed (but see Galor and Mountford 2002). We argue that the reversal in long run wage-rent ratio trends can in large part be explained by a crucial change in the world economy that coincided with the Industrial Revolution: Europe became dramatically more open to trade in the decades following Waterloo. Global market integration could on its own have cut the links between factor prices and domestic endowments, or at least weakened them dramatically.

It might be objected that intercontinental trade had been on the rise at least since the Voyages of Discovery -- growing at around 1 percent per annum between 1500 and 1800 -- and thus that trade should have influenced factor prices for several centuries before the structural break occurred. However, it turns out that the measured growth in European overseas trade was not due to global commodity market integration, as measured by a decline in intercontinental price gaps, but rather to shifts in demand and supply in Europe, Asia and the Americas (O'Rourke and Williamson 2002a). It was only with the new transport technologies of the 19th century that a sustained decline in transport costs and intercontinental price gaps began to leave their mark; and it was only in the 19th century that large-scale intercontinental trade in such basic commodities as grain and animal products became possible. It follows that it was only in the 19th

century that intercontinental trade began to have the effects on factor prices which were identified by two famous Swedish observers of the period, Eli Heckscher and Bertil Ohlin (Flam and Flanders 1991). Indeed, in earlier work we have shown that international trade did affect wage-rent ratios in the manner identified by Heckscher-Ohlin theory in the years between 1870 and 1913: trade raised wage-rent ratios in Europe, by lowering the price of imported agricultural products relative to the price of exported manufactured goods; and trade lowered wage-rent ratios in the New World, by increasing the price of exported agricultural products relative to the price of imported manufactured goods (O'Rourke and Williamson 1994, 1999; O'Rourke, Taylor and Williamson 1996).

If the first great globalization shock hit the world economy in the early 19th century rather than after 1492, then it follows that European commodity prices should have been determined primarily by domestic supply and demand prior to the early 19th century, while they should have been determined by global supply and demand afterwards. We test this intuition here for one country, England, which was at the heart of the 19th century global economy and which was thus fully exposed to the effects of growing international trade. We ask: At what stage did English commodity prices become decoupled from English factor endowments? What difference did the opening up of the domestic economy to trade make to the long run evolution of relative commodity prices in England? What were the determinants of the wage-rent ratio before the structural break compared with their determinants afterwards? And finally, what were the relative contributions of the industrial revolution and international trade in producing this historic reversal in long-run wage-rent ratio trends?

Section 2 presents the wage-rent ratio evidence, while section 3 reviews the evidence

suggesting that the 19th century was a period of commodity market integration in a way that earlier centuries simply were not. Section 4 presents evidence on how English factor prices were determined in the pre-1750 period, consistent with closed economy theory, and generates predictions as to how wage-rent ratios would have continued to evolve had the structure of the economy remained unchanged. Section 5 compares these predictions with the post-1840 English reality, and attempts to measure the role of industrialization and trade in accounting for the difference between prediction and reality. Section 6 discusses the transition which the English economy underwent between 1750 and 1840, and Section 7 concludes.

2. Wage-Rent Ratios in Western Europe Since 1450

Wage-Rent Ratio Trends in England Since 1500

Figure 1 plots three indices of wage-land rent ratios in England from 1500 to 1936. The sources used are described in Appendix 1. Briefly, they all use the same nominal agricultural wage series, based on recent work by Gregory Clark (2001b, n.d.) for the 16th to the 18th centuries, and on older sources for the 19th and 20th centuries (Fox 1903; Bowley and Wood in Mitchell 1988). The difference between the three series thus hinges on the land rent series used. The 'Clark' series is based on Clark (2002) until 1831 (using data from the Charity Commissioners), and Robert Thompson (1907) and H. A. Rhee (1949) thereafter; the Turner series uses the estimates of M. Turner, J. V. Beckett and B. Afton (1997) wherever available, and otherwise uses the Clark series; and the 'Allen' series uses Robert Allen's (1988) South Midlands data until 1831, and then Thompson and Rhee thereafter. All three series show a large

decline in wage-rent ratios between 1500 and about 1850, and a substantial rise thereafter. In the econometric exercises that follow we use the Allen series, since its overall trends offer a compromise between the other two series, and since the Turner series is the outlier from 1600 onwards. In any case, all three series document a long run decline in the wage-rent ratio to the mid-19th century and a secular recovery thereafter.

So Goes England, So Goes Europe?

As the first industrial country, and the dominant world economy of the 19th century, the English experience is clearly important in its own right. Still, it is worth asking whether this U-shaped pattern traced out by the English wage-rent ratio over half a millennium was unique to England. A similar wage-rent data base can also be constructed for France and the Netherlands (Appendix 2). Figure 2 plots the three available series up to no later than 1750: the French wage-rent ratio starts in 1450, and the Dutch and English ratios start in 1500. Figure 3 plots the three available series up to no later than the eve of World War II. For all three countries, the wage-rent ratio traces out a long run U-shaped pattern. In France the wage-rent ratio halved between 1450 and 1700, and almost halved again over the following century, before increasing sharply after 1800. In Holland there were ups and downs, but the overall trend was clearly downward between 1500 and roughly 1870, with an increase thereafter.

Figure 2 shows that wage-rent ratio trends in the three countries correlate very well up to 1700 or so, and pairwise correlations for the years 1450 to 1700 confirm it. For England and France (1565-1700) the correlation is 0.883; for England and Holland (1565-1700) it is 0.634; and for France and Holland (1500-1700) it is 0.607. Figure 3 shows that the wage-rent correlations are even

higher after 1850, and pairwise correlations for the years between 1850 and 1936 confirm it: England-France (1850-1936) 0.865, England-Holland (1850-1914) 0.891, and France-Holland (1850-1914) 0.949.

Wage-rent ratio trends thus correlate very highly in western Europe during the two subperiods 1500-1700 and 1850-1936, but the correlation collapses in between: for England and France it is 0.033, for England and Holland it is 0.547, and for France and Holland it is 0.201. The reason for the collapse is, of course, that the nadir of the wage-rent ratio U trend occurred at different times (roughly speaking, 1800 in France, 1850 in Britain and 1870 in Holland), and the magnitudes varied as well. Precocious England begins to experiment with modern economic growth first and thus drifts away from lagging France and Holland in the 18th century, but the correlation between pre-industrial France and Holland remains fairly tight. By 1850, Holland and France rejoin England and, as we have seen, wage-rent ratio trends conform again much like they did prior to 1700.

We conclude that the English, Dutch and French economies were obeying the same economic laws of motion before 1700 and after 1850, but that different experiences with the industrial revolution, globalization, or (in the French case) political upheaval produced different trends in between.

3. Global Commodity Market Integration: The 19th Century Was Different

Since we want to offer an explanation for the rise in wage-rent ratios after 1800 that discriminates between industrialization and trade as potential causes, we need to be precise about

exactly when the European economies opened up to intercontinental trade. This section stresses intercontinental trade, since it was the dramatically different factor endowments of the New World that would eventually place European land rents under sustained pressure, and contribute to the reversal in wage-rent ratios. Obviously within Europe there were regions of relative land abundance and relative land scarcity, and the costs of trade between these regions had been declining for several centuries. For example, David Jacks (2000) has documented substantial commodity market integration across the North Sea and Baltic Sea between 1500 and 1800. But no amount of trade with Prussia, for example, could have had the same impact on the British economy, or on British factor prices, as trade with the Americas eventually did in the 19th century.

The costs of trading across frontiers will be reflected in price differentials for homogenous goods in different markets, and a decline in these price differentials provides the clearest indication of international commodity market integration. Prior to the 19th century, there is no systematic evidence of inter-continental price convergence.[1] For example, Figure 4 reports data on price gaps between Amsterdam and Southeast Asia for three commodities -- cloves, coffee and black pepper, important evidence when we remember that spices and pepper combined were 68 percent of Dutch homeward cargoes in the mid-17th century (Reid 1993: 288-9). We have enough evidence to compute clove price gaps between Amsterdam and Maluku in the Southeast Asian archipelago; the pepper price gap between Amsterdam and Southeast Asia (in and around Sumatra); and the coffee price gap between Amsterdam and Java or Sumatra

[1] There is, however, evidence of price convergence within the European continent, as noted earlier.

(Bulbeck, Reid, Tan and Wu 1998). Figure 4 plots price gaps or markups for the three commodities, where these gaps or markups are defined as the ratio of the European to the Asian price. There is plenty of evidence of price convergence for cloves from the 1590s to the 1640s, but it was short-lived, since the spread soared to a 350-year high in the 1660s, maintaining that high level during the Dutch East India Company monopoly and up to the 1770s. The clove price spread fell steeply at the end of the French Wars, and by the 1820s was one-fourteenth of the 1730s level. This low spread was maintained across the 19th century. Between the 1620s and the 1730s, the pepper price spread showed no trend, after which, however, it soared to a 250-year high in the 1790s. By the 1820s, the pepper price spread of the early 17th century was recovered, and price convergence continued up to the 1880s, when the series ends. While there is some evidence of price convergence for coffee during the half century between the 1730s and the 1780s, everything gained was lost during the French Wars. At the war's end, price convergence resumed, so that the coffee price spread in the 1850s was one-sixth of what it had been in the 1750s, and in the 1930s it was one-thirteenth of what it had been in the 1730s. In all three cases, the story is the same: while substantial price convergence occurred after 1800, little or no price convergence took place before.

Similarly, there is no evidence that Anglo-Indian price convergence took place from the mid-17th to the mid-18th century. In previous work (O'Rourke and Williamson 2002b: Figure 5) we examine similar mark-up figures for the East India Company's trade in pepper, saltpetre, tea, raw silk, coffee, and indigo, between about 1660 and 1710. With the possible exception of saltpetre, it would be very hard to establish a convincing case that mark-ups were declining during this fifty-year period. Finally, we have also explored (*ibid.*, Figure 6) the Anglo-Indian

trade in cloth, and the relationship between the average prices received by the East India Company on its Asian textile sales in Europe, and the average prices it paid for those textiles in Asia. Again, there is no sign of declining mark-ups (where mark-ups include all trade costs, as well as any East India Company monopoly profits) over the century between 1664 and 1769. Thus, the trade expansion between 1500 and 1800 appears to have been due to demand and supply growth generated within the continents, not to commodity market integration between them (O'Rourke and Williamson 2002a).

The 19th century could not have been more different. Figure 4 shows rapid Dutch-Asian price convergence for the 19th century; Figure 5 provides similar evidence for another commodity, wheat, and a different pair of countries, Britain and the US.[2] The price gap fluctuated widely around an average of about 100 percent between 1800 and 1840, after which it fell sharply, reaching negligible levels by the eve of World War I. Strikingly, the timing of this decline in price differentials coincides with the timing of the sustained decline in ocean freight rates documented by C. Knick Harley (1988), and supports his view that it was the new transport technologies of the 19th century that were crucial in revolutionizing world trade, rather than the institutional factors stressed by Douglass North (1958), which had been in operation from an earlier date. The evidence of Figure 5 could be replicated many times over: by the late 19th century it is difficult to find commodities and pairs of markets for which there is no evidence of

[2] The British data are *Gazette* averages through 1980, and are taken from Mitchell (1988). After 1980, they are taken from the commodity price trends tables in the UK *Annual Abstract of Statistics*. The US data for 1870-1913 are taken from O'Rourke (1997), where they are expressed in shillings per cwt; onto these data are spliced the series in U.S. Department of Commerce (1975) for 1800-1870 and the US Department of Agriculture series for 1914-1999 (http://usda.mannlib.cornell.edu/usda/usda.html).

powerful commodity market integration.[3] To take just three examples, London-Cincinnati percentage price differentials for bacon fell from 92.5 percent in 1870 to 17.9 percent in 1913 ; Liverpool-Bombay price differentials for cotton fell from 57 percent in 1873 to 20 percent in 1913; and London-Rangoon price differentials for rice fell from 93 to 26 percent over the same period (O'Rourke and Williamson 1999: 43-53). Commodity market integration during the century before World War I was a genuinely worldwide phenomenon, and it was immense.

