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Progress and poverty in early modern Europe¹

By ROBERT C. ALLEN

At the end of the middle ages, the urban, manufacturing core of Europe was on the Mediterranean with an important offshoot in Flanders. The Netherlands were thinly populated,² and England was an agrarian periphery. By 1800 the situation was largely reversed. First the Netherlands and then Britain emerged as commercial and manufacturing powerhouses with the largest urban economies in Europe. Italy and Spain slipped behind. Only present-day Belgium managed to remain near the leaders, perhaps because of its proximity to the Netherlands.

Explaining this reversal in fortunes has been a central problem of social science, and the literature includes many conflicting hypotheses. This article attempts to give an integrated assessment of six: population, enclosure, empire, representative government, technology, and literacy.

Population can function in two ways to explain social and economic change in early modern Europe. First, changes in the land-labour ratio can explain differences in real wages and land rents. These, in turn, may affect other aspects of economic life such as the extent of serfdom or proto-industrialization. Second, different demographic regimes may affect development by changing population growth and income levels. Hajnal has identified differences in marriage patterns which suggest that western Europe exhibited Malthus's preventive check, while eastern Europe may have been an example of the positive check model. Historians of the 'European miracle' have argued that just such a difference accounts for Europe's lead over Asia.³ Perhaps it explains the advance of north-western Europe as well?⁴

Modernization of traditional rural society is a long-standing explanation of the lead of north-western Europe. The enclosure movement in England is the inspiration for this theory. Liberals have emphasized that enclosure replaced communal property with private property, which they regard as more 'efficient' since it aligned the interests of farmers and landlords more tightly with the results of their decisions.⁵ Marxists have emphasized

¹ I am grateful to the Social Sciences and Humanities Research Council of Canada for supporting this research through its research grants program and the Team for Advanced Research on Globalization, Education, and Technology.

² Van Zanden, "Revolt of the early modernists", has argued that the Netherlands was already advanced in 1500, and that view is supported by its relatively high agricultural productivity and urbanization: see below, tab. 1, figs. 2, 6-8.

³ Hajnal, 'European marriage patterns'; Jones, *European miracle*; Blaut, *Colonizer's model*, pp. 128-35.

⁴ Weir, 'Life under pressure'.

⁵ North and Thomas, *Rise of the western world*; Hardin, *Managing the commons*.

that the three-tiered social structure—landlords, tenant farmers, and landless labourers—that emerged in the eighteenth century and that seemed to accompany enclosure was a ‘capitalist’ arrangement that forced farmers to innovate since high productivity was the only way to pay their landlords and their workers.⁶

Both the English and the Dutch were winners in the early modern scramble for empire, and that success is the inspiration for the imperial theory of economic development. Marx developed this theme as well as the agrarian argument. The role of empire as a source of capital and a market for manufactures has since been emphasized by ‘world system theorists’ including Wallerstein, Arrighi, and Frank.⁷ Acemoglu and his co-authors also emphasize the importance of Asian and American trade, as does Inikori.⁸

Eighteenth-century liberals contrasted the absolutism of France with England’s ‘mixed monarchy’ and the constitution of the Dutch Republic. Representative institutions were alleged to be economically superior, as evidenced by lower interest rates in England and the Netherlands compared with France. These arguments have been restated by recent theorists such as North and Weingast and De Long and Schleifer, who allege that absolutist kings expropriated property and raised taxes in ways that discouraged business enterprise.⁹ Eckland and Tollinson have proposed complementary explanations in terms of rent seeking.¹⁰

Theorists have long emphasized that continuous technological progress is the only basis for sustained economic growth.¹¹ The relationship between the scientific revolution of the seventeenth century and the industrial revolution has often been discussed, and has been probed recently by Jacob and Mokyr, who argue that north-western Europe benefited from an ‘industrial enlightenment’ (in Mokyr’s phrase) and England, in particular, from a distinctive scientific culture that led to economic advance.¹² But is it possible to measure technological performance and assess its contribution to economic growth?

A final candidate which might explain success was the spread of literacy. When Gutenberg invented movable type in the mid-fifteenth century, less than 10 per cent of adult Europeans could sign their names. By 1800, the proportion was higher everywhere, and it exceeded half in the economic leaders. Much recent theorizing has emphasized the importance of education and human capital accumulation for economic growth, so it makes sense to probe its importance in earlier years. Was a literate population the seed bed for economic expansion?

⁶ See, for instance, Brenner, ‘Agrarian class structure’, and the spirited debate in Aston and Philpin, eds., *The Brenner debate*.

⁷ Wallerstein, *Modern world system*; Arrighi, *Long twentieth century*; Frank, *World accumulation*; *idem*, *ReOrient*.

⁸ Acemoglu et al., ‘Rise of Europe’; Inikori, *Africans and the industrial revolution*.

⁹ North and Weingast, ‘Constitutions and commitment’; De Long and Schleifer, ‘Princes and merchants’.

¹⁰ Eckland and Tollinson, *Politicized economies*.

¹¹ Jones, *Introduction to economic growth*.

¹² Jacob, *Scientific culture*; Mokyr, *Gifts of Athena*.

The importance of these developments has been debated extensively, usually in terms of internal coherence. The enclosure argument, for instance, has been called into question by historians who have denied that enclosure led to much growth in agricultural productivity.¹³ The empire argument has been attacked on the grounds that the extra-European markets were too small to matter, and that the same was true of the profits earned on slavery and colonial trade.¹⁴ The representative government argument has been disputed by those who assert that France did not have particularly high interest rates or taxes. Recent research has downplayed the importance of technological progress and literacy in explaining the British industrial revolution.

This article takes a different approach to assessment by estimating a five-equation simultaneous equation model of European development. The model explains five variables—the population, the wage rate, urbanization, agricultural productivity, and the proto-industrial revolution. It is estimated with an aggregate dataset for Europe from 1300 to 1800.¹⁵ The units of observation are countries at intervals of approximately a century. The countries are defined in terms of their boundaries in 1945 and include England and Wales, Belgium, France, the Netherlands, Spain, Italy, Germany, Poland, and Austria/Hungary/Czechoslovakia. The years include 1300, 1400, 1500, 1600, 1700, 1750, and 1800, although observations in 1300 are available only for England and Italy, and the Netherlands does not enter the dataset until 1500.

A very serious issue is whether countries are appropriate units of analysis—in particular, whether they were homogeneous enough. Was there an ‘English’ or an ‘Italian’ wage, for instance? In many respects, the countries were internally heterogeneous, and are represented here with averages. However, if world empires or agrarian institutions were powerful enough to remake societies, their effects should show up in the average experience of the countries concerned. And they do.

A second question is whether the same model fits all countries; in particular, does a single, five-equation model summarize the variety of

¹³ Comparisons of open and enclosed villages and of large and small farms find that England’s unique rural institutions made little contribution to productivity: Allen, *Enclosure*; Clark, ‘Commons sense’. Likewise, studies of share cropping in southern Europe and the Meseta in Spain find it to have been more efficient than liberals and marxists have thought: Hayami and Otsuka, *Economics of contract choice*; Hoffman, *Growth in traditional society*; Nugent and Sanchez, ‘Efficiency of the Meseta’; Simpson, *Spanish agriculture*. International comparisons also call into question the importance of ‘modern’ institutions. The open-field farmers of north-eastern France achieved wheat yields that were on a par with those of farmers of enclosed land in England: O’Brien and Keyder, *Economic growth*; Allen and Ó Gráda, ‘On the road again’. Moreover, the farmers who accomplished the Dutch agricultural revolution were mainly owner-occupiers rather than the capitalist tenants of great estates: De Vries, *Dutch rural economy*.

¹⁴ The debate is enormous. Relevant works showing the diversity of approaches include Williams, *Capitalism and slavery*; Wallerstein, *Modern world system*, I and II; Frank, *World accumulation*; Findlay, “‘Triangular trade’”; Darity, “‘Original sin’”; Engerman, ‘Slave trade’; Thomas and Bean, ‘Fishers of men’; O’Brien, ‘European economic development’; *idem*, ‘Imperialism’; O’Brien and Engerman, ‘Exports’; O’Brien and Prados, ‘Costs and benefits’. Morgan, *Slavery*, is a survey of some important aspects, and Inikori, *Africans and the industrial revolution*, and Ormrod, *Rise of commercial empires*, are the most recent contributions.

¹⁵ The data are tabulated in app. I.

development experiences seen in early modern Europe, or do we need specific, different models for each country to capture the divergent paths of development on the continent? The surprising answer is that one model does fit all, and it indicates why some countries were more successful than others.

I

It is possible to distinguish the successful economies from the unsuccessful by three indicators—real wages, economic structure, and agricultural productivity. These require discussion since they are the axes around which the present analysis is constructed.

Income is fundamental and is best measured by the real wage.¹⁶ Figure 1 plots real wages for leading European cities and highlights the differences in performance between regions. In the fifteenth century, wages in north-western Europe were already higher than elsewhere on the continent, but the advantage was comparatively small. A large gap emerged by 1750—not because of advance in the north but rather because real wages collapsed in central and southern Europe. Figure 1 shows the drop for Valencia and Vienna. Similar declines occurred in other cities in France, Spain, Italy, Germany, Austria, and Poland. Conversely, the real wage in London showed ups and downs, but the trend was stable in the long run. Wages in other English towns fell like those on the continent between 1450 and 1650, but then began to converge up to the London level. Real wages in Antwerp and Amsterdam showed little variation from 1500 to 1800.¹⁷ Roughly speaking, real wages were constant in the leading cities of north-western Europe between 1500 and 1750, but they halved elsewhere on the continent.

Concentration on the real wage also links economic success in early modern Europe to one of the great divides of human history—the escape from the Malthusian trap. Europe took its first steps in that direction between 1500 and 1800. Previously, if an economic expansion raised the standard of living of the majority of the population, their good fortune was unsustainable since the better living conditions induced an increase in population that eventually drove the standard of living back to its

¹⁶ Maddison, *World economy*, has estimated GDP per head for many countries in the early modern period, and some of his estimates concur with the usual view. Thus, he shows Italy to have had the highest income in Europe in 1500, but with little growth from then until 1820. Likewise, between 1500 and 1820 he finds considerable growth in the Dutch Republic and the UK, which were the two richest economies at the time. More problematic reconstructions include Spain, which, according to Maddison's figures, was a rapidly growing economy in that period. Discrepancies such as this emphasize that estimates of GDP for the early modern period must be treated with great caution. Even for the early nineteenth century, the calculation of GDP per head is fraught with difficulties. Thus, Maddison, *Monitoring*, and Prados, 'International comparisons', agree that Britain had the highest income in Europe in 1820, but they disagree significantly about the income of the US—Maddison putting it below Britain's, while Prados puts it above. The differences in ranking reflect difficulties in deflation, for which there are no simple solutions.

¹⁷ Allen, 'Great divergence'.