4. What Determined English Commodity and Factor Prices Prior to 1750?

If sustained global commodity market integration only began in the 19th century then it follows that the distributional implications of international trade should only have begun to manifest themselves some time between Waterloo and the Great War. In order to test this hypothesis we gathered data on English factor endowments, commodity prices, productivity and factor prices from 1500 to 1936. For these four centuries, we were able to construct: the ratio of agricultural land to the economy-wide labor supply (LANDLAB); the ratio of agricultural prices to industrial prices (PAPM); the ratio of wage rates to farm land rents (WR); total factor productivity in agriculture (TFPAG); and labor productivity in manufacturing (INDPROD). The sources of these English data are described in Appendix 1.

Is it the case that English commodity prices were more closely linked to English

[3] Continental European grain markets protected by defensive tariffs provide one exception in the late 19th century: see O'Rourke (1997). Defensive protection against an invasion of European manufactures was even greater in Latin and North America, but it did not overturn the forces of global integration caused by transport improvements (Clemens and Williamson 2002; Coatsworth and Williamson 2002).

endowments prior to the 19th century? And if so, when did this traditional (closed economy) relationship break down? Figure 6 explores the question of when the structural break took place: it assumes a simple log-linear relationship between relative commodity prices, PAPM, and the land-labor ratio LANDLAB, and plots Chow test statistics for every year between 1502 and 1935 to see where a structural break in this relationship is most likely to have taken place. There is a slow, hardly noticeable rise in the test statistic between 1500 and 1700, followed by a significant rise from 1700 to 1750, and a larger rise from 1750 to 1800. This timing coincides well with what we know about the gradual opening of the English economy to international trade during the course of the 18th century: for example, the share of exports in national income rose from 8.4% in 1700 to 14.6% in 1760 and 15.7% in 1801 (Crafts 1985: Table 6.6, 131). The figure suggests that traditional links between relative commodity prices and endowments were already breaking down during this century; however, the sharpest acceleration in the test statistic occurs between about 1800 and 1840. Figure 6 indicates that the best candidate for a structural break is the second quarter of the 19th century, with the peak in the series occurring in 1838. Strikingly, this 1838 peak in Figure 6 is very similar to the timing of decline in both the Harley freight index and the UK-US grain price gap. Furthermore, it is consistent with qualitative accounts regarding the liberalization of trade policy which have long been a staple in the economic history literature. That is, the two decades or so after 1815 were full of pro-globalization policy changes. Prior to 1828, grain imports were prohibited if domestic prices fell below a certain 'port-closing' level, and during the early postwar years grain imports were effectively excluded much of the time. In 1828, the Duke of Wellington's government replaced these import restrictions with tariffs which varied with the domestic price, a policy that not only lowered British grain prices

but also increased the integration of British and Continental grain markets. Moreover, this adoption of the sliding scale tariff came at the end of a decade which had seen several other moves towards freer trade: a reform of the Navigation Acts in 1822; tariff reductions across the board; and the repeal of more than 1,100 tariff acts in 1825, the year in which the emigration of skilled workers was once again authorized. Of course, prior to 1815 the French Wars had severely restricted international trade (Findlay and O'Rourke 2001). In short, by 1838 there had already been a radical liberalization of British commercial policy (Williamson 1990), and Britain stuck with that pro-globalization policy stance up to the more famous 1846 Repeal of the Corn Laws and beyond.

Table 1 estimates a simple log-linear regression of PAPM on LANDLAB for the initial, closed economy period, which we take to be 1500-1750. In principle, rising land-labor ratios should have pushed up food supply relative to food demand, and lowered the relative price of food: the coefficient on LANDLAB should thus be negative, which it is. Moreover, the regression passes standard Engle-Granger cointegration tests at the 10 percent level. Figure 7 plots the natural logarithm of PAPM, and of its predicted value generated by this regression (labeled PAPMF). Thus, PAPMF represents the relative price of agricultural goods that would have prevailed had they continued to be determined by domestic endowments after 1750. Since land-labor ratios continued to decline in Britain after 1750, the regression predicts that the relative price of food should have continued to rise. But in fact it stopped rising somewhere around the middle of the 19th century, and then started to decline. Table 1 does a very good job of predicting the behavior of PAPM prior to the middle of the 18th century, but Figure 7 shows that it does a very poor job after the beginning or middle of the 19th century -- consistent with the

hypothesis that commodity prices became uncoupled from domestic endowments by the mid-19th century, and were determined on world markets thereafter.

How were wage-rent ratios determined in pre-19th century England? In a closed economy without trade, a decline in land-labor ratios should lead to a fall in the wage-rent ratio, and for standard Malthusian reasons. Rising industrial productivity, due either to rising capital-labor ratios or to better industrial technology, should raise wage-rent ratios, for reasons stated earlier. The impact of better agricultural technology on wage-rent ratios should depend on whether it was labor-saving or land-saving. Table 2 gives the results of regressing the wage-rent ratio (WR) on endowments (LANDLAB), on industrial productivity (INDPROD), and on agricultural productivity (TFPAG), for the years 1500-1750.[4] (Once again, all variables are expressed in natural logarithms.) As expected, the wage-rent ratio was positively related to the land-labor ratio. It was also positively related to industrial productivity. However, it was *negatively* related to agricultural productivity, suggesting that technical change in early modern English agriculture tended to be labor-saving, or land-using, which is what socialist critics of the enclosure movement have long maintained (Marx 1867; Hammond and Hammond 1932; Dobb 1946), an assertion that has been supported by recent empirical analysis (Allen 1992: Chp. 11).

Table 3 uses these results to decompose changes in the wage-rent ratio into those components which were due to changes in LANDLAB, TFPAG and INDPROD. Panel A reports the actual changes in these variables between 1500 and 1750. Panel B then uses the coefficients from Table 2 to derive the change in the wage-rent ratio due to changes in each of these three

[4] The relationship is at the margins of cointegration, passing the Engle-Granger test at the 15 percent level.

exogenous variables and an unexplained residual. These impact estimates are all expressed as percentages of the actual change in WR. Thus, the first row of panel B shows that 53.2 percent of the 16th century decline in wage-rent ratios was due to falling land-labor ratios; 19.5 percent was due to improved agricultural labor-saving technology; and 28.5 percent was due to a decline in industrial productivity; leaving very little unexplained by the residual. Over the period as a whole, the dominant factors pushing down the wage-rent ratio were a rising population and improvements in agricultural technology: according to the final row of panel B, 74.5 percent of the decline in wage-rent ratios in the quarter millennium after Columbus was due to falling land-labor ratios, while 38.5 percent was due to improvements in agricultural total factor productivity. Falling industrial productivity between 1500 and 1600 reinforced those trends, but rising industrial productivity from 1600 onwards served to counter them: over the period as a whole, changing industrial productivity had little impact on changing wage-rent ratios. Residual forces, unaccounted for by the regression in Table 2, served to lower the wage-rent ratio, but those forces were not very powerful over the quarter millennium as a whole. However, those residual forces certainly rose over time. Indeed, the very large residual which finally appears between 1700 and 1750 signals that these closed-economy, pre-industrial relationships were already breaking down in the first half of the 18th century. Still, the main message emerging from Table 3 is that population pressure on the land was crucial in explaining the collapse in the wage-rent ratio before 1750, an empirical finding fully consistent with a characterization of the epoch as 'Malthusian'.

5. What Determined Factor Prices After 1840?

Figure 8 displays the central fact motivating this paper. The predicted WR in the figure is the natural logarithm of the wage-rent ratio which the pre-1750 relationship estimated in Table 2 implies for the full 450 years after Columbus: that is to say, it takes the regression coefficients estimated in Table 2, and applies these to the actual movements in LANDLAB, TFPAG and INDPROD over the entire period. From 1750 on it thus represents a counterfactual WR series which would have obtained had there been no fundamental regime change. If pre-industrial relationships had been sustained, the wage-rent ratio would have continuously declined throughout, and at a much more rapid rate in the 19th century than before. Panel C of Table 3 reports the change in this counterfactual wage-rent ratio series (WRCF) between 1750 and 1936, as well as the actual changes in the exogenous variables which are driving the counterfactual series. Panel D then decomposes the change in the counterfactual series into the components explained by changes in each of the three exogenous variables. Declining land-labor ratios explain almost the entire decline in the counterfactual series (93 percent); more rapid technological progress in agriculture also helps push down counterfactual wage-rent ratios (40 percent), but this agricultural productivity effect is almost entirely offset by the impact of even more rapid improvements in industrial productivity (-33 percent).

If there had been no fundamental change in regime, 19th century wage-rent ratios would have continued to decline rapidly, but this is not at all what happened. On the contrary, Figure 8 shows that the wage-rent ratio actually declined at a far more sedate pace until 1850 or so, before turning around and increasing markedly. What explains this dramatic departure from the

historical norm? Was it the industrial revolution, which pulled workers into the cities at an accelerating pace, thus raising wage-rent ratios? Or was it the growing internationalization of the British economy, effectively raising Britain's land-labor ratio by importing land-intensive foodstuffs and manufacturing intermediates (e.g. cotton, wool and timber) produced on more abundant land overseas? Or was it both?

Table 4 estimates a (log-linear) open-economy model of the wage-rent ratio over the period 1840-1936.[5] This period was chosen since the previous two sections suggested that it was only after the late 1830s that the transition from a relatively closed economy to a relatively open one, in which relative commodity prices were effectively delinked from domestic endowments, was complete. In an open economy, WR could still be a function of INDPROD, TFPAG and LANDLAB (assuming that the number of factors exceeds the number of traded goods), but it should also be a function of relative commodity prices PAPM, which are now taken as exogenous in a newly globalized world. The specific factors trade model predicts that as the relative price of food declines, resources should be transferred out of agriculture, and land rents (returns to the immobile factor) should fall relative to wages (returns to the mobile factor): thus WR should be a negative function of PAPM. TFPAG and LANDLAB are omitted from the regression since when equations were estimated including them, the coefficients on TFPAG and LANDLAB were statistically insignificant, and the equations failed Engle-Granger cointegration tests. We are thus left with a parsimonious specification in which the wage-rent ratio is a function of industrial productivity and relative commodity prices alone. As Table 4 shows, WR was again

[5] O'Rourke and Williamson (2002c) show that while closed economy models similar to the one estimated earlier work well before 1800, they do not work at all well from the 19th century on. Similarly, open economy models work well for the later period, but not for the earlier one.

positively related to industrial productivity, and the estimated coefficient is almost exactly the same as that found in Table 2 for 1500-1750 (i.e. 1.02). Furthermore, WR was negatively related to the relative price of agricultural goods, just as trade theory suggests. The equation passes the Engle-Granger cointegration test at the 5 percent level.