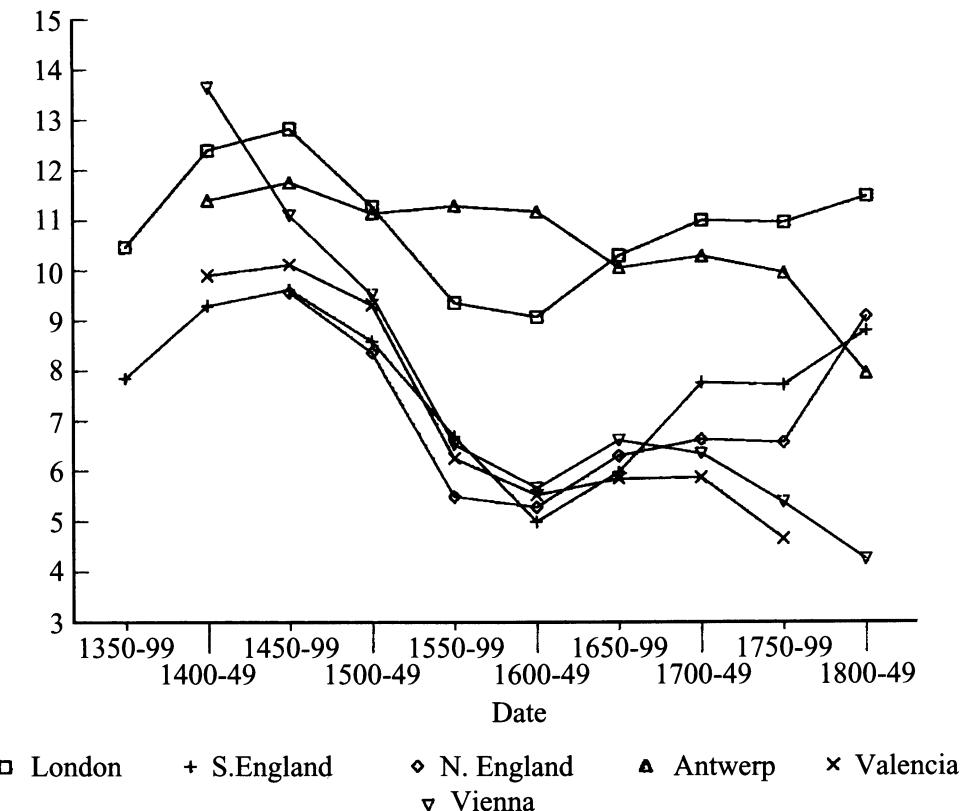


Figure 1. *Real wages, 1350-1850*

Source: Amounts are in Strasbourg prices of 1750-9 from Allen, 'Great divergence'.

earlier value.¹⁸ The economic expansions of the Dutch and English, however, were sustained for centuries without serious falls in the standard of living. This was not because fertility was restrained; on the contrary, these countries had the most rapidly growing populations in Europe. The secret of their success was maintaining even more rapid growth in their economies.¹⁹ The problem of combining economic growth and stable living standards was solved for the first time by vigorous economic expansion rather than by demographic restraint.

The economies that achieved high wages in 1750 were also the ones that experienced the most rapid structural change. Table 1 shows the distribution of the population in major European countries in 1500 and 1800. At the end of the middle ages, Italy, Spain, and present-day Belgium were the leading economies, and they had the smallest proportions of their populations in agriculture and the most extensive degree of urbanization. Elsewhere, about three-quarters of the population was

¹⁸ Abel, *Agricultural fluctuations*; Le Roy Ladurie, *Peasants*; Postan, 'Agrarian evidence'; Wrigley and Schofield, *Population history*.

¹⁹ North and Thomas, *Rise of the western world*.

Table 1. *Distribution of the population by sector, 1500-1800*

| | 1500 | | | 1800 | | |
|----------------------------------|-------|------------|-------|-------|------------|-------|
| | Urban | % Rural | Agric | Urban | % Rural | Agric |
| <i>Greatest transformation</i> | | | | | | |
| England | 7 | 18 | 74 | 29 | 36 | 35 |
| <i>Significant modernization</i> | | | | | | |
| Netherlands | 30 | 14 | 56 | 34 | 25 | 41 |
| Belgium | 28 | 14 | 58 | 22 | 29 | 49 |
| <i>Slight evolution</i> | | | | | | |
| Germany | 8 | 18 | 73 | 9 | 29 | 62 |
| France | 9 | 18 | 73 | 13 | 28 | 59 |
| Austria/Hungary | 5 | 19 | 76 | 8 | 35 | 57 |
| Poland | 6 | 19 | 75 | 5 | 39 | 56 |
| <i>Little change</i> | | | | | | |
| Italy | 22 | 16 | 62 | 22 | 20 | 58 |
| Spain | 19 | 16 | 65 | 20 | 16 | 64 |

Notes and sources: The procedures and estimates used in Wrigley, 'Urban growth', are generalized to the countries shown here. Total population and urban population are taken from McEvedy and Jones, *Atlas*, and from Bairoch, *La Population*. Census data from the nineteenth century are used to divide the rural population into agricultural and non-agricultural components in 1800. The comparable division in 1500 is made on the assumption that 80% of the rural population at that time was agricultural. Intervening years are linearly interpolated. For details, see Allen, 'Economic structure'.

agricultural—a proportion similar to that in most of the less developed countries early in the twentieth century—and the urban population was correspondingly small.

In analysing changes in the early modern period, it is useful to distinguish four groups. England was undoubtedly the most successful economy, with a drop in the agricultural population to 35 per cent of the whole and a rise in both the urban and 'rural non-agricultural' shares. The latter corresponds to the 'proto-industrial revolution', which involved the expansion of manufacturing (particularly textiles) in small villages organized in the putting-out system.²⁰ Belgium and the Netherlands experienced a similar transformation, with agriculture declining to a point where it employed 49 per cent and 41 per cent of the population, respectively, in 1800. Spain and Italy showed little change in economic structure, and, indeed, much of the growth in north-western Europe was at their expense as key industries such as woollen textiles relocated from the south to the north. Finally, France, Germany, Austria, and Poland experienced only modest structural transformation. The small decline in the agricultural share was reflected in rural manufacturing rather than in the growth of cities. Although historians of proto-industry have often been enthusiastic about its development potential—hence the term—it was as often associated with economic stagnation as with advance.²¹

²⁰ Mendels, 'Proto-industrialization'.

²¹ Coleman, 'Proto-industrialization'.

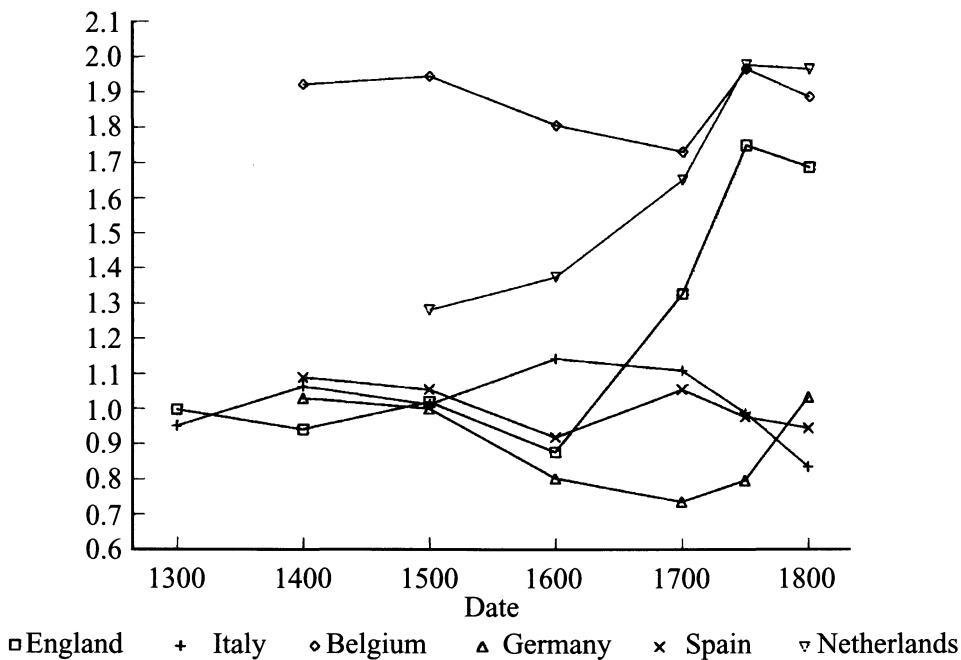


Figure 2. *Total factor productivity in agriculture, 1300-1800*

Source: see app. II.

Agricultural productivity is a third indicator of economic success in the early modern period. An immediate reason why England and the Netherlands could reduce the proportion of their population engaged in agriculture was that the productivity of farmers and cultivators increased substantially between the middle ages and the nineteenth century. In present-day Belgium, output per agriculturalist was high during the middle ages and remained so until 1800. England and the Netherlands were the two countries which experienced agricultural revolutions in the early modern period: labour productivity in both of these countries was low in the medieval period, but both closed the gap with Belgium during the seventeenth and eighteenth centuries.²² Roughly the same was true of total factor productivity, as shown in figure 2.²³ Rising agricultural efficiency contributed to economic development by supplying food, wool, and flax to support the non-agricultural economy, by releasing labour for employment in manufacturing, and by providing a surplus that could finance investment or sustain the conspicuous consumption of the aristocracy and the state.

II

In explaining economic development, a distinction must be made between the explanatory variables and those that are explained. The model

²² Allen, 'Economic structure'.

²³ The calculation of TFP in agriculture is explained in app. II.

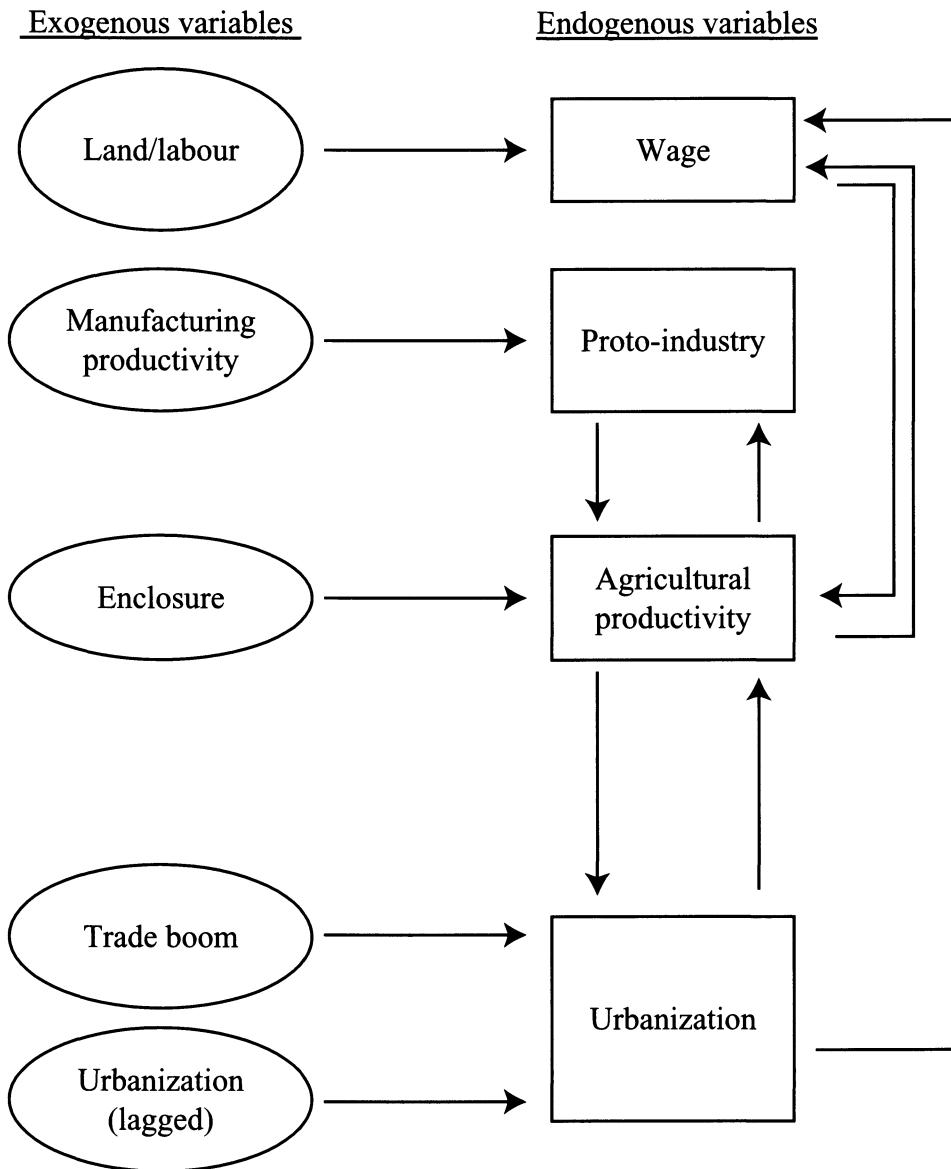


Figure 3. *Flow chart (one period) of the model*

Note: The role of population is explained on p. 411.

developed here explains five variables: population, the real wage, the urban and proto-industrial shares of the population, and agricultural productivity. They are endogenous variables; each influences the others. A productive agriculture, for instance, promoted the development of cities, while urbanization induced growth in agricultural productivity. Hence, the view of development is one in which living standards, urbanization, proto-industrialization, and agricultural revolutions were mutually reinforcing. None was a prime mover pushing all of the others forward.

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All of these five variables are ultimately explained by other variables in the model—the enclosure of the open fields, for instance, and the establishment of world empires. Other prime movers include the literacy rate, a productivity variable indexing the growth of competitive advantage in the new draperies, previous levels of urbanization, and the land-labour ratio. The model contains five equations to explain the five endogenous variables in terms of the other variables.

The model works as a recursive system. In each period (century), four equations are solved to determine four endogenous variables—the real wage, the urban and proto-industrial proportions of the population, and agricultural productivity—in terms of the exogenous variables and the population. Figure 3 is a flow diagram that shows the logic of this solution. It demonstrates the links between variables that emerge as important in the statistical analyses to be discussed: many more links were examined but failed to be statistically or historically significant. The four endogenous variables are shown in rectangles and the exogenous variables in ellipses. The endogenous variables influenced each other in many ways. Higher urbanization, for instance, led to higher agricultural productivity. Causation worked in the opposite way as well, with higher agricultural productivity increasing the proportion of the population living in cities. In the model developed here, agricultural and urban revolutions are both a cause and a consequence of economic development.

Population change links successive solutions of the model summarized in figure 3: once the model is solved for one period, the implied wage and urbanization rates are used to project population forward to the next. The process is then repeated as the model is resolved to determine the wage, urbanization, agricultural productivity, and proto-industry for the new period. Urbanization was also a self-perpetuating process that linked one simulation period to the next.

Figure 3 shows the variables that were ultimately causal, and their influence is what would be expected on general grounds. They are now reviewed in turn.

The standard explanation for falling real wages in the sixteenth and seventeenth centuries is population growth in the context of a fixed supply of natural resources.²⁴ This diminishing returns effect is confirmed in the present model. Here the natural resource base is measured by agricultural land, T , in the 1950s. Although there were improvements in the quality of land over the period, the total did not change in most cases.²⁵ The labour force, L , is indexed by the population, and the model

²⁴ Abel, *Agricultural fluctuations*; Le Roy Ladurie, *Peasants*; Postan, ‘Agrarian evidence’; *idem*, *Medieval economy*; Wrigley and Schofield, *Population history*; Wrigley, *Continuity*.

²⁵ Land is the area of agricultural land as given in the UN Food and Agricultural Organization, *Production year-book*, 1958, vol. 12, p. 3. (Figures for England and Wales are taken from Stamp, *Land use statistics*, p. 30. The corresponding figures for the UK agree with those of the FAO.) Agricultural land includes cropped land, meadow, pasture, and rough grazing, but not forest. This total is treated as a constant for each country from 1300 to 1800. The quality of land was certainly improved by drainage, irrigation, and so on, and the intensity of land use grew as a consequence. Nevertheless, the extent of land in the 1950s defines the potential resource base. For instance, in England and Wales between 1688 and 1960 there was a reduction in rough pasture (called ‘waste

uses Bairoch's estimates, which are generally taken from McEvedy and Jones.²⁶ The land and population estimates supposedly relate to boundaries that applied in 1945. Dividing agricultural land by the population gives the land-labour ratio T/L.

The productivity record of early modern manufacturing was mixed, but some significant advances were made in textiles, which were the most important products of the age. These improvements affected growth through trade.

The commercial revolution of the seventeenth century was an intra-European affair, and the changing locus of textile production was central to it. In the middle ages, woollen cloth was produced in the cities of Italy and Flanders and exported across the continent. The English were also successful in exporting heavy broadcloths. By the sixteenth century, the English and the Dutch were beginning to make the 'new draperies' which were light worsteds. These were patterned after Italian fabrics. The northern imitations were so successful that English and Dutch exports drove Italian producers out of business in the seventeenth century.²⁷ New manufacturing industries were established in East Anglia and the Low Countries. The Norwich industry was started in the middle of the sixteenth century by Flemish refugees, although it drew on an earlier craft tradition.²⁸ At the end of the seventeenth century, about 40 per cent of England's woollen cloth production was exported, and woollen fabrics comprised 69 per cent of the country's exports of domestic manufactures.²⁹ Wool was even more important for London. The new draperies flowed out of the capital: cloth accounted for 74 per cent of its exports and re-exports in the 1660s and made a large contribution to its growth.³⁰

Productivity growth in textiles can be measured by prices. Figure 4 plots an index of input prices (a geometric average of the price of wool and the wage rate) divided by the price of cloth. Throughout the early modern period, there was no growth in efficiency in the production of traditional woollen broadcloth, but productivity rose by 70 per cent in the new draperies from the inception of production until they became established in the 1620s. Since the English and Italians were paying similar wages and were buying wool and selling cloth in the same markets,

and common' by Gregory King) and a corresponding increase in improved farm land, but the total land available for agriculture remained the same according to King and the recent estimates. Cf. Allen, 'Agriculture during the industrial revolution', p. 104; Stamp, *Land use statistics*, p. 30.

²⁶ Bairoch, *La Population*, p. 297; McEvedy and Jones, *Atlas*. However, Bairoch reports figures for the UK rather than for England and Wales. Population totals were taken from Hatcher, *Plague*, and from Wrigley and Schofield, *Population history*, pp. 528-9. The model follows the lead of Wrigley and Schofield, *ibid.*, p. 566, in increasing their estimates for England (excluding Monmouthshire) by 6% to include Wales. The adjustment is rough, but agrees with the figures of de Vries, *European urbanization*, p. 36.

²⁷ Rapp, 'Mediterranean trade hegemony'; Harte, ed., *New draperies*.

²⁸ Munro, 'English "new draperies"'; Holderness, 'Reception and distribution'; Martin, 'New draperies in Norwich'.

²⁹ Deane, 'Output', pp. 209-10; Davis, 'English foreign trade', p. 165.

³⁰ Rapp, 'Unmaking of hegemony', p. 502.

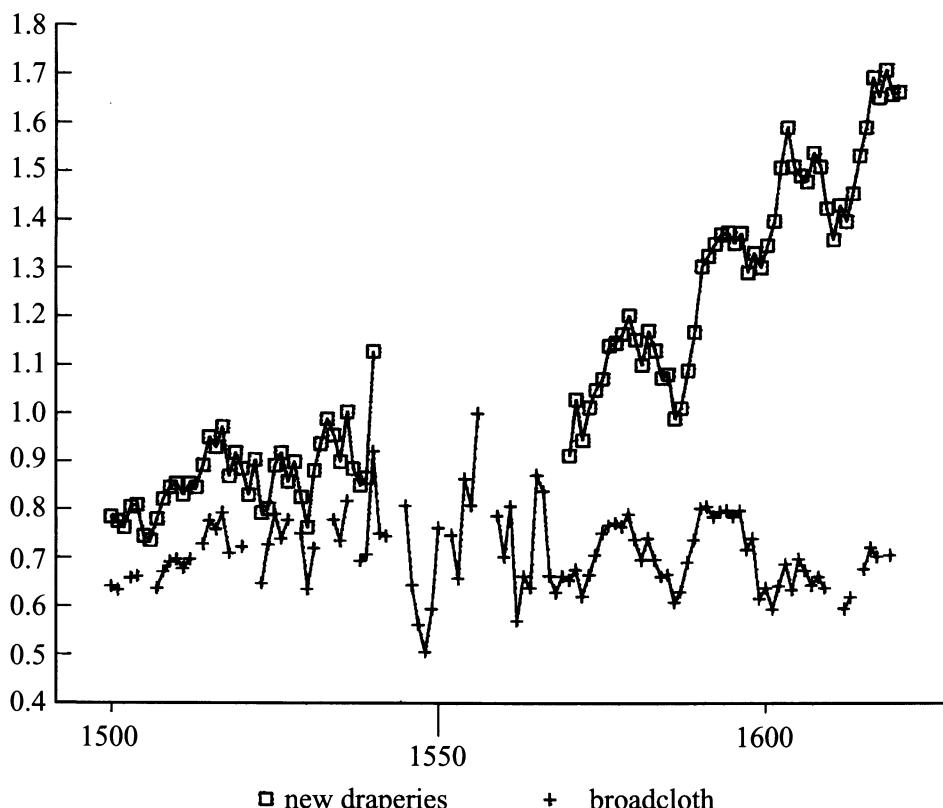


Figure 4. *Total productivity in English cloth, 1500-1620*

Sources: The indices were computed by, first, calculating a geometric average of a series of the price of raw wool and a wage rate and, then, dividing that average by a cloth price series. The raw wool series is described in Allen, *Enclosure*, pp. 327-8, and the wage rate for craftsmen in *idem*, 'Great divergence', p. 435. For the new draperies, the cloth price for Norwich is from Rogers, *History*, IV, p. 569 and V, p. 576. For broadcloth, the cloth price is series A in Beveridge, *Prices*, pp. 85-90.

their efficiency was similar before the invention of the new draperies.³¹ The rising efficiency of English worsted production compared with traditional woollens is, thus, also indicative of the increasing advantage enjoyed by northern European worsted producers over the Italians.