Panel E of Table 3 reports the actual changes in WR, INDPROD and PAPM between 1840 and 1936, while Panel F decomposes the change in WR into those portions due to changing industrial productivity and changing relative prices. From the results in Panel F it might appear that the industrial revolution was the dominant actor in the story, while globalization was only a bit player. After all, the rise in industrial productivity accounted for *all* of the rise in the wage-rent ratio after 1840, while falling relative agricultural prices accounted for "only" a fifth of the rise (and the impact of PAPM was almost precisely offset by residual factors). However, this decomposition is a grossly inaccurate reflection of the impact on factor prices of Britain opening up to intercontinental trade between the 1820s and 1840s, since the decomposition measures the impact of changing commodity prices relative to an implicit counterfactual of *no* change in relative commodity prices. In fact, the appropriate no-trade counterfactual is one of a continued rise in relative agricultural prices (Figure 7), and it is against that counterfactual that the impact of the regime switch to openness should be gauged.

Figure 9 supplies a far more accurate accounting of the relative impact of globalization[6] and the industrial revolution in explaining the turn-about in wage-rent trends after the 1830s. It

[6] We use the word "globalization" to denote a rise in trade driven by commodity market integration. It does *not* include the effect of globalization on labor markets carried by mass migration (Hatton and Williamson 1998) or on capital markets carried by the great capital export from Europe (Obstfeld and Taylor 2002). After all, these factor market effects are already embedded in LANDLAB and INDPROD.

reports the actual behavior of the wage-rent ratio from 1840 onwards (based on fitted values from the regression in Table 4) and the "predicted" wage-rent ratio which would have applied had pre-1750 relationships continued to hold (based on fitted values from the regression in Table 2). While the wage-rent ratio in fact increased more than four-fold over the period, it would have declined by more than 80 percent had it continued to evolve according to pre-1750 relationships. The figure also plots three counterfactual wage-rent ratio series. The first, labeled 'no industrial revolution,' is again based on the estimated equation in Table 4, but holds the level of industrial productivity constant in every year (at its 1840 level). Thus, it shows the wage-rent ratios which would have obtained had relative commodity prices evolved in the way they did, but had there been no improvement in industrial productivity from 1840 onwards. As can be seen, if there had been no increase in industrial productivity over that century, the wage-rent ratio would have remained roughly constant throughout -- rising by a mere 29 percent by 1936, rather than recording an actual increase of 354 percent. Presumably, this is the channel of causation -- from the industrial revolution to rising wage-rent ratios -- which would have been favored by Jones, Galor and Weil, Lucas and other theorists, had they addressed this relative factor price issue explicitly.[7]

The second series, labeled 'no trade,' also uses the coefficients which were estimated in Table 4. It assumes that the English economy remained relatively closed to international trade, and, to be more precise, that relative commodity prices continued to be determined by domestic factor endowments after the 1830s. This counterfactual thus allows INDPROD to evolve as it

[7] In fact, several papers in this literature (e.g. Galor and Weil 2000, Jones 2001 and Galor and Mountford 2002) assume that returns to land are zero for reasons of analytical tractability.

did, but substitutes the counterfactual PAPMF series in Figure 7 for the actual PAPM series. As can be seen from Figure 9, if there had been no open economy forces causing relative commodity prices to diverge from their historical trajectory the wage-rent ratio would have remained relatively constant between 1840 and 1936, increasing by a mere 59 percent, rather than by 354 percent as actually occurred. Figure 9 suggests that globalization and the industrial revolution had roughly equal effects on wage-rent ratios throughout this period: the two counterfactual series are remarkably close to each other. Finally, the 'no industrial revolution & no trade' series holds INDPROD constant as before, and also substitutes PAPMF for PAPM as in the 'no trade' counterfactual. In this final counterfactual, the wage-rent ratio actually falls by 55 percent between 1840 and 1936, and at almost the same rate as if pre-1750 relationships had been maintained.

We conclude two things from these counterfactuals. First, industrial revolutionary forces and the opening up of the English economy to trade together explain the historic reversal in long-run wage-rent ratio trends. If industrial productivity had failed to increase, and if relative commodity prices had continued to evolve as they had done prior to 1750, then the wage-rent ratio would have continued to decline after the 1830s as they had since 1500, and by a substantial amount. However, once INDPROD and PAPM are allowed to evolve as they actually did, our econometric model replicates the actual rise in wage-rent ratios which took place between 1840 and 1936. Second, and just as important, while the long-run turnaround in wage-rent ratio trends can be explained partly by industrial revolutionary forces, it is also explained by the open economy forces identified long ago by Eli Heckscher and Bertil Ohlin. Comparing the 'no trade' and 'no industrial revolution' series in Figure 9, it would appear that trade was just as important

as industrial revolutionary forces in explaining the historic relative factor price turn-around. A closed economy account of the revolutionary change in growth and distribution performance during the 19th century misses half the story.

6. The Transition, 1750-1840

We have argued that there were not one but two regime switches which occurred in Britain during the late 18th and early 19th centuries. The first was a transition to modern industrial growth and the second was a transition towards a more open trading environment. It is important to note that these regime switches were not abrupt, but rather took place over a number of decades. Furthermore, a number of economic historians have argued that these two transitions were intimately related to each other.

Traditional economic history has always taught that the Industrial Revolution marked a sharp and "revolutionary" discontinuity. The older evidence seemed to support this view; for example, Walther Hoffmann's (1955) data show a dramatic acceleration of industrial output after 1770. More recent work, however, has found that aggregate growth and technical change were much slower between 1770 and 1830 than had been previously thought (e.g. Crafts and Harley 1992), with technical change largely concentrated in a number of key industries. Moreover, the aggregate growth rate had been steadily increasing since the beginning of the 18th century. Thus, "the origins of modern economic growth extended over a longer time period and a wider geographical area than are traditionally encompassed in studies of the Industrial Revolution" (Harley and Crafts 2000: 820-21). Furthermore, there is another tradition that focuses on pre-

factory cottage industry development, so-called proto-industrialization. This recent scholarship has encouraged some to discard the phrase "industrial revolution" entirely!

While the price gap evidence outlined in section 3 certainly documents a stark contrast – no intercontinental price convergence before 1800, but substantial price convergence thereafter – it is important to note that the move to a more open British economy had also been taking place over a long period. To repeat, the share of exports in British national output gradually rose from 8.4% in 1700 to 14.6% in 1760, 15.7% in 1801, and 19.6% in 1851 (Crafts 1985: Table 6.6, 131).[8] Furthermore, the role of intercontinental trade was also increasing throughout the 18th and early 19th centuries: Europe took 85.3% of English exports in 1700-1, but only 77% in 1750-1, 49.2% in 1772-3, and 30.1% in 1797-8. The Americas (the source of abundant land) were the most important overseas destination, with their share of total exports rising from 10.3% to 57.4% over the same period (O'Brien and Engerman 1991: Table 4, 186). Figure 6 indicated that traditional "Malthusian" relationships between English prices and endowments were already breaking down during the 18th century, consistent with this gradual opening of the economy. True, wars continuously served to interrupt the contribution of long run fundamentals pushing international commodity market integration. For example, Figure 4 indicates a spike in the clove price gap which coincided with the Seven Years War (1756-63), and an increase in coffee and black pepper price gaps during the 1790s which coincided with the outbreak of the French and Napoleonic Wars. The *pax Britannica* that prevailed after Waterloo allowed those fundamentals to exert their full impact. These included the technological breakthroughs in transport which

[8] Of course, much of this rise in the trade share was due to rising demand generated by successful economic growth, rather than to globalization (O'Rourke and Williamson 2002a).

were crucial in driving down freight rates so dramatically in the 19th century (Harley 1988).

Finally, the two revolutions which we argue were responsible for reversing the long run decline in wage-rent ratios were connected in a number of ways -- although the precise nature of these links remains a subject of lively debate.[9] Most obviously, the innovations which drove down freight rates – notably the metal steamship – depended on the steam engine and developments in metallurgy which together constituted some of the most notable technological breakthroughs of the Industrial Revolution. But the causation may also have gone the other way around, from trade to the Industrial Revolution. While it is clear that the industrial revolution was supply-driven, and that export demand was therefore not the cause of it in any old-fashioned Keynesian sense (Mokyr 1977), and while Marxist accounts of the industrial revolution, which link British accumulation to profits derived from the colonial trade, do not withstand scrutiny either (O'Brien 1982), it is difficult to imagine that English industrial growth between 1750 and 1850 would have been as rapid as it was in fact without ample and elastic supplies of imported raw materials such as cotton, and the ability to sell industrial output in overseas markets (Findlay 1982, 1990; O'Brien and Engerman 1991). Overseas markets were in fact more important for industry than for the economy as a whole: the export share in gross industrial output was 24.4% in 1700, and 34.4% in 1801 (O'Brien and Engerman 1991: 188). Between 1780 and 1801, the increase in industrial exports was 46.2% of the increase in gross industrial output; in 1801, exports were 24% of iron output, and an astonishing 62% of cotton output. While no scholar has quantified what would have happened to British investment incentives had industrialists been

[9] For a recent survey of the historiography, see Morgan (2000). Economists have had an equally lively debate as they have tried to disentangle the late 20th century impact of globalization on growth and inequality.

forced to sell their output solely on domestic markets, and source all their raw materials domestically, the direction of the effect seems obvious. Without trade, the prices of manufactures would have declined by more than they actually did, and manufacturing inputs would have been far more expensive. Thus, profitability and (presumably) investment would have been lower (especially given that textile fibers such as wool were less easily mechanized than raw cotton, making a counterfactual switch from imported cotton to domestic wool very difficult). Furthermore, an elastic supply of raw cotton to the British economy required not only elastic supplies of New World land, but elastic supplies of slave labor as well. Thus, the British Industrial Revolution was intimately bound up with the Triangular Trade linking Africa, Europe and the Americas (Findlay 1990).

7. Conclusion

This paper has provided evidence of a dramatic structural break in European long run relative factor price trends which coincided with the more familiar break which occurred in living standards and aggregate productivity behavior. If the English wage-rent ratio had continued to follow the same laws of motion after 1750 as before it would have declined continuously throughout the modern period, and at an accelerating rate as population growth increased and the land-labor ratio fell ever more dramatically. Instead, it declined briefly and moderately until it started its modern rise sometime around 1850.

We have argued that this reversal in wage-rent ratio trends was due not only to the industrial revolution, but to the opening of the English economy to trade. Evidence on falling

transport costs, rising liberal policy, evaporating international commodity price gaps, rising trade shares, and the relationship between commodity prices and factor endowments all suggest that the English economy became much more open to trade during the 18th and early 19th centuries, and particularly during the quarter century or so after Waterloo. By the middle of the 19th century relative commodity prices no longer evolved as if they were determined by English factor endowments; relative agricultural prices stopped their secular rise, and eventually even started to decline. We have shown that trade was just as important as rising industrial productivity in explaining the reversal in wage-rent ratio trends after 1840. Factor price ratios would not have increased dramatically in the absence of industrial revolutionary forces; nor would they have increased dramatically had relative commodity prices continued to be determined by domestic factor endowments, as they had been for the quarter millennium prior to 1750 and even longer.

It is certainly true that standard (static) models predict that trade will have a larger impact on relative factor prices than on average living standards. Nonetheless, our results caution against any attempt to explain the shift away from a Malthusian regime to a modern growth regime by use of closed economy thinking alone. Indeed, this paper probably understates the importance of trade in producing regime shifts during this period, since it ignores the possibility that the industrial revolution may itself have been intimately connected with the development of international trade during the 18th and early 19th centuries. Without the possibility of intercontinental trade, industrial productivity would almost certainly not have increased by as much as it actually did during the industrial revolution: trade may not have kick-started the First

Industrial Revolution, but it surely played an indispensable supporting role.[10] Open economy forces must have played an even more important role after 1750 than our already-impressive econometric results suggest.