The enclosure of the open fields and commons is the best-known aspect of the agricultural revolution in England, and it is measured by ENCL, the proportion of land enclosed. England is famous as the only country that had an enclosure movement in this period, but it was not the only country with enclosed farms. Indeed, there was considerable variation in the proportion of land enclosed as shown by Pounds.³² For countries other than England, the proportion of land enclosed is taken from this source; for England, where the proportion grew over time,

³¹ The cloth market was highly integrated, for, as Munro reports, the cost of shipping woollens between the North Sea and Mediterranean ports was 15% of their value and often less during the fourteenth century: Munro, 'English "new draperies"'.

³² Pounds, *Historical geography*, p. 335.

Wordie's estimates have been used with slight adjustment to match the dates in the dataset.³³ Including ENCL in cross-national regressions explaining agricultural productivity provides a focused test of England's most distinctive rural institution.

Some countries were successful in the race for empire, while others were not. Spain seized a vast empire in Latin America and the Philippines; England acquired much of North America, some rich sugar islands in the Caribbean, and Bengal; the Netherlands conquered Indonesia, the original Spice Islands and Surinam; and France had important possessions in North America, the Caribbean, and India. Portugal had a substantial empire in Brazil, Africa, and South Asia but is not in the database analysed here. The other European countries were not in the running.

The effect of empire is measured by TRADEPOP, the volume of non-specie trade per caput.³⁴ All of the countries were mercantilist and tried to reserve trade with their colonies for their nationals. The experience of the Dutch is the exception that proves the rule. They were highly efficient in shipping and came closest to being free traders in the Atlantic economy (but not in the Asian). However, the Dutch were squeezed out of most Atlantic colonial trade by the regulations of the English, French, and Spanish. Only in times of war could the Dutch make much headway.³⁵ Many factors affect trade volumes, but the experience of the Dutch shows the primacy of politics in this period, and this is why trade is treated as an exogenous measure of imperial advantage.

It should be noted that trade volumes are measured exclusive of shipments of gold and silver. This affects the measurement of Spanish trade where bullion was the main cargo. While the Dutch and, especially, the English empires offered trade and markets, the Spanish may have been too successful in generating loot: the gold and silver from the Americas inflated prices and wages in Spain, rendering much manufacturing unprofitable.³⁶ The effects of the Spanish empire are tested in some specifications by including a dummy variable SPANEMP.

The early modern period saw the invention and spread of printing with movable type, an increase in book publishing, and a concomitant rise in the ability to read and write. The proportion of the population that could sign its name has been established for most parts of Europe in the seventeenth and eighteenth centuries, and provides a rough indi-

³³ Wordie, 'Chronology of enclosure'.

³⁴ Trade volumes were derived from Deane and Cole, *British economic growth*, p. 87; Levasseur, *Histoire*, I, p. 18, II, pp. 20-2, 94-6; Haudrere, *La Compagnie française*, IV, p. 1201; Villiers, 'Slave and colonial trade', p. 211; de Vries and van der Woude, *First modern economy*, pp. 393, 445, 460, 474, 478; Garcia Fuentes, *El comercio español*; Morineau, *Incroyables gazettes*, pp. 267, 494; Hamilton *American treasure*, pp. 33-4; Fisher, *Commercial relations*, pp. 67-8; *idem*, *Economic aspects*, pp. 164-70, 201-6. The English imports and exports for the eighteenth century were valued with prices of c. 1700, so they are quantity indices. Prices of linen and sugar were used to convert the values of exports and imports, respectively, for other countries to sterling values of 1700 comparable with the English values. For the sources of the prices, see Allen, 'Great divergence'.

³⁵ De Vries and van der Woude, *First modern economy*, pp. 476-9.

³⁶ Hamilton, *American treasure*; *idem*, *Money, prices, and wages*; *idem*, *War and prices*.

Table 2. *Adult literacy, 1500-1800*

| | 1500 % | 1800 % |
|-----------------|-----------|-----------|
| England | 6 | 53 |
| Netherlands | 10 | 68 |
| Belgium | 10 | 49 |
| Germany | 6 | 35 |
| France | 7 | 37 |
| Austria/Hungary | 6 | 21 |
| Poland | 6 | 21 |
| Italy | 9 | 22 |
| Spain | 9 | 20 |

Notes and sources: Literacy is taken as the ability to sign one's name. Figures for 1500 are estimated from the rural-urban breakdown. Rural population is assumed to be 5% literate. This is suggested by later data from Nalle, 'Literacy and culture', p. 71, and Houston, *Literacy*, pp. 140-1, 152-3, for Spain; Wyczanski, 'Alphabetisation', p. 713, for Poland; Le Roy Ladurie, *Peasants*, pp. 161-4, for Languedoc; Graff, *Legacies of literacy*, p. 106, for England.

Urban population is assumed to be 23% literate, generalizing from the estimate for Venice in 1587 given in Grendler, *Schooling*, p. 46, that 33% of the men and between 12.2% and 13.2% of the women were literate. The proportion was of the same order in Valencia (Nalle, 'Literacy and culture', p. 71), and among the nobles and bourgeoisie of Poland (Wyczanski, 'Alphabetisation', p. 713), and perhaps a little lower in fifteenth-century London (Graff, *Legacies of literacy*, p. 106). Because of the limited urbanization of countries other than Spain and Italy at this time, the urban literacy rate has no discernible impact on the national average.

Data are fuller for the seventeenth and eighteenth centuries and are taken from: Nalle, 'Literacy and culture'; Houston, *Literacy*; Graff, *Legacies of literacy*; Cressy, *Literacy and social order*; *idem*, 'Levels of literacy'; Viñao Fraga, 'Literacy in Spain'; Grendler, *Schooling*; Ruwet and Wellemans, *L'analphébetisme*; Wyczanski, 'Alphabetisation'; Furet and Ozouf, *Lire et écrire*; Gelabert, 'Niveaux d'alphabetisation'; de Vries and van der Woude, *First modern economy*; Park 'Education revolution?'; Chartier, *Lectures et lecturers*; Cipolla, *Literacy and development*; Kuipers, 'Lezen en schrijven'; Larguie, 'L'Alphabetisation des Madriléños'.

cator of literacy (table 2). Data for 1500 are less satisfactory, but literacy was clearly far lower at that date, no matter how the material is processed. Literacy increased in all parts of Europe during the subsequent three centuries, but especially in the north where economic growth was most pronounced. Casual speculation suggests that the ability to read and write contributed to technological progress, and this opinion draws some strength from the studies of twentieth-century economic growth that identify schooling and human capital as important causes.³⁷ Could the same have been true of the pre-industrial economy? The answer appears to be negative, and this is why literacy does not appear in figure 3.

European political systems varied enormously between 1300 and 1800. The model here follows the classification of De Long and Schleifer who have distinguished 'princes' (absolutist monarchs) from more representative and other systems.³⁸ Medieval Italy, the Dutch Republic, and eighteenth-century England were the classic 'representative' states. Most of the rest were ruled by absolutist 'princes'.³⁹

³⁷ The discussion is voluminous and runs from Denison, *Sources of economic growth*, to Barro, *Determinants*.

³⁸ De Long and Schleifer, 'Princes and merchants'.

³⁹ Ibid. Implicitly, these authors have classified Napoleon as a prince. This article does likewise. In 1800, therefore, France and the Netherlands (at that time a dependency of France) are placed in the 'prince' category.

DeLong and Schliefer did not categorize Poland, but it is necessary to do so for the present analysis. Poland is an interesting case, for its government was representative with an exceptionally weak monarch until its dismemberment, which was completed in the 1790s. For the periods before 1800, therefore, Poland is placed in the 'non-prince' category; in 1800 it is assigned to the 'prince' category, for Russia, Prussia, and Austria were all absolutist states.

III

Five equations explain the five endogenous variables—the real wage, agricultural productivity, urbanization, proto-industrialization, and the population. Since the first four of these comprise a simultaneous system, they are estimated by two-stage least squares (instrumental variables). The instruments are all the exogenous variables in the model—LNTL, TRADEPOP, SPANEMP, ENCL, ENG18, LIT, MANPROD, PRINCE, LNURBLG, and the constant. All of these variables are defined in this section. All equations are exactly identified or over identified by the order condition. The four equations solved simultaneously in each period are considered next, and then the equation explaining population growth.

The wage equation is key, for the divergence between north and south is ultimately a question of labour income. Figure 5 defines the problem. D is the demand curve for labour in pre-industrial society. Since the land area is fixed, diminishing returns to labour implies that a larger population can be employed only if the wage falls. For that reason, the demand curve slopes downwards. S represents the supply of labour, which is shown as inelastic (equivalent to the population) for simplicity. With S at a low level, the wage is high at w . In most of Europe, the population expanded between 1500 and 1800, and the wage fell from w to w_1 , as shown in figure 5. In the successful economies, however, the story was different. There the demand curve for labour shifted to the right (to D_1) in step with the population growth. As a result, the wage remained at w . The key question in early modern economic history is why the demand curve for labour grew in a few countries and remained constant in the rest. Answering that question will explain the great divergence in incomes that occurred in the early modern period.

The demand curve in figure 5 shifts to the right if capital per worker increases or if efficiency rises. The model can be implemented empirically by choosing proxies for these variables. Regression 1 in table 3 provides a basic specification in which the wage⁴⁰ depends on two variables

⁴⁰ The wage is the daily wage of a craftsman converted to constant purchasing power with an international inter-temporary consumer price index. The sources of most wages and prices, and the consumer price index, are described in Allen, 'Great divergence'. The English wage is an average of London, southern towns, and northern towns. The series for southern English towns is that of Phelps Brown and Hopkins, 'Building wages', and for northern English towns, Woodward, *Men at work*, is used. For the fifteenth, sixteenth, and seventeenth centuries the York series was used, but it did not differ materially from any of the other northern series; for the eighteenth century the source was the Lancashire wages in Gilboy, *Wages*. All of the English wage series were deflated with the same consumer price index.

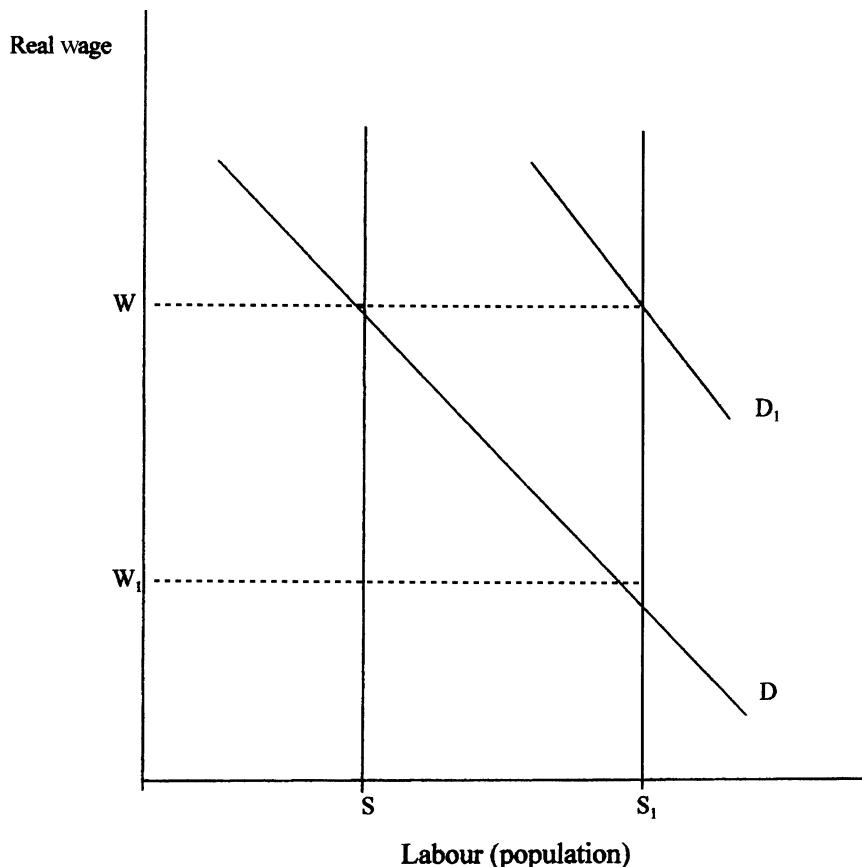


Figure 5. *The supply of and demand for labour*

indexing efficiency and capital per worker—the logarithm of total factor productivity in agriculture (LNAGTFP) and the log of the urbanization rate (LNURB)—as well as on the log of the land-labour ratio (LNTL). The last of these captures the fall-off in productivity as population presses more heavily on the resource base. This effect explains the downward slope of the demand curve in figure 5. The coefficients of all variables are positive and statistically significant, as expected, and the equation fits the data reasonably well.

More variables are added to the basic regression in other specifications. Regression 2 contains PRINCE, a dummy variable equalling 1 for absolutist monarchies. Its coefficient is negative but very small and statistically insignificant, indicating that absolutism had a negligible impact on the demand for labour. Regression 3 includes LIT (the proportion of the adult population that could sign its name), TRADEPOP (intercontinental commodity trade per caput), and LNPROTO (the proportion of the population engaged in rural, non-agricultural activities). None of these variables was statistically significant. It is particularly important that

Table 3. *Wage equation*
(*t*-ratios in parentheses)

| regression dep. var. | 1 LNWAGE | 2 LNWAGE | 3 LNWAGE |
|-------------------------|-----------------|----------------|-----------------|
| estimator | IV | IV | IV |
| LNTL | .42 (5.84) | .40 (4.58) | .20 (1.69) |
| LNURB | .23 (3.24) | .23 (3.18) | -.11 (-.60) |
| LNAGTFP | .60 (2.68) | .54 (1.98) | 1.03 (3.25) |
| PRINCE | | -.03 (-.43) | -.09 (-1.08) |
| LNPROTO | | | -.66 (-1.81) |
| LIT | | | -.01 (-.02) |
| TRADEPOP | | | -.03 (-.03) |
| constant | -.86 (-1.51) | -.66 (-.88) | -.84 (-.83) |
| R ² | .60 | .59 | .65 |

Notes: The dependent variable is the real wage.

neither representative government nor literacy shifted the demand for labour to the right.

There are two approaches to explaining the growth in agricultural productivity. The traditional view, discussed above, attributes agricultural revolutions to the 'modernization' of rural institutions. This approach, however, has been called into question by the micro studies which have shown that rural institutions did not influence efficiency. If agrarian institutions, which limit the responsiveness of agriculture to new opportunities, do not explain why some countries were more productive than others, differences in the challenges faced by agriculture may explain the variation in performance. The second approach attributes high agricultural productivity to the growth of the non-agricultural economy. Large cities and rural industries increased the demand for food, flax, wool, leather, and labour, thereby providing an incentive to farmers to modernize their methods. Von Thünen noticed that agriculture was more intensive near cities, and the second approach generalizes that observation into a theory of agricultural development.⁴¹ Hence, the growth of the non-agricultural economy may explain agricultural productivity.

This article measures the relative importance of agrarian institutions and the non-agricultural economy in raising farm efficiency by including

⁴¹ Grantham, 'Diffusion of new husbandry'; *idem*, 'Agricultural supply'; Campbell, *English seigniorial agriculture*, pp. 411-40.

Table 4. *Agricultural productivity equation*
(*t*-ratios in parentheses)

| regression dep. var. estimator | 1 LNAGTFP IV | 2 LNAGTFP IV | 3 LNAGTFP IV | 4 LNAGTFP IV |
|--------------------------------------|--------------------|--------------------|--------------------|----------------------------------|
| LNURB | .27 (5.67) | .24 (4.61) | .23 (4.27) | .50 (1.84) |
| LNPROTO | .55 (4.39) | .43 (3.07) | .50 (3.05) | 1.19 (1.73) |
| LNWAGE | .47 (3.02) | .33 (1.90) | .44 (2.00) | .50 (1.35) -.31 (-1.04) |
| ENG18 | | | | |
| ENCL | | .19 (1.55) | .18 (1.53) | .35 (1.36) |
| PRINCE | | | .06 (.85) | .05 (.37) |
| LIT | | | | -.128 (-1.01) |
| constant | .63 (2.03) | .58 (1.98) | .40 (1.10) | 2.16 (1.22) |
| R ² | .53 | .57 | .58 | .29 |

Notes: The dependent variable is total factor productivity in agriculture; see app. II.

indicators of both in the statistical model. In table 4, regression 1, TFP in agriculture is regressed on LNURB, LNPROTO, and LNWAGE. They are indices of the growth of the non-agricultural economy. All have positive and statistically significant coefficients. Larger values for the first two variables indicate greater demands on agriculture for food and fibre, while higher wages provide an incentive to shed low productivity jobs or to increase efficiency in other ways in order to generate enough net income to keep the farm labour force from migrating to the city. Regression 1 substantiates the view that a larger non-agricultural economy induced an increase in farm efficiency.

The role of agrarian institutions in limiting the response to these demands is ascertained by including two additional variables in equations 2-4. The first is ENCL, the proportion of land enclosed. Its coefficient was usually about .18. ENCL was statistically significant at about the 15 per cent level, which is low by most standards. There is, however, much to be said in favour of the coefficient. The value of .18 implies that the TFP of enclosed farms was 18 per cent higher than that of open fields. If rent accounted for one-third of revenues, then enclosure would have boosted rent by 64 per cent, e.g. a rise from 12 shillings to 20 shillings per acre. This result is consistent with rent differences similar to those observed in some districts in the south midlands but rather higher than Clark's recent findings.⁴² Arthur Young would have been enthusiastic about the regression coefficient, for it is close to the doubling he often

⁴² Allen, *Enclosure*, p. 172; *idem*, 'Tracking'; Clark, 'Commons sense'.

Table 5. *Urbanization equation*
(*t*-ratios in parentheses)

| regression dep. var. estimator | 1 LNURB IV | 2 LNURB IV | 3 LNURB IV | 4 LNURB IV | 5 LNURBCON IV |
|--------------------------------------|------------------|------------------|------------------|------------------|---------------------|
| LNAGTFP | .45 (2.32) | | .31 (1.47) | .58 (.60) | |
| TRADEPOP | | .16 (2.53) | .10 (1.40) | .10 (1.06) | |
| SPANEMP | | | | .20 (.89) | |
| PRINCE | | | | .02 (.22) | .01 (.33) |
| LIT | | | | -.10 (-.25) | |
| MANPROD | | | | -.08 (-.13) | |
| LNURBLG | .82 (13.77) | .90 (23.06) | .84 (14.49) | .77 (5.00) | |
| constant | -.39 (-2.67) | -.19 (-2.20) | -.35 (-2.47) | -.46 (-1.35) | |
| R ² | .90 | .92 | .91 | .89 | .01 |

Note: The dependent variable in regressions 1–4 is the rate of urbanization. The dependent variable in regression 5 is LNURBCON = LNURB − .14*TRADEPOP − .79*LNURBLG − .41*LNAGTFP + .46. The values of the independent variables in this equation are thus constrained to the values in the definition of LNURBCON.

spoke of. Despite the low *t*-ratios, ENCL is included in the model both as a tribute to Young and to make sure that enclosure gets its due.

The second variable representing agrarian institutions was ENG18, a dummy variable equalling one for England in the eighteenth century, at the time when its distinctive agrarian institutions—great estates, large-scale farms, and landless labourers—reached their fully developed form. If they mattered, presumably, they would have pushed the efficiency of England above the level implied by the other variables. However, the coefficient of ENG18 is always negative, close to zero, and statistically insignificant. This finding contradicts the importance of England's eighteenth-century institutions as a source of agricultural improvement.

Finally, PRINCE and LIT were included to see whether they had any observable effect on growth in agricultural productivity. They did not, in any specification.

The proportion of the population living in cities changed very little in many countries during the early modern period, while rising in the Netherlands and, especially, in England. It is difficult to find one equation that captures both stasis and dynamism.⁴³ The problem is made more difficult by the collinearity among important variables in north-western Europe. This is a bigger problem for this equation than for the others.

Table 5 reports regressions that explain Europe's urbanization rate. The

⁴³ Magisterial overviews of European urbanization are provided by De Vries, *European urbanization*, and Bairoch, *La Population*. For recent surveys of English urbanization in this period, see Sweet, *English town*; Chalklin, *English town*; Ellis, *Georgian town*.

lagged urbanization rate LNURBLG is included in all equations to account for the persistence of cities, as will be explained below. LNAGTFP is introduced as an explanatory variable since a highly productive agriculture might have nurtured cities by providing them with food, raw materials, capital, and labour. TRADEPOP is included to measure the contributions of American and Asian empires, and SPANEMP to detect any further effects of the Spanish empire. PRINCE and LIT measure the impact of absolutism and of literacy on urbanization. MANPROD measures the productivity of the new draperies relative to traditional woollen cloth and hence the productivity advantage of northern textiles.

The log of the urbanization rate lagged by a century (LNURBLG) is a significant variable in all regressions with a coefficient of about .8. Lagged urbanization captures the persistence of city size since its coefficient means that the urban proportion would have been 80 per cent of its value a century earlier if nothing else had caused it to change.

Persistence represents several social processes. The most common case was countries such as Austria or Germany where the proportion of city dwellers was low and remained so—in other words, where growth was modest. A more interesting case is Italy where the accumulation of social capital allowed cities to renew themselves even when their economic base collapsed. In the middle ages, a major Italian industry was woollen cloth. When its manufacture was destroyed by the exports of the new draperies from northern Europe the Italian cities did not disappear. Instead, their economies were recreated on the basis of silk. This involved raising silkworms in the countryside as well as weaving silk cloth in the city. Although different technical skills were involved, business skills and networks were carried over from wool production. Italians showed tremendous enterprise in the seventeenth century, but they encountered difficulties also, and the economy as a whole did not advance.