Our findings are consistent with a vast economic history literature which emphasizes the role of the Atlantic economy (most recently, Acemoglu et al. 2002), and the many economic interactions between Europe and the rest of the world, in explaining Europe's take-off in the late 18th and 19th centuries. They are also consistent with a long-standing tradition in economic history of viewing the Voyages of Discovery as providing Europe with a crucial resource windfall and easing Malthusian constraints – but *only* after New World land had been brought into cultivation, and *only* after transport technology had progressed to the point where the output of that land could be cheaply carried back to Europe (Jones 1981; Pomeranz 2000), and *only* after liberal policies and institutions allowed the trade to take place.[11] Our findings are inconsistent with the many closed economy models used by theorists to explain Europe's take-off into sustainable modern economic growth. True, some of the theorists cited early in this paper recognize the limitations of their closed economy assumptions. For example, in their concluding speculations Galor and Weil state "that the inflow of grain and other commodities as well as the outflow of migrants during the nineteenth century may have played a crucial role in Europe's development. By easing the land constraint at a crucial point – when income per capita had

[10] Indeed, Acemoglu, Johnson and Robinson (2002) have offered new evidence recently that participation in the Atlantic economy was essential in making modern Western European growth possible before 1850.

[11] The third "only" in this sentence is there to stress that there was no world globalization after Columbus until mercantilism broke down sometime in the transitional 18th century (O'Rourke and Williamson 2002b).

begun to rise rapidly, but before the demographic transition had gotten under way – the "ghost acres" of the New World provided a window of time, which allowed Europe to pull decisively away from the Malthusian equilibrium" (Galor and Weil 2000: p. 826). It is our contention that these open economy forces deserve far more than a footnote. Indeed, they should get equal billing with closed economy industrial revolutionary forces in any model of long run growth over the past two centuries.

References

D. Acemoglu, S. Johnson and J. Robinson (2002), "The Rise of Europe: Atlantic Trade, Institutional Change and Economic Growth," paper given to the Harvard Joint Development and Economic History Workshops, Harvard University (April 5, 2002).

P. Aghion and P. Howitt (1998), *Endogenous Growth Theory* (Cambridge, Mass.: MIT Press).

P. Aghion, E. Caroli and C. Garcia-Penalosa (1999), "Inequality and Economic Growth: The Perspective of the New Growth Theories," *Journal of Economic Literature* 37, 4 (December): 1615-60.

A. Alesina and R. Perotti (1994), "The Political Economy of Growth: A Critical Survey of the Literature," *World Bank Economic Review* 8, 3: 351-71.

— (1996), "Income Distribution, Political Instability and Investment," *European Economic Review* 40, 6: 1203-28.

R. C. Allen (1988), "The Price of Freehold Land and the Interest Rate in the Seventeenth and Eighteenth Centuries," *Economic History Review* 41, 1 (February): 33-50.

— (1992), *Enclosure and the Yeoman* (Oxford: Clarendon Press).

--- (2001), "The Great Divergence in European Wages and Prices from the Middle Ages to the First World War," *Explorations in Economic History* 38, 4 (October): 411-47.

W. Beveridge (1939), *Prices and Wages in England from the Twelfth to the Nineteenth Century, Volume 1, Price Tables: Mercantile Era* (London: Longmans, Green and Co).

D. Bulbeck, A. Reid, L. C. Tan and Y. Wu (1998), *Southeast Asian Exports Since the 14th Century: Cloves, Pepper, Coffee, and Sugar* (Leiden, The Netherlands: KITLV Press).

G. Clark (n.d.), "The Long March of History: Farm Laborers' Wages in England 1208-1850," mimeo, University of California, Davis.

— (2001a), "The Secret History of the Industrial Revolution," paper presented to the *Fourth European Historical Economics Conference*, Oxford (September 21-23).

— (2001b), "Farm Wages and Living Standards in the Industrial Revolution: England, 1670-1850," *Economic History Review* 54, 3 (August): 477-505.

— (2002), "Land Rental Values and the Agrarian Economy: England and Wales, 1500-1912," *European Review of Economic History* (forthcoming).

M. A. Clemens and J. G. Williamson (2002), "Who Protected and Why? Tariffs the World Around 1865-1940," paper to be presented at the *Conference on the Political Economy of Globalization*, Dublin (August 29-31).

J. H. Coatsworth and J. G. Williamson (2002), "The Roots of Latin American Protectionism: Looking Before the Great Depression," paper to be presented at the *IDB Conference on Economic Integration in the Americas: Prospects and Policy Issues*, Punta del Este (November).

N.F.R. Crafts (1985), *British Economic Growth During the Industrial Revolution* (Oxford: Clarendon Press).

— (1994), "The Industrial Revolution," in R. Floud and D. McCloskey (eds.), *The Economic History of Britain Since 1700, Volume 1* (Cambridge: Cambridge University Press).

N.F.R. Crafts and C.K. Harley (1992), "Output Growth and the Industrial Revolution: A Restatement of the Crafts-Harley View," *Economic History Review* 45, 4: 703-30.

M. Dobb (1946), *Studies in the Development of Capitalism* (London: Routledge and Kegan Paul).

R. Findlay (1982), "Trade and Growth in the Industrial Revolution," in C.P. Kindleberger and G. Di Tella (eds.), *Economics in the Long View: Essays in Honor of W.W. Rostow* (Macmillan).

— (1990), "The 'Triangular Trade' and the Atlantic Economy of the Eighteenth Century: A Simple General-Equilibrium Model," *Essays in International Finance* 177, International Finance Section, Department of Economics, Princeton University.

R. Findlay and K. H. O'Rourke (2001), "Commodity Market Integration 1500-2000," *NBER Working Paper* 8579 (Cambridge, Mass.: NBER).

H. Flam and M. J. Flanders (1991), *Heckscher-Ohlin Trade Theory* (Cambridge, Mass.: MIT Press).

A. W. Fox (1903), "Agricultural Wages in England and Wales During the Last Fifty Years," *Journal of the Royal Statistical Society* 66, 2: 273-359.

O. Galor and A. Mountford (2002), "Why are a Third of People Indian and Chinese? Trade, Industrialization and Demographic Transition," *CEPR Discussion Paper* 3136 (London: CEPR).

O. Galor and D. N. Weil (2000), "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond," *American Economic Review* 90, 4 (September): 806-28.

M. Goodfriend and J. McDermott (1995), "Early Development," *American Economic Review* 85, 1 (March): 116-33.

E. J. Hamilton (1934), *American Treasure and the Price Revolution in Spain, 1501-1650* (Cambridge, Mass.: Harvard University Press).

— (1936), *Money, Prices and Wages in Valencia, Aragon and Navarre 1351-1500* (Cambridge, Mass.: Harvard University Press).

— (1947), *War and Prices in Spain, 1651-1800* (Cambridge, Mass.: Harvard University Press).

J. L. Hammond and B. Hammond (1932), *The Village Labourer 1760-1832* (London: Longman).

G.D. Hansen and E.C. Prescott (1998), "Malthus to Solow," *NBER Working Paper* 6858 (Cambridge, Mass.: NBER).

C. K. Harley (1988), "Ocean Freight Rates and Productivity, 1740-1913: The Primacy of Mechanical Invention Reaffirmed," *Journal of Economic History* 48, 4 (December): 851-76.

C.K. Harley and N.F.R. Crafts (2000), "Simulating the Two Views of the British Industrial Revolution," *Journal of Economic History* 60, 3 (September): 819-41.

T. J. Hatton and J. G. Williamson (1998), *The Age of Mass Migration: Causes and Economic Impact* (Oxford: Oxford University Press).

W.G. Hoffmann (1955), *British Industry, 1700-1950* (Oxford: Basil Blackwell).

D. Jacks (2000), "Market integration in the North and Baltic Seas, 1500-1800," *LSE Working Papers in Economic History* 55/00.

E. L. Jones (1981), *The European Miracle* (Cambridge: Cambridge University Press).

C. I. Jones (2001), "Was the Industrial Revolution Inevitable? Economic Growth Over the Very Long Run," *Advances in Macroeconomics* 1, 2, article 1.

R. D. Lee (1973), "Population in Pre-Industrial England: An Econometric Analysis," *Quarterly Journal of Economics* 87 (November): 581-607.

R. Lucas (1999), *The Industrial Revolution: Past and Future*, mimeo., University of Chicago, Department of Economics.

A. Maddison (1982), *Phases of Capitalist Development* (New York: Oxford University Press).

— (1995), *Monitoring the World Economy 1820-1992* (Paris: OECD Development Centre).

— (2001), *The World Economy: A Millennial Perspective* (Paris: OECD Development Centre).

T. R. Malthus (1826), *An Essay on the Principle of Population* (Cambridge: Cambridge University Press).

K. Marx (1867), *Capital*, trans. S. Moore and E. Aveling, 3 vols., 1867-94, vol. i (New York: Random House, 1906).

B. R. Mitchell (1988), *British Historical Statistics* (Cambridge: Cambridge University Press).

J. Mokyr (1977), "Demand vs. Supply in the Industrial Revolution," *Journal of Economic History* 37: 981-1008.

— (1990), *The Lever of Riches: Technological Creativity and Economic Progress* (New York: Oxford University Press).

K. Morgan (2000), *Slavery, Atlantic Trade and the British Economy 1660-1800* (Cambridge: Cambridge University Press).

D. C. North (1958), "Ocean Freight Rates and Economic Development 1750-1913," *Journal of Economic History* 18: 538-55.

P. K. O'Brien (1982), "European Economic Development: The Contribution of the Periphery," *Economic History Review* 35 (February): 1-18.

P. K. O'Brien and S. L. Engerman (1991), "Exports and the Growth of the British Economy from the Glorious Revolution to the Peace of Amiens," in B. L. Solow (ed.), *Slavery and the Rise of the Atlantic System* (Cambridge: Cambridge University Press): 177-209.

M. Obstfeld and A. M. Taylor (2002), "Globalization and Capital Markets," paper presented to the *NBER Conference on Globalization in Historical Perspective*, Santa Barbara (May 4-5).

K. H. O'Rourke (1997), "The European Grain Invasion, 1870-1913," *Journal of Economic History* 57 (December): 775-801.

K. H. O'Rourke, A. M. Taylor and J. G. Williamson (1996), "Factor Price Convergence in the Late Nineteenth Century," *International Economic Review* 37 (August): 499-530.

K. H. O'Rourke and J. G. Williamson (1994), "Late 19th Century Anglo-American Factor Price Convergence: Were Heckscher and Ohlin Right?" *Journal of Economic History* 54 (December): 892-916.

— (1999), *Globalization and History: The Evolution of a 19th Century Atlantic Economy* (Cambridge, Mass.: MIT Press).

— (2002a), "After Columbus: Explaining the Global Trade Boom 1500-1800," *Journal of Economic History* 62 (March): 1-31.

— (2002b), "When Did Globalization Begin?" *European Review of Economic History* 6 (April): 23-50.

— (2002c), "The Heckscher-Ohlin Model Between 1400 and 2000: When It Explained Factor Price Convergence, When It Did Not, and Why," in R. Findlay, L. Jonung and M. Lundahl (eds.), *Bertil Ohlin: A Centennial Celebration* (Cambridge, Mass.: MIT Press, forthcoming).

S. Pamuk, *Prices and Wages in Istanbul and Other Cities* (Ankara: State Institute of Statistics, 2000).

H. Phelps-Brown and S.V. Hopkins (1956), "Seven Centuries of the Prices of Consumables, Compared with Builders' Wage Rates," *Economica* 23: 296-315.