The proportion of city dwellers also remained high in Spain throughout the early modern period, but for a different reason. The manufacturing industries that sustained the medieval cities were destroyed by the inflation caused by imports of American bullion. Their population losses were counterbalanced by the growth of Madrid as American treasure was used to build the capital.⁴⁴ These very different histories are summarized by the inclusion of the lagged urbanization rate.

Lagged urbanization does not, of course, explain the urban revolutions in England and the Netherlands. Equation 1 indicates that higher agricultural productivity significantly increases urbanization, and equation 2 indicates the same thing for intercontinental commodity trade. However, as equation 3 shows, these variables are highly correlated so they are not jointly significant. Adding PRINCE, LIT, SPANEMP, and MANPROD makes no significant contribution to the explanation (equation 4).

The collinearity problem was addressed on the basis of subsidiary simulations. They indicated that the various national histories could be successfully tracked if the coefficients of LNAGTFP, LNURBLG,

⁴⁴ Ringrose, *Madrid*.

TRADEPOP, and the intercept were set to the values noted in table 5. These are all within a standard error of their values in the rest of the table. Equation 5 shows the value implied for the coefficient of PRINCE if these restrictions are imposed, and that is also very close to its unconstrained value. Consequently, in subsequent simulations, equation 5 is used for urbanization. With this specification, urbanization depends on its lagged value, agricultural productivity, the volume of intercontinental trade, and PRINCE, the dummy variable coding absolutism. The last is not statistically significant but is included, as in the other equations, to give the representative government argument the best possible run for its money.

Proto-industry was not a direct determinant of labour demand, but it influenced wages and other variables through its impact on agricultural productivity. Proto-industry had contradictory causes that reflect its ambiguous role in early modern development. On the one hand, there were large rural manufacturing industries in the leading economies, and these industries played an important role in economic growth. The English woollen cloth industry is a case in point. On the other hand, many rural industries developed in backward regions and left no legacy for industrialization.

The dual nature of proto-industry is reflected in the statistical analysis of its causes (table 6). The negative coefficient of LNAGTFP means that proto-industrialization was a consequence of low agricultural productivity rather than of high productivity: it was often the occupation of poor peasants practising a backward agriculture as in central Europe (table 1). The negative coefficient on LNWAGE conveys the same lesson.

Why, then, was there a proto-industrial revolution in north-western

Table 6. *Proto-industry equation*
(*t*-ratios in parentheses)

| regression | 1 | 2 | 3 |
|----------------|------------------|------------------|------------------|
| dep. var. | LNPROTO | LNPROTO | LNPROTO |
| estimator | IV | IV | IV |
| LNAGTFP | -1.14 (-1.98) | -.93 (-1.58) | -.94 (-.83) |
| LNWAGE | -.84 (-3.67) | -1.00 (-4.02) | -1.01 (-1.63) |
| MANPROD | 1.48 (3.29) | 1.27 (2.76) | 1.36 (2.59) |
| PRINCE | | -.18 (-1.50) | -.17 (-.99) |
| LIT | | | -.14 (-.10) |
| TRADEPOP | | | .01 (.08) |
| SPANEMP | | | (-.08) (-.20) |
| constant | -1.41 (-2.01) | -.80 (-.99) | -.83 (-.57) |
| R ² | .37 | .40 | .40 |

Notes: The dependent variable is the rate of proto-industrialization.

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Europe? Table 6 shows that MANPROD, which indexes the growth in productivity in the new draperies, offset the depressing effect of high-productivity agriculture. The proximate cause of north-western Europe's proto-industrial revolution was, thus, quite different from the cause of its urban revolution. The former was due to rising productivity in textile manufacturing in the sixteenth and seventeenth centuries, and the latter was due, in the first instance, to empire. Manufacturing productivity did not directly promote urban growth, nor did empire promote rural manufacturing. It should be emphasized, however, that these are 'first-round' effects. Allowing for feedback between the sectors means that all exogenous variables affected urbanization and proto-industrialization, sometimes in dramatic ways.

Equations 2 and 3 also include PRINCE. Its coefficient in these tables is larger in absolute value than in the other tables and almost statistically significant by the usual criteria. This is the strongest evidence that absolutism depressed economic development, and equation 2 will be used in simulations to assess its impact. LIT is included in equation 3, and it remains insignificant.

With the data at hand, it is impossible to explore the determinants of fertility and mortality separately; only the overall impact of wages on population change can be examined. As a first step, the population growth rate over a century was graphed against the real wage at the beginning of that century. Century data are of much lower frequency than the annual data usually used in such investigations, but the wage and population cycles extend over periods of several centuries, so century data can reveal the elements of the system.⁴⁵

Graphical analysis revealed two very different demographic regimes. In England and the Netherlands, population growth clearly rose with the wage—these countries, in other words, exhibited the Malthusian preventive check. The rest of the continent did not: no relationship was discernible between population growth and wages. It may be that other data would reveal Malthusian behaviour, but it is not apparent here.

The graphical analysis was extended with regression models of population growth. Table 7 shows regressions for England and the Netherlands as well as for the rest of Europe. Mendels's view that proto-industrialization caused population growth⁴⁶ was tested with these data by including the proto-industrial share of the population as an explanatory variable, but it was never significant. Other variables included in the regressions are the wage rate, the urbanization rate, and dummy variables for the Black Death (DBD), the Thirty Years War (D30), and the Netherlands (DN). Urbanization is included in recognition of the very high mortality rate in cities.⁴⁷ The results are plausible: according to equation 2, population growth increased with the wage and decreased with urban density.

⁴⁵ For the same reason, Lee, 'Population in pre-industrial England', analysed English data at 50-year intervals.

⁴⁶ Mendels, 'Proto-industrialization'.

⁴⁷ Wrigley, 'London's importance'; van Zanden, 'Holland's economy'.

Table 7. *Population growth equations*
(*t*-ratios in parentheses)

| | 1 Eng/Neth POPGROW | 2 Eng/Neth POPGROW | 3 Eng/Neth POPGROW | 4 cont POPGROW | 5 cont POPGROW |
|----------------|--------------------------|--------------------------|--------------------------|----------------------|----------------------|
| regression | | | | | |
| region | | | | | |
| dep. var. | | | | | |
| CONSTANT | -.47 (-.89) | .15 (.29) | .43 (1.11) | 1.27 (15.88) | 1.28 (15.72) |
| WAGE | .21 (3.13) | .16 (2.65) | .14 (2.65) | -.0042 (-.44) | -.0016 (-.14) |
| URBRATE | .68 (.44) | -.62 (-.43) | -1.58 (-2.20) | | -.16 (-.57) |
| DBD | | -.58 (-2.00) | -.68 (-2.70) | -.52 (-2.79) | -.51 (-3.52) |
| DN | -.64 (-1.53) | -.30 (-.80) | | | |
| D30 | | | | -.21 (-1.53) | -.21 (-1.53) |
| R ² | .64 | .80 | .77 | .36 | .34 |

Notes: The dependent variable is the ratio of the population at one time to its value a century earlier. Equations 1-3 were estimated for England and the Netherlands, equations 4 and 5 for the remaining continental countries.

WAGE = real wage

URBRATE = proportion of the population living in cities

DBD = dummy variable for Black Death

DN = dummy variable for the Netherlands

D30 = dummy variable for the Thirty Years War

Urban density was higher in the Netherlands than in England, and so there is some collinearity between a dummy variable for the Netherlands and urbanization. The *t*-statistic on DN in equation 2 shows it to be insignificant, so equation 3 has been used in later analysis. This gives a large, negative weight to urbanization in accounting for population change.

The rest of the continent had a different demographic regime according to this regression analysis. As equations 4 and 5 indicate, neither the wage nor urban density had an appreciable impact. The equation predicts population growth of about 24 per cent per century (0.2 per cent per annum) over much of Europe irrespective of economic conditions. The fourteenth century aside, population growth in north-western Europe varied between zero and 50 per cent per century on account of changes in the wage and in urbanization. The mean was similar, but the sensitivity to economic conditions was more Malthusian.

IV

An important test of the simulation model is to see whether it can account for the different paths of development followed by different parts of Europe. If the model is simulated from 1400 onwards, do Italy and France show falling wages and limited structural transformation? Do the Netherlands and England maintain their wages and exhibit urban and agricultural revolutions? The questions have been addressed using simulations with the five-equation version of the model in which population is endogenous and with a four-equation version in which population is