K. Pomeranz (2000), *The Great Divergence* (Princeton, NJ: Princeton University Press).

N. W. Posthumus (1946 and 1964), *Inquiry into the History of Prices in Holland, Volumes I and II* (Leiden: E. J. Brill).

L. Pritchett (1997), "Divergence, Big Time," *Journal of Economic Perspectives* 11 (Summer): 3-18.

D. S. Reher and E. Ballesteros (1993), "Precios y Salarios en Castilla La Nueva: La Construccion de un Indice de Salarios Reales, 1501-1991," *Revista de Historia Economica*, 11, 1: 101-36.

A. Reid (1993), *Southeast Asia in the Age of Commerce 1450-1680: Volume Two: Expansion and Crisis* (New Haven, Conn.: Yale University Press).

H. A. Rhee (1949), *The Rent of Agricultural Land in England and Wales* (London: Central Landowners Association).

J. E. T. Rogers (1866-92), *A History of Agriculture and Prices in England* (Oxford: Clarendon Press), 7 volumes.

N. L. Stokey (1991),"Human Capital, Product Quality, and Growth," *Quarterly Journal of Economics* 106 (2): 587-616.

P. Temin (1997), "Two Views of the British Industrial Revolution," *Journal of Economic History* 57, 1 (March): 63-82.

R.J. Thompson (1907), "An Inquiry into the Rent of Agricultural Land in England and Wales during the Nineteenth Century," *Journal of the Royal Statistical Society* 70 (December): 587-616.

M. E. Turner, J. V. Beckett, and B. Afton (1997), *Agricultural Rent in England 1690-1914* (Cambridge: Cambridge University Press).

U. S. Department of Commerce (1975), *Historical Statistics of the United States* (Washington, D.C.: USGPO).

H. van der Wee (1963), *The Growth of the Antwerp Market and the European Economy (Fourteenth-Sixteenth Centuries): I Statistics* (Louvain: Publications Universitaires).

J. L. van Zanden (2001), "A Survey of the European Economy, 1500-1800," in M. Prak (ed.), *Early Modern Capitalism* (London: Routledge).

J. G. Williamson (1990), "The Impact of the Corn Laws Just Prior to Repeal," *Explorations in Economic History* 27, 2 (April): 123-56.

Table 1. Explaining Relative Commodity Prices, 1500-1750

(Dependent Variable: PAPM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.37	0.10	86.98	0.00
LANDLAB	-0.76	0.01	-53.20	0.00
R-squared	0.919	Mean dependent var		3.256
Adjusted R-squared	0.919	S.D. dependent var		0.222
S.E. of regression	0.063	Akaike info criterion		-2.676
Sum squared resid	0.996	Schwarz criterion		-2.648
Log likelihood	337.837	F-statistic		2830.276
Durbin-Watson stat	0.017	Prob(F-statistic)		0.000

Source: See text

Table 2. Explaining Wage-Rent Ratios, 1500-1750

(Dependent Variable: WR)

Variable	Coef.	Std. Error	t-Statistic	Prob.
C	-2.190016	1.850914	-1.183208	0.2379
LANDLAB	1.663841	0.162203	10.25779	0.0000
TFPAG	-1.965769	0.312101	-6.298505	0.0000
INDPROD	1.021139	0.141353	7.224027	0.0000
R-squared	0.940723	Mean dependent var		5.167565
Adjusted R-squared	0.940003	S.D. dependent var		0.760859
S.E. of regression	0.186366	Akaike info criterion		-0.506396
Sum squared resid	8.578912	Schwarz criterion		-0.450214
Log likelihood	67.55272	F-statistic		1306.634
Durbin-Watson stat	0.05314	Prob(F-statistic)		0.0000

Source: See text.

Table 3. Decomposing Changes in Wage-Rent Ratios, 1500-1936

Panel A. Actual movements in variables 1500-1750 (change in log)					
	WR	LANDLAB	TFPAG	INDPROD	
1500-1600	-1.7	-0.5	0.2	-0.5	
1600-1700	-0.2	-0.2	0.1	0.3	
1700-1750	-0.1	-0.1	0.1	0.1	
1500-1750	-1.9	-0.9	0.4	-0.1	
Panel B. Explaining movements in WR 1500-1750 (percent accounted for)					
	TOTAL	LANDLAB	TFPAG	INDPROD	RESIDUAL
1500-1600	100.0	53.2	19.5	28.5	-1.1
1600-1700	100.0	143.9	103.5	-131.6	-15.8
1700-1750	100.0	421.4	335.2	-183.0	-473.7
1500-1750	100.0	74.5	38.5	2.7	-15.7
Panel C. Counterfactual change in WR and actual movements in other variables 1750-1936 (change in log)					
	WRCF	LANDLAB	TFPAG	INDPROD	
1750-1936	-3.9	-2.2	0.8	1.3	
Panel D. Explaining movements in counterfactual WR 1840-1936 (percent accounted for)					
	WRCF	LANDLAB	TFPAG	INDPROD	
1750-1936	100.0	93.0	40.1	-33.1	0.0
Panel E. Actual movements in variables 1840-1936 (change in log)					
	WR	INDPROD	PAPM		
1840-1936	1.2	1.2	-0.3		
Panel F. Explaining movements in WR 1840-1936 (percent accounted for)					
	TOTAL	INDPROD	PAPM	RESIDUAL	
1840-1936	100.0	101.6	20.8	-22.5	

Source: See text.

Table 4. Explaining Wage-Rent Ratios, 1840-1936

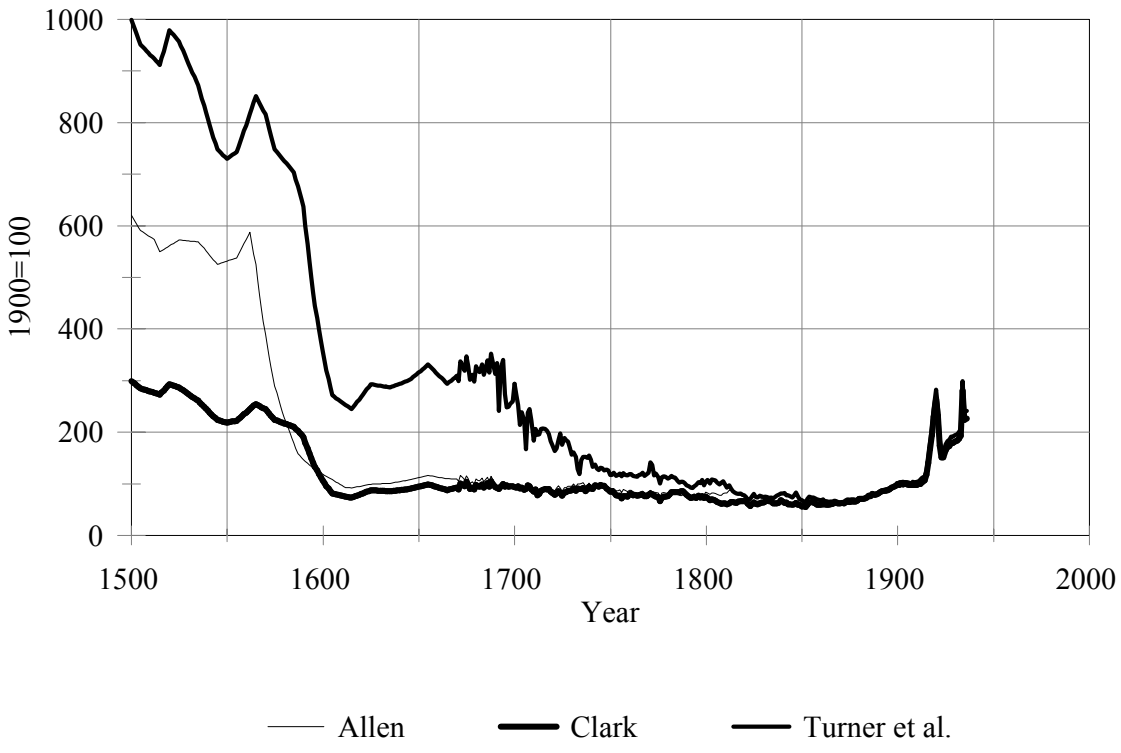
(Dependent Variable: WR)

Variable	Coef.	Std. Error	t-Statistic	Prob.
C	3.955426	1.199848	3.296605	0.0014
INDPROD	1.019983	0.064368	15.84601	0.0000
PAPM	-0.85516	0.221852	-3.854637	0.0002
R-squared	0.823835	Mean dependent var		4.508884
Adjusted R-squared	0.820087	S.D. dependent var		0.439814
S.E. of regression	0.186552	Akaike info criterion		-0.489771
Sum squared resid	3.271363	Schwarz criterion		-0.410141
Log likelihood	26.75392	F-statistic		219.796
Durbin-Watson stat	0.289086	Prob(F-statistic)		0.0000

Source: See text.

Figure 1. English wage-rental ratio

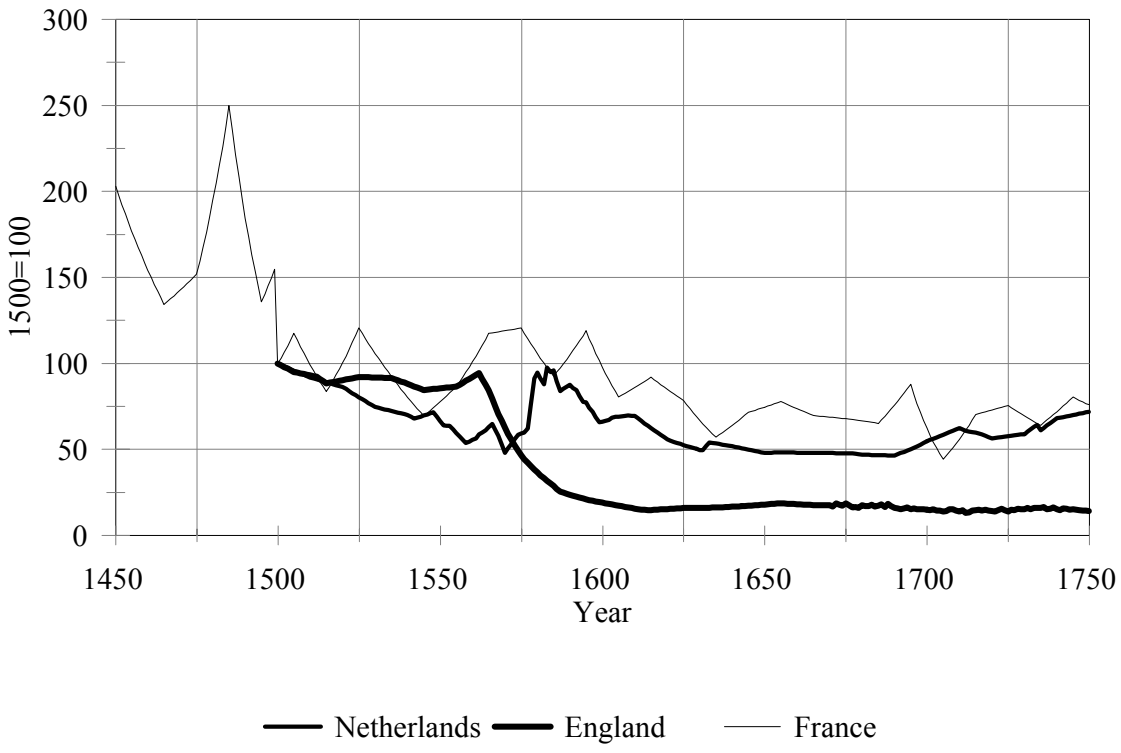
1500-1936, 1900=100



Source: Appendix 1.