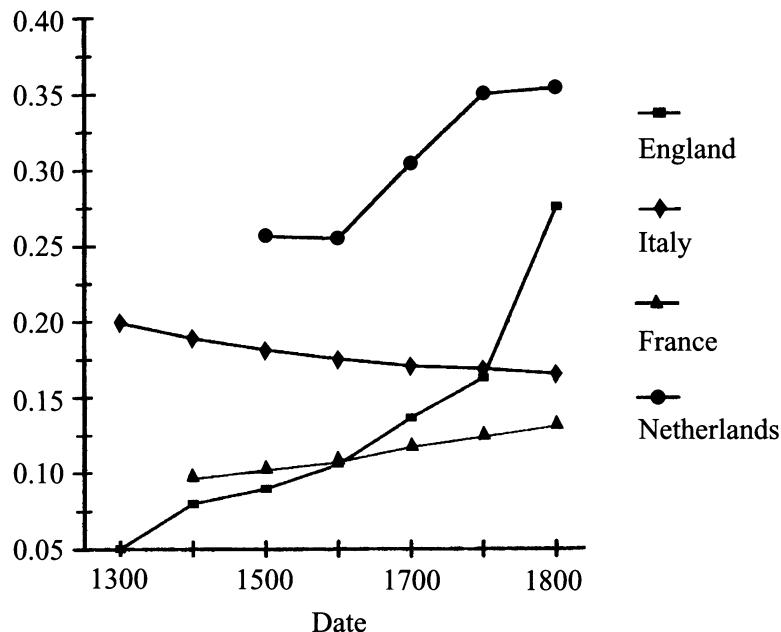


Figure 6. *Simulated urbanization rate, 1300-1800*

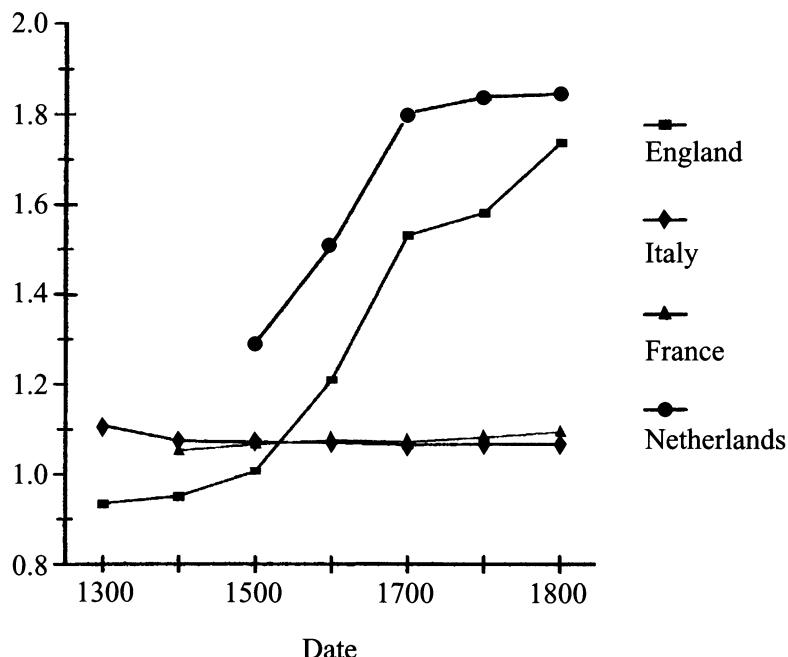


Figure 7. *Simulated total factor productivity [TFP] in agriculture, 1300-1800*

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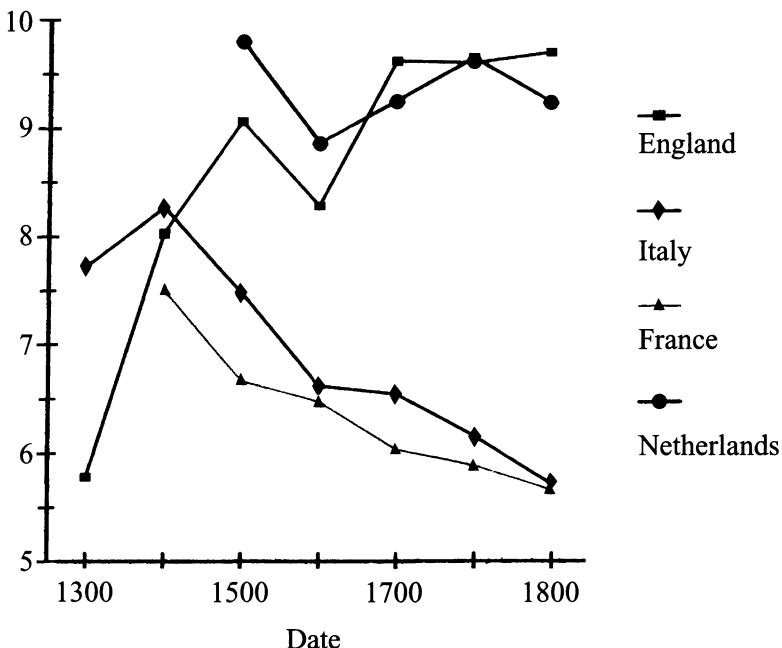


Figure 8. *Simulated real wage, 1300-1800*

treated as exogenous. The answers are similar in both cases, but the model with endogenous population introduces some erratic movements in simulated wages when there are discrepancies in simulating population. The simulations of the other variables are scarcely affected. This section concentrates on the model with exogenous population and considers the effects of endogenous population at the end of the discussion.

Figures 6-8 compare simulated trajectories for urbanization, agricultural productivity, and wages for England, Italy, France, and the Netherlands. The simulations use regression 2 in table 3, regression 3 in table 4, regression 5 in table 5, regression 2 in table 6, and regressions 3 and 4 in table 7. The simulations for France are very similar to those for Germany, Austria, and Poland. They show little cumulative urbanization, static agricultural productivity, and falling real wages. For France and the major countries of central Europe, the model predicts little economic development. The simulations for Italy and Spain are almost as bleak, although their initially higher urban shares are largely maintained.

The simulations for the Netherlands and England, on the other hand, show successful patterns of economic development. In the first place, urbanization was much more extensive. The Dutch were already more highly urbanized in 1500 than much of the continent, and the development of commerce and empire built on that base to produce the highest rate of urbanization in 1800. The English started from a much lower level of urbanization in 1500, overtook France and Italy, and almost caught up with the Dutch by 1800.

Unlike the major continental countries, both England and the Nether-

lands had agricultural revolutions, and the simulation model reproduces these. Revisionist historians have undermined the view that the modernization of agrarian institutions caused productivity growth in agriculture, which, in turn, spurred economic development generally. This article has taken that reassessment to its logical conclusion by modelling the growth in farm efficiency as a response to the development of the non-agricultural economy. This hypothesis works rather well. It replicates the agricultural revolutions of north-western Europe and the stagnation of productivity in much of the continent.

Urbanization, greater farm efficiency, and proto-industrialization had a pronounced impact on wages. In north-western Europe, the simulated wage remains high during the early modern period. The simulation for England shows a drop in the sixteenth century and then a rebound in the seventeenth and eighteenth centuries as economic development tightened up the labour market. This was escape from the Malthusian trap through rapid development. The contrast with most of the continent is impressive. There, simulated real wages fell as population grew and the economy stagnated.

V

The simulation model can be used to factor out the differences between successful and unsuccessful economies. This section concentrates on the comparison between England, the most successful economy, and its large continental rivals such as France and Austria. How did England maintain a high wage despite rapid population growth, while continental wages fell even though the population grew little? The possibilities—as incorporated in the model—include the replacement of absolutist by representative government in the seventeenth century, the enclosure of the open fields, the productivity advantage associated with the new draperies, and the growth in intercontinental trade consequent upon the formation of the British empire.⁴⁸ In addition, the preventive check demographic regime may have accelerated economic development. By successively removing these sources of growth and re-simulating the model, the fundamental differences between England and the continent are identified. These simulations include the ramifications of the changes throughout the economy and not simply in the sector concerned.

Figures 9-11 show alternative simulations for England of TFP in agriculture, the urbanization rate, and the real wage from 1300 to 1800. In all figures, the top line is the ‘simulated actual’ history of the variable, that is, the value implied by the model when it is simulated with the historical time paths of the variables describing the proportion of the land enclosed, relative textile productivity, and so forth. If the model

⁴⁸ In principle, development could also be simulated holding literacy at medieval levels. Since the sign of the coefficient of literacy was usually negative, these simulations perversely generate greater growth than actually occurred. However, they have little relevance because the negative coefficients on literacy were never statistically significant.

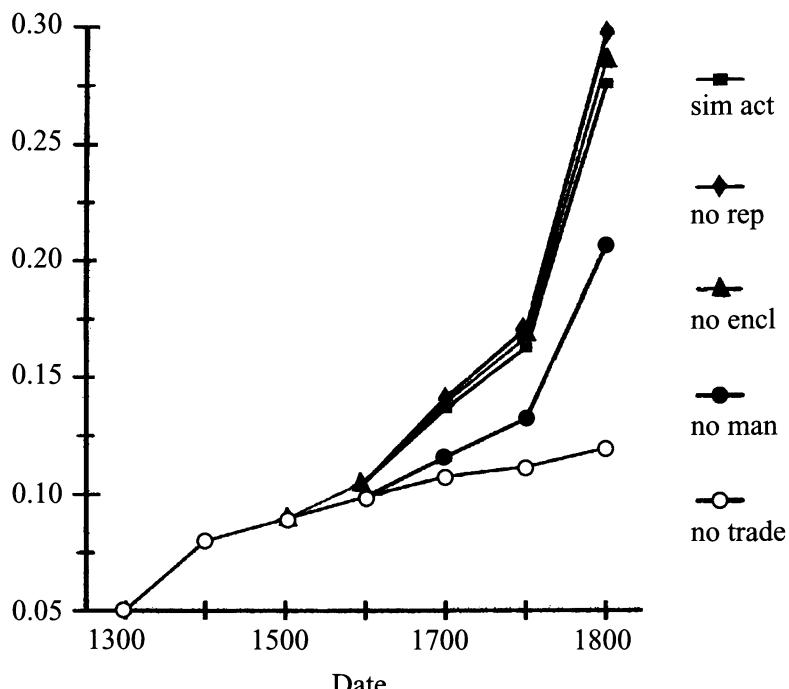


Figure 9. *Simulated urbanization rate for England, 1300-1800*

Note: The abbreviations are explained in the text

were perfect, the simulated values would equal their historical time paths. In the event, the main features are replicated.

The lower lines show the simulated value of the variables as growth-promoting factors are removed from the calculations. The line marked 'not representative' shows the course of the variable if England had remained an absolutist monarchy in the eighteenth century. The removal of exogenous factors cumulates as one moves down the graphs. Thus, the line marked 'no enclosure' keeps the proportion of enclosed land at its 1500 level, while also eliminating representative government. The difference between the 'not representative' line and the 'no enclosure' line, therefore, shows the impact of enclosure, and the difference between the 'no enclosure' line and the 'no manufacturing' line shows the effect of the new draperies. By the same reasoning, the bottom line labelled 'no intercontinental trade' shows the result of eliminating all four growth-promoting factors.

Figures 9-11 make several important points about England's success. First, the bottom lines trace out a no-growth trajectory like that of the large continental countries: little growth in agricultural productivity or in urbanization and a falling real wage. In the absence of the growth-promoting factors, in other words, the history of England would have resembled that of France, Germany, or Austria. Second, the ascendancy of parliament in the eighteenth century made little contribution to England's development. Several studies of interest rates have failed to detect any

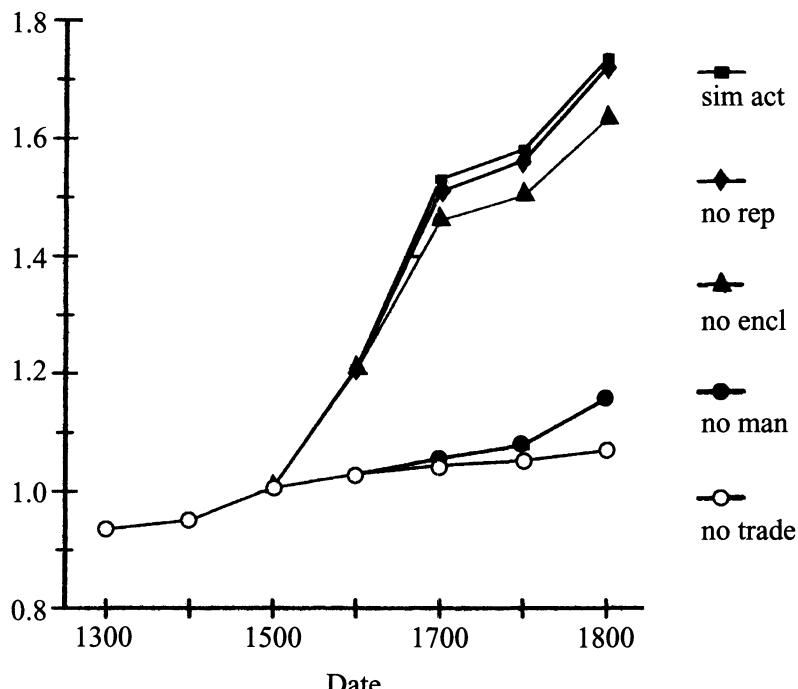


Figure 10. Simulated total factor productivity [TFP] in English agriculture, 1300-1800

Note: The abbreviations are explained in the text

growth-promoting result of the Glorious Revolution of 1688,⁴⁹ and the present study supports that view.