Figure 2. European wage-rent ratios

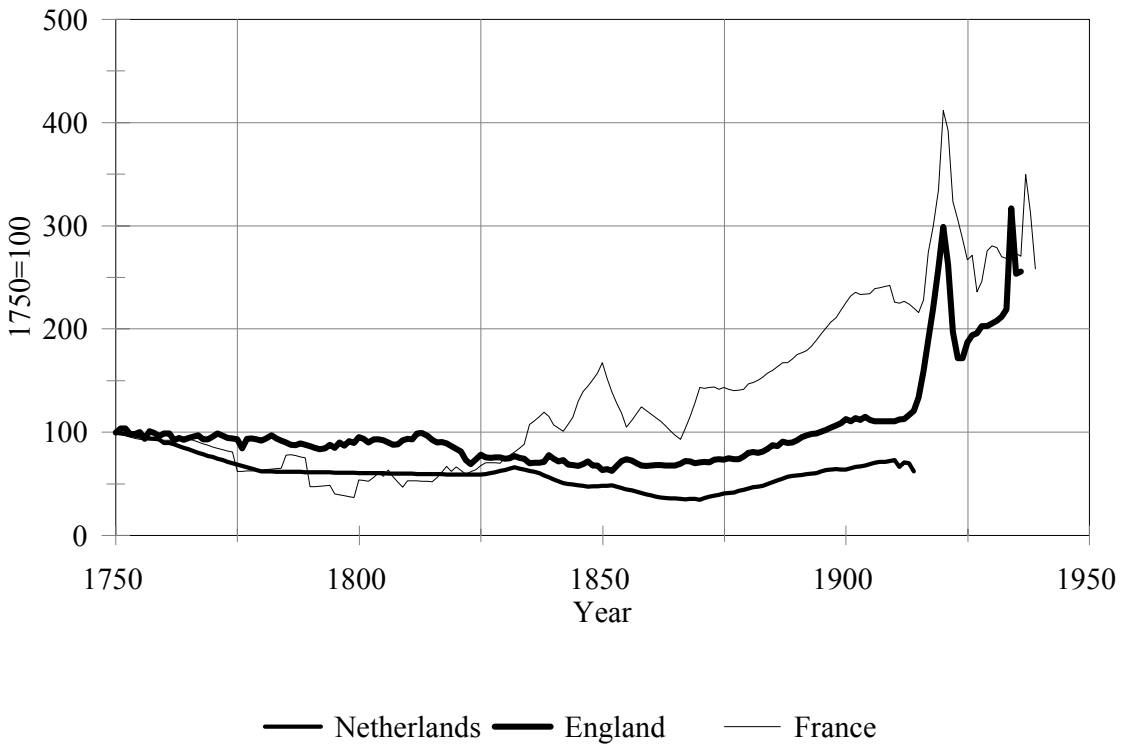
1450-1750, 1500=100



Source: Appendices 1 and 2.

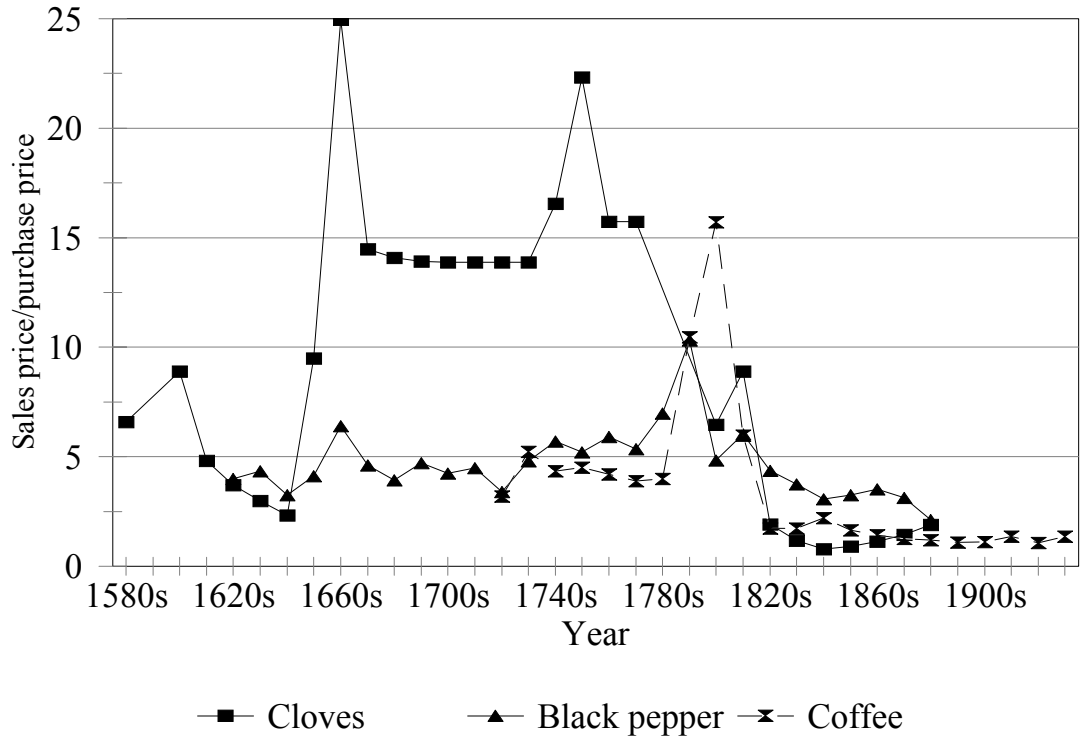
Figure 3. European wage-rent ratios

1750-1939, 1750=100



Source: Appendices 1 and 2.

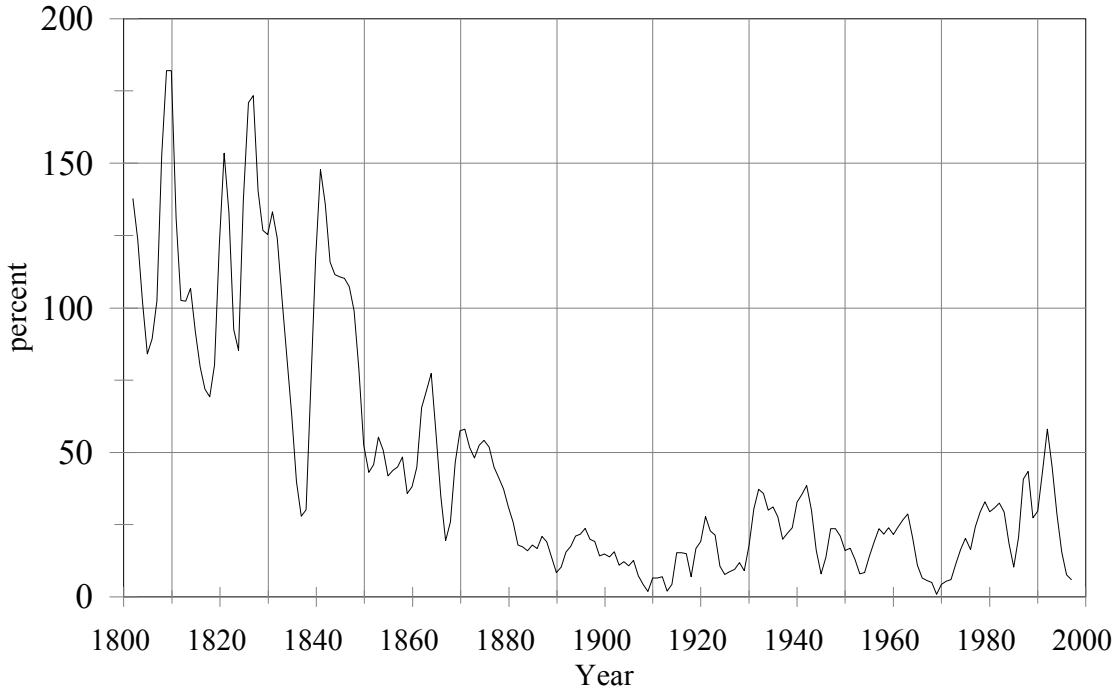
Figure 4. Spice and coffee markups: Amsterdam vs. Southeast Asia 1580-1939



Source: O'Rourke and Williamson (2002b).

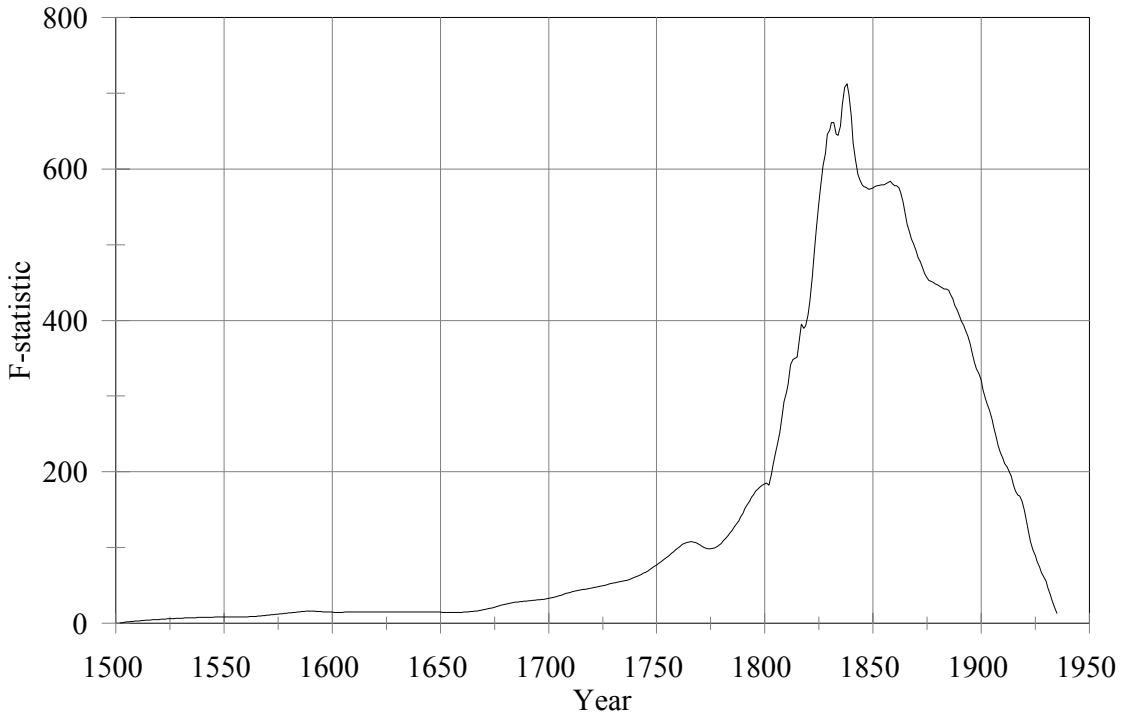
Figure 5. GB-US wheat price gaps

percent, 3-yr. moving average



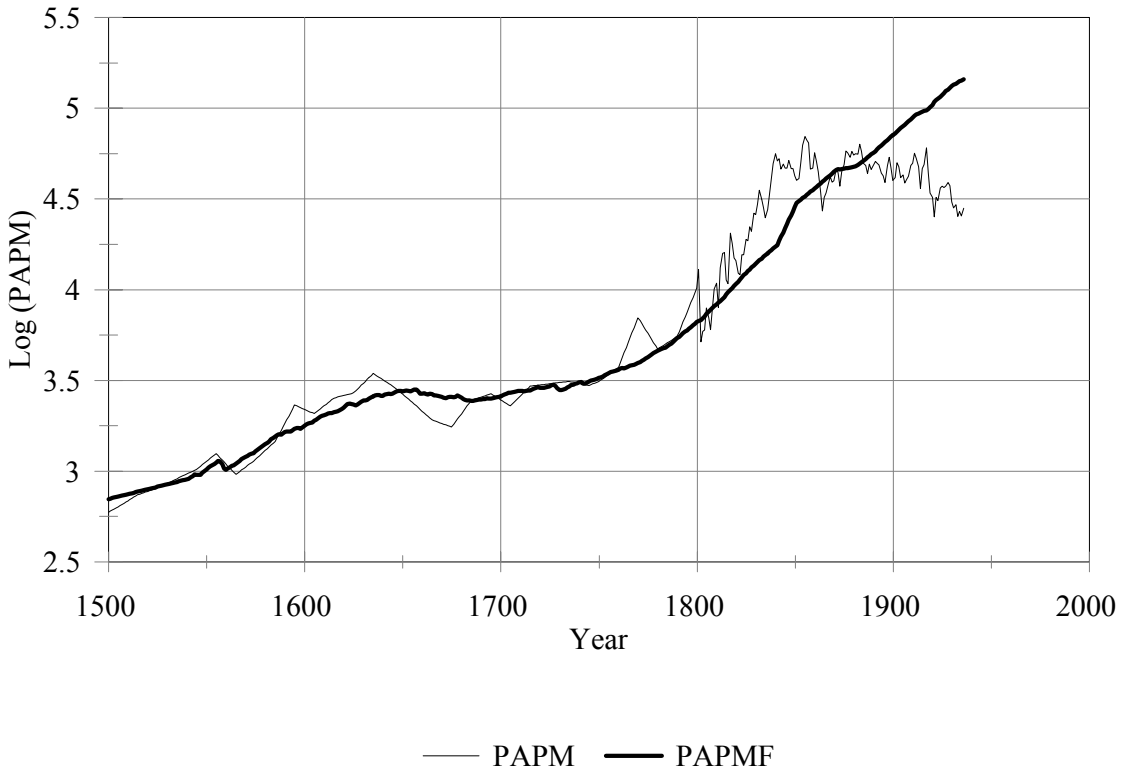
Source: see footnote 2.

Figure 6. Chow test statistics



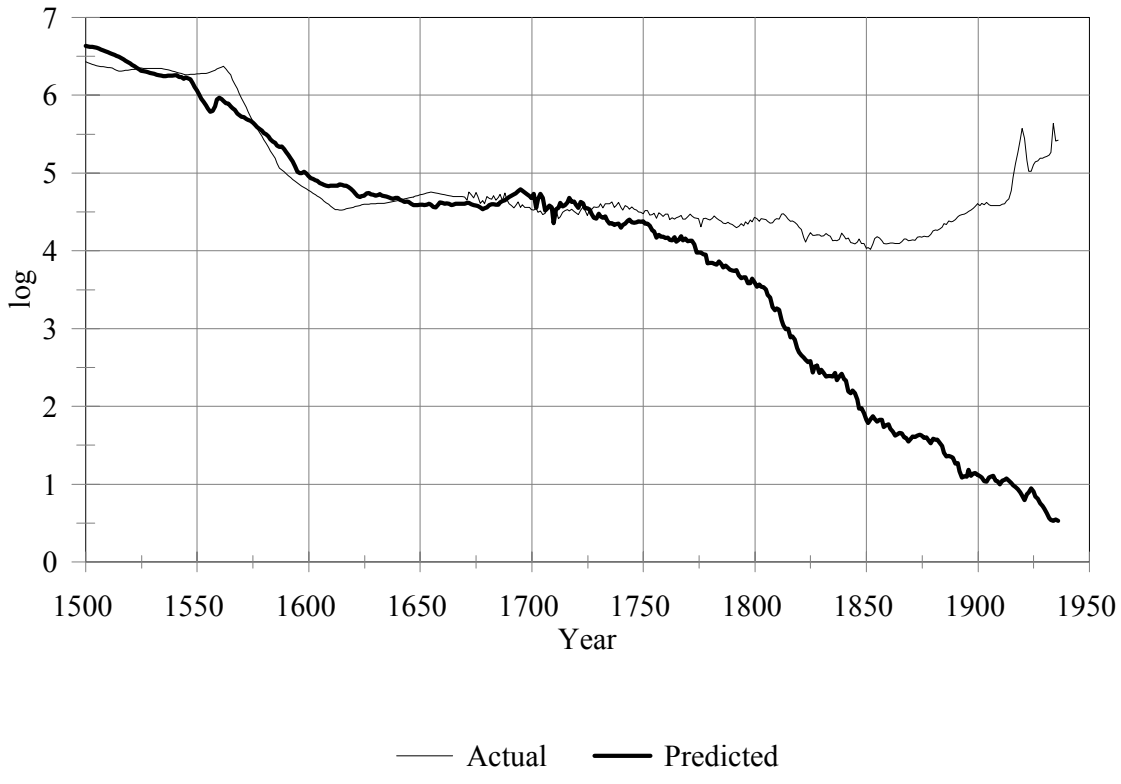
Source: see text.

Figure 7. Actual and predicted PAPM



Source: see text.

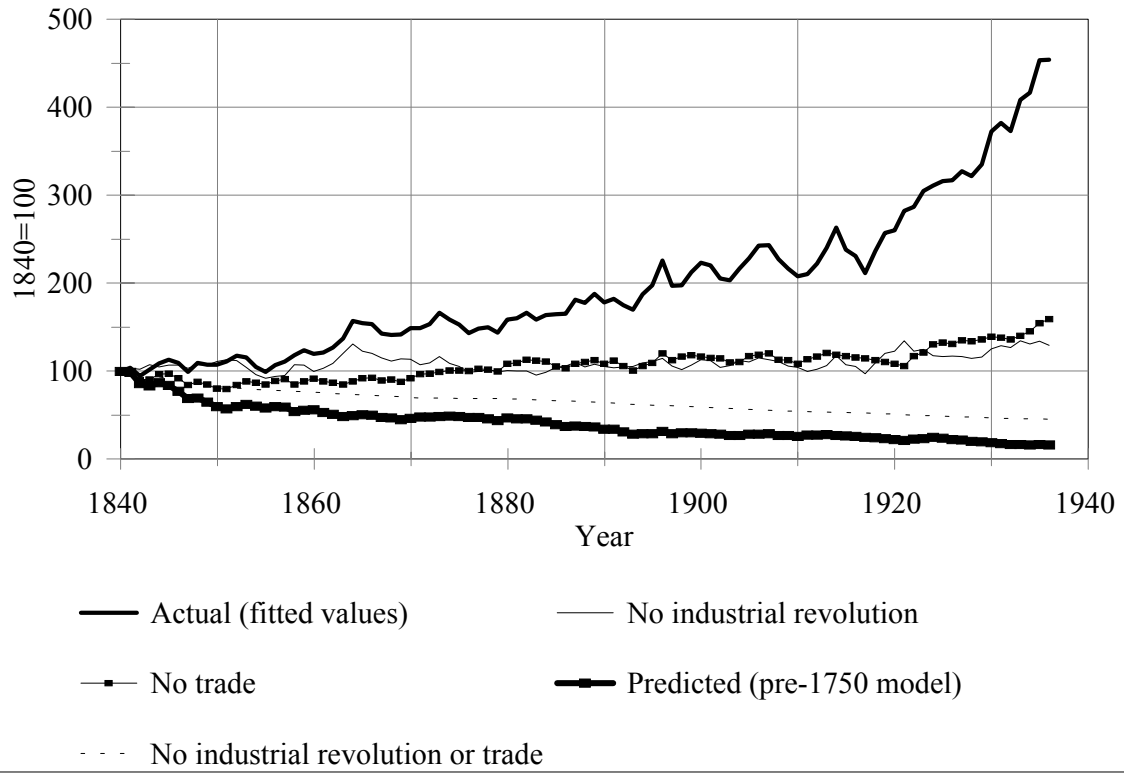
Figure 8. Actual & predicted w/r



Source: see text.

Figure 9. Actual & counterfactual w/r

1840-1936



Source: see text.

Appendix 1

English Wages, Land Rents, Inter-Sectoral Terms of Trade, Land-Labor Ratios and Sectoral Productivity 1500-1936

Nominal Agricultural Wages 1500-1936 (1900=100)

1500-1670: male day wages in agriculture, pence per day; reported decadal, interpolated geometrically to get annual; from G. Clark, "The Long March of History: Farm Laborers' Wages in England 1208-1850," mimeo, University of California, Davis (n.d.), Table 4, p. 26.
1670-1851: "Winter" farm wages, pence per day; annual; from G. Clark, "Farm Wages and Living Standards in the Industrial Revolution: England, 1670-1850," Economic History Review 54, 3 (August 2001), pp. 477-505.
1851-1902: average weekly cash wages of ordinary laborers paid 67 farms in England and Wales, shillings per week; annual; from A. Wilson Fox, "Agricultural Wages in England and Wales During the Last Fifty Years," Journal of the Royal Statistical Society 66, 2 (1903), pp. 273-359 and Appendix II, pp. 331-2.
1902-1914: Bowley and Wood's index of average agricultural wages, England and Wales, in a normal week; annual index (1891=100); taken from B. R. Mitchell, British Historical Statistics (Cambridge: Cambridge University Press, 1988), pp. 158-9; original source: A. L. Bowley, Wages and Income Since 1860 (Cambridge: 1937).
1914-1920: weekly wage rate in agriculture, England and Wales, in July; annual index (July 1914=100); taken from Mitchell (1988), p. 160; original source: A. L. Bowley, Prices and Wages in the United Kingdom, 1914-1920 (Oxford: Oxford University Press, 1921).
1920-1936: weekly wage rate in agriculture, England and Wales; annual index (1924=100); taken from Mitchell (1988), p. 160; original source: E. C. Ramsbottom, "The Course of Wage Rates in the United Kingdom, 1921-34," Journal of the Royal Statistical Society XCVIII (1935) and similar article for 1934-7 in *ibid.*.

Nominal Farm Land Rents 1500-1936 (1900=100)

Index A:
1500-1831: land rental values, England average, £/acre; from G. Clark, "Land Rental Values and the Agrarian Economy: England and Wales, 1500-1912," European Review of Economic History (forthcoming 2002), Table 8; values are given for 1500-39 (taken to be 1520), 1540-59 (1550), 1560-79 (1570) and 1580-99 (1590); reported by decade for the 17th century; reported at 5 yearly intervals from 1700 onwards; interpolated geometrically to get annual; rents are assumed constant from 1500-1520, in line with the data on land and farmhouse rental values in G. Clark, "The Secret History of the Industrial Revolution," mimeo, October 2001, Table 2, p. 15.; and also in line with the data in R. C. Allen, "The Price of Freehold Land and the Interest Rate in the Seventeenth and Eighteenth Centuries," Economic History Review XLI, 1 (February 1988), pp. 33-50, discussed below under Index C.
1831-1870: annual; from J. Thompson, "An Inquiry into the Rent of Agricultural Land in England and Wales during the Nineteenth Century," Journal of the Royal Statistical Society, LXX (December 1907), Appendix, Table A, p. 612.

1871-1900: annual; an unweighted average of Thompson (1907) and H. A. Rhee, The Rent of Agricultural Land in England and Wales (London: Central Landowners Association, 1949), Appendix Table 2, pp. 44-5.
1900-1936: annual; Rhee (1949).

Index B:
Alternative index 1690-1914: annual; linked forwards and backwards to the rest of Index A above: M. E. Turner, J. V. Beckett, and B. Afton, Agricultural Rent in England 1690-1914 (Cambridge: Cambridge University Press, 1997), Appendix Table A2.2, pp. 314-8.

Index C:
1500-1831: South Midlands average rent, shillings per acre; by quarter century, interpolated geometrically; taken from Allen (1988), Table 2, p. 43.
1831-1936: as Index A above; annual.

Inter-Sectoral Terms of Trade, Pa/Pm (1900=100): Pa 1316-1938

1316-1450: Exeter wheat; annual; from B. R. Mitchell and P. Deane, Abstract of British Historical Statistics (Cambridge: Cambridge University Press, 1962), pp. 484-6.
1450-1649: "average - all agricultural products," including grains, other arable crops, livestock and animal products; reported decadal, interpolated geometrically to get annual; from J. Thirsk (ed.), The Agrarian History of England and Wales, Volume IV: 1500-1640 (Cambridge: Cambridge University Press, 1967), Table XIII, p. 862.
1640-1749: "average - all agricultural products," including grains, other field crops, livestock and animal products; reported decadal, interpolated geometrically to get annual; from J. Thirsk (ed.), The Agrarian History of England and Wales, Volume V: 1640-1750 (Cambridge: Cambridge University Press, 1985), Table XII, p. 856.
1749-1805: wheat; reported decadal, interpolated geometrically to get annual; from P. Deane and W. A. Cole, British Economic Growth 1688-1959, 2nd ed. (Cambridge: Cambridge University Press, 1962),Table 23, p. 91.
1805-1913: total agricultural products; annual; from Mitchell and Deane (1962), pp. 471-3.
1913-1938: total food; annual; from Mitchell and Deane (1962), p. 475.

Inter-Sectoral Terms of Trade, Pa/Pm (1900=100): Pm 1450-1938

1450-1649: "industrial products"; reported decadal, interpolated geometrically to get annual; from Thirsk (1967), Table XIII, p. 862.
1640-1749: "industrial products"; reported decadal, interpolated geometrically to get annual; from Thirsk (1985), Table XII, p. 856.
1740-1796: "other prices" (equals unweighted average of Schumpeter's producer goods); annual; from Deane and Cole (1962), Table 23, p. 91.
1796-1938: price indices of merchandise exports (equals Imlah and Board of Trade, linked on 1913); from Mitchell and Deane (1962), pp. 331-2.

Land/Labor Ratios (1900=100): Total Economy-Wide Labor Force 1500-1940

Post-1840:
1841-1951: "total occupied," males and females; reported for census dates, interpolated geometrically to get annual (including the missing years 1932-1936); from Mitchell and Deane (1962), pp. 60-1.
Pre-1841:
Labor force or population age distribution estimates do not exist for the period prior to the late 18th century. Thus, we simply link the population totals up to 1841 with the economy-wide labor force totals 1841-1936 (e.g., we assume the 1841 labor participation rate was constant between 1560 and 1840, and at the 1841 rate).
Population 1541-1841: England; annual; from E. A. Wrigley and R. S. Schofield, The Population History of England, 1541-1871 (Cambridge: Cambridge University Press, 1981), Table A3.3, pp. 531-4.
Population 1500-1541: assumes that growth was at the rate suggested by Wrigley and Schofield (1981), p. 737.

Land/Labor Ratios (1900=100): Land in Agriculture 1500-1940

Post-1866:
1867-1936: acreage in crops; Great Britain; annual: from Mitchell and Deane (1962), pp. 78-9.
Pre-1867:
In his seminal piece on population in pre-industrial England, Ronald D. Lee ("Population in Preindustrial England: An Econometric Analysis," Quarterly Journal of Economics 87, 4, November 1973: 581-607) quotes Postan to justify his assumption of a constant farm land endowment: "By 1066 the occupation of England by the English had gone far enough to have brought into cultivation ... most of the area known to have been occupied in later centuries of English history." (M. M. Postan, "Medieval Agrarian Society in Its Prime," in H. J. Habakkuk and M. M. Postan (eds.), Cambridge Economic History of Europe, Volume I (Cambridge: Cambridge University Press, 1966; 2nd ed.), Chapter VII, Part 7, pp. 567-8. We make the same assumption.

Manufacturing Productivity (1900=100)

1869-1936: Manufacturing output divided by manufacturing employment; annual (with interpolations between 1913 and 1920); taken from S. N. Broadberry, The Productivity Race: British Manufacturing in International Perspective, 1850-1990 (Cambridge: Cambridge University Press, 1997), Appendix 3, pp. 42-4.

1700-1869: Industrial production divided by industrial labor force. Industrial production taken from N. F. R. Crafts and C. K. Harley, "Output Growth and the British Industrial Revolution: A Restatement of the Crafts-Harley View," Economic History Review XLV, 4 (November 1992), pp. 703-30, 'revised best guess', Table A3.1, pp. 725-7; annual. Industrial labor force based on applying estimates of the industrial share of the labor force to the annual labor force estimates above. N. F. R. Crafts, British Economic Growth During the Industrial Revolution (Oxford:

Clarendon Press, 1985), Table 3.6, pp. 62-3, gives estimates of the industrial share of the male labor force for 1700, 1760, 1800, 1840 and 1870. Data for intervening years are generated by geometric interpolation. The procedure assumes that the industrial share of the female labor force was similar to that of the male labor force.

1500-1700: Non-agricultural output divided by non-agricultural labor force. Based on data given in Clark (October 2001). Data on nominal GDP are taken from his Table 3, pp. 19-20, and are deflated using the GDP deflator in his Table 7, pp. 30-31. Real GDP is then divided into its agricultural and non-agricultural components by assuming that these are proportional to the wage bills in the two sectors (which is equivalent to assuming that the ratio of the average products in the two sectors is equal to the ratio of the marginal products in the two sectors). The ratio of the wage bill in the two sectors is derived using the data on sectoral wages and the farm share of the labor force, given in Table 1, pp. 8-9 (and, following Clark, p. 7, letting the non-farm wage be the average of urban craftsman and laborer wages). The resulting output series is divided by the non-agricultural labor force, derived using Clark's farm share of the labor force and the annual labor force series described above.

Total Factor Productivity in Agriculture

1500-1911: Clark (forthcoming 2002), Table 9, p. 48; data for 1520, 1550, 1570, 1590; decadal from 1605; interpolated to get annual. We assume that the 1520-1550 growth rate applied to 1500-1520.

1911-1936: derived assuming constant growth rate of 0.4% p. a. 1911-1924; 2.1% p. a. 1924-1936. Based on R. C. O. Matthews, C. H. Feintstein, and J. C. Odling-Smee, British Economic Growth 1856-1973 (Stanford, Cal.: Stanford University Press, 1982), Table L.2, p. 607 and Table I.3, p. 598. The calculation assumes that the 1899-1913 growth rate persisted until 1924.

Appendix 2

Dutch and French Wage-Rent Ratio Series 1374-1940

2.1 Dutch Wage-Rent Ratio Series 1500-1914

Nominal Rents per Hectare (guilders): Holland, 1500-1830 [1]
Background data to Graph 2, p. 74 in Jan Luiten van Zanden, "The Development of Agricultural Productivity in Europe 1500-1800," NEHA-jaarboek 61 (1998): 66-85. Data sent by van Zanden to the authors July 3, 2000. It should be pointed out that van Zanden's Graph 1 plots rent trends 1451-1825 in Flanders and Brabant, and while these two show a sharp plunge from 1451/1475 to 1576/1600, the series for Holland shows no fall at all, but rather a rise.
Nominal Rents per Hectare (guilders): the Netherlands, 1820-1910 [2]
As five-year averages starting 1820-24, average for all of the Netherlands, farm land and pasture, sent July 6, 2000 as an email attachment (along with description) from Arthur van Riel.
Nominal Land Prices per Hectare in Groningen (guilders): northern Netherlands, 1713-1914 [3]
Prices of farmland in Groningen, sent July 6, 2000 as an email attachment (along with description) from Arthur van Riel.

Nominal Daily Wage (Amsterdam, building trades, painter's wage 1749-53=100), 1500-1910 [4]
H. Nusteling, Welvaart en Werkgelegenheid in Amsterdam 1540-1860 (Amsterdam: De Bataafsche Leeuw 1985), Table 5.2, index R3 (weighted average of R1, carpenters, and R2, painters), pp. 255-7.
Nominal Daily Wage (Amsterdam), 1910-1939 [5]
D. J. van der Veen and J. L. van Zanden, "Real-Wage Trends and Consumption Patterns in the Netherlands, c.1870-1940," in P. Scholliers (ed.), Real Wages in 19th and 20th Century Europe: Historical and Comparative Perspectives (New York: Berg 1989), Table 8.6, pp. 227-8.

Linking the Series: the Netherlands 1500-1914
For 1500-1830, we construct wage-rent series as [4]/[1], interpolating over missing years. For 1820-1910, we construct the series as [4]/[2], interpolating over missing years. The two series are linked at decade average over 1820-1830 = 1825. For 1910-1914, we construct wage-rent series [5]/[3], linking this extension to the previous series at 1910.

2.2 French Wage-Rent Ratio Series 1450-1940

1450-1775: Paris region
Wage-rent ratios are from personal correspondence with Philip Hoffman, based on the Paris region. These data underlie his *Growth in a Traditional Society: The French Countryside, 1450-1815* (Princeton, NJ: Princeton University Press, 1996), where, for example, nominal rent is reported in Table 4.2, col. (3), p. 90. Hoffman's observations are decade averages. We interpolate geometrically the missing years (e.g., decade beginning 1450 is average for 1450-1459, which we take as 1455 in the interpolation procedure).

1700-1870: Normandy and Provence regions

Jean-Laurent Rosenthal reports wage-rent ratios for France in his *The Fruits of Revolution: Property Rights, Litigation, and French Agriculture, 1700-1860* (Cambridge: Cambridge University Press, 1992). His Table A1.1, pp. 183-4 reports for Normandy 1702-1870 nominal land prices (V), the wage rate (w) and the interest rate (i), and his Table A1.3, p. 187 has the same data for Provence 1700-1855. We derive the rent estimates from land prices by using the simplest (very) long run capital asset model where r/i=V so that w/r=w/(V)(i).

1870-1940: Basse Normandy region

The rent data are for the Basse Normandy region, and they are taken from Maurice Levy-Leboyer, *Le Revenue Agricole et la Rente Fonciere en Basse-Normandie: Etude de Croissance Regionale* (Paris: Editions Lincksieck, 1972), Table K-62, p. 200 where he reports a land rent series for the whole region (variant II, col. 4). The nominal wage rate is taken from Jeanne Singer-Kérel, *Le coût de la vie à Paris de 1840 a 1954* (Paris: A. Colin, 1961), Table 43, pp. 536-7.

Linking the sources into a complete 1450-1940 series:

The full series is linked in five parts: the **1450-1750** portion of the Paris region series is linked to the next at 1750; the **1750-1775** portion is an unweighted average of the Normandy, Provence and Paris region series, linked to the next at 1775; the **1775-1855** portion is an unweighted average of the Normandy and Provence region series, linked to the next at 1855; the **1855-1870** portion uses the Provence region series, linked to the next at 1870; and the **1870-1940** portion uses the Basse-Normandie region rent series with the all-France nominal wage underlying J. G. Williamson, "The Evolution of Global Labor Markets Since 1830: Background Evidence and Hypotheses," *Explorations in Economic History* 32, 2 (April 1995), 141-96.