It is not surprising that representative government did not accelerate growth. Property was secure in all the leading European countries, whatever their constitution. Indeed, as Rosenthal has shown, one of France's problems was that property was too secure: the state, for instance, could not push forward profitable irrigation projects in Provence because landowners could block these initiatives in the courts.⁵⁰ Parliamentary ascendancy in England led to higher taxes than in France, contrary to the views of liberals then or now.⁵¹ And while representative government could provide good government—England's local improvement acts are a case in point—it could also provide spectacularly bad government. The concentration of power in the diet emasculated the Polish state and ultimately destroyed it. It would be a great surprise if there were a straightforward statistical relationship between absolutism and underdevelopment, and there was not in these tests.

⁴⁹ Clark, 'Political foundations'; Epstein, *Freedom and growth*, pp. 12-37; Quinn, 'Glorious Revolution's effect'.

⁵⁰ Rosenthal, 'Irrigation in Provence'.

⁵¹ Mathias and O'Brien, 'Taxation in England and France'; Mathias and O'Brien, 'Incidence of taxes'; Hoffman and Norberg, *Fiscal crises*; Bonney, *Fiscal state*.

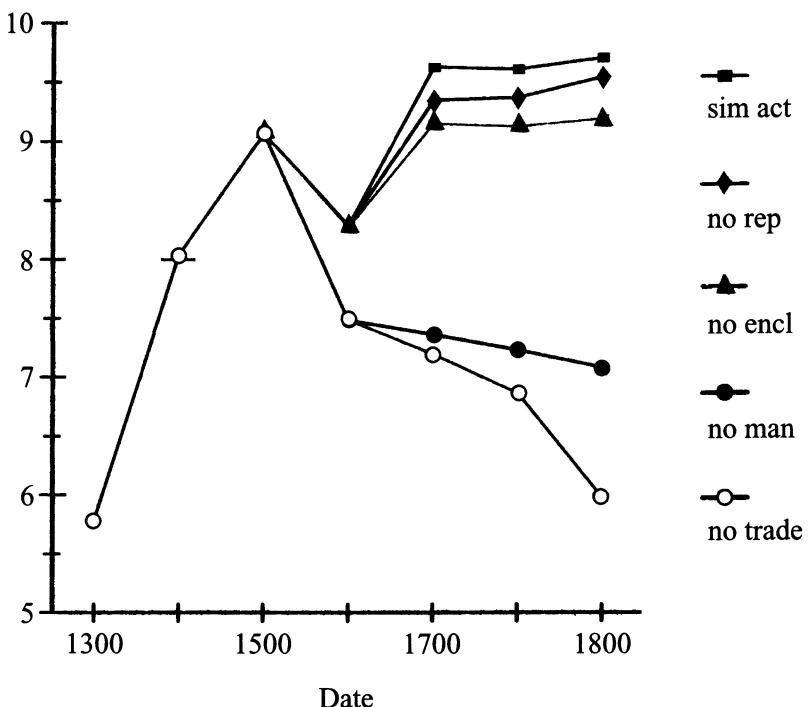


Figure 11. *Simulated real wage for England, 1300-1800*

Note: The abbreviations are explained in the text

Third, the enclosure movement made little contribution to England's progress. In all cases, the 'no enclosure' trajectory grows almost as rapidly as the 'simulated actual'. Figures 9-11 extend the findings of agricultural historians who downplay the importance of enclosure by showing that it had only a small impact on urbanization, on the real wage—and even on TFP in agriculture. This simulation includes not only the direct effect of enclosure on farm efficiency but also the feedback effect when the impact of rising farm efficiency on city growth, for instance, is taken into account. In this broad framework—as well as in the more narrowly defined study of farming methods—the enclosure movement was peripheral to English development.

The converse of this conclusion needs underlining. The success of English agriculture was a response to the growth of the urban and proto-industrial sectors and to the maintenance of a high wage economy. Farmers responded to these challenges by increasing output and by economizing on labour. The latter was effected by increasing the size of farms and by enclosing land to convert arable to pasture. To the degree that these changes, the hallmarks of the English agricultural revolution, increased productivity, they should be seen as responses to an urbanized, high wage economy rather than as autonomous causes. (Dutch agriculture, it should be noted, developed along similar lines for similar

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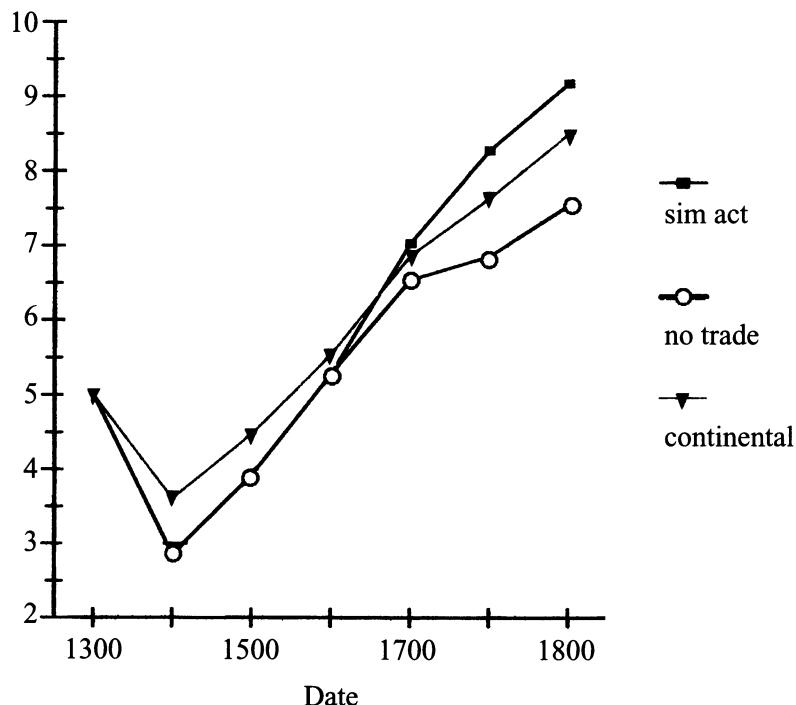


Figure 12. *Simulated population for England, 1300-1800*

Note: The abbreviations are explained in the text

reasons.) In other words, the traditional historiography should be stood on its head.⁵²

Fourth, the rise in productivity underlying the success of the new draperies in the seventeenth century was of great importance for England's success. It provided a strong boost to urbanization, and the growth of rural industry. Through these effects, the success of the new draperies was responsible for a large proportion of the growth in TFP in agriculture as farmers successfully responded to the greater demand for food, wool, and labour. Without seventeenth-century success, wages, agricultural productivity, and city size would all have been lower in 1800.

Fifth, the empire established in the seventeenth and eighteenth centuries also contributed to growth. The greatest impact was on city size. Over half of England's urban expansion is attributed to empire in these simulations.

How are these conclusions affected by demographic considerations? There are two questions to consider. The first is how English population history would have been affected by changes in the development of the economy, and the second is how English history would have differed had England had a continental population regime. Figure 12 summarizes

⁵² This view is not shared by Crafts and Harley, who argue that capitalist agriculture played an important role in explaining the growth of industrial employment in the British industrial revolution: N.F.R. Crafts and C.K. Harley, 'Precocious British industrialization: a general equilibrium perspective' (London School of Economics, Working Papers in Economic History, no. 67/02).

some simulations that highlight the important features. First, the rapid growth of the English economy due to the new draperies and the intercontinental trade boom had an important effect on population growth. This is indicated in figure 12 by the difference between the 'simulated actual' population history and the 'no trade' simulation, which eliminates representative government, enclosure, the new draperies, and the trade boom. Without these growth-stimulating effects, England's population would have been cut from a simulated 9.2 million in 1800 to 7.5 million. This is the expected result in a preventive check population model where population surges in response to economic expansion.

Second, the substitution of a continental demographic regime would not have had much impact on English development. With continental demography, the population would have been insensitive to the real wage and to urbanization, and so would have reached 8.5 million whatever happened to the economy. If all the growth-promoting developments occurred, the population would have remained at 8.5 million rather than rising to 9.2 million, and the real wage in England would have been somewhat higher than it actually was. There would have been very little difference in urbanization, proto-industry, or agricultural productivity. A population regime that was less responsive to economic variables would probably have benefited labour at the expense of landlords and capitalists, but would probably have had little impact on growth. Malthus and Ricardo would not have been surprised.

VI

The simulations show that a simple model captures the factors responsible for success and failure in the early modern economy. The intercontinental trade boom was a key development that propelled north-western Europe forwards. This conclusion has also been advanced by Acemoglu and his co-authors.⁵³ However, this article emphasizes that the ascent of north-western Europe began in the century before the American and Asian trades became important. This emphasis extends the work of historians such as Davis and particularly Rapp, who have noted that the commercial revolution began in the seventeenth century before the Atlantic trades became significant and was an intra-European reorganization in which north-west Europeans outstripped Mediterranean producers in woollen textiles.⁵⁴ On this reading of the evidence, the ascendancy of north-western Europe and the eclipse of Italy predated the rise of the Atlantic economy. The success of north-western Europe was based on a two-step advance—the first within Europe, the second in America and Asia.

This success, it might be noted, marked the first steps out of the Malthusian trap. High wages were sustainable even with pre-industrial fertility so long as the economy grew fast enough. The reason is that the population growth rate was limited to about 2 per cent per year, the

⁵³ Acemoglu et al., 'Rise of Europe'.

⁵⁴ Davis, 'English foreign trade'; Rapp, 'Mediterranean trade hegemony'.

difference between the maximum observed fertility rate (50 per 1,000 or 5 per cent per year) and the mortality rate, which was about 3 per cent per year in the early modern period. If the demand for labour grew faster than 2 per cent annually, wages could rise even without the fertility restraint of twentieth-century Europeans. This favourable conjuncture first occurred in England and the Low Countries in the early modern period when high wages were maintained even as the population expanded at a brisk rate. In the rest of Europe, where population grew less rapidly, wages sagged as the economy stagnated. Rapid economic development, rather than fertility reduction, was the basis of continued high wages.

The simulations reported here have some important lessons for thinking about economic growth. The dominant paradigm in economics sees sustained growth as the result of human capital accumulation and invention. These are promoted by limited government. This view receives little support from the analysis of this article.

The establishment of representative government had a negligible effect on development in early modern Europe. The stress placed on its importance links together the form of the constitution, the security of property, low taxes, and good government. These could come in many combinations, however. In England, for instance, most agricultural producers acquired the secure property that was a precondition for the agricultural revolution when royal courts created copyhold and beneficial leasehold tenures in the late fifteenth and sixteenth centuries.⁵⁵ This was judicial activism by royal officials rather than the action of parliament. Much of England's rise to pre-eminence occurred before the Glorious Revolution of 1688. The English had displaced the Italians in woollen cloth production by then, and the population of London had exploded from 55,000 in 1520 to 475,000 in 1670.⁵⁶ In eighteenth-century France, property was secure enough for the Atlantic ports to boom as a result of their involvement in intercontinental trade. Would representative government have made them grow faster? Perhaps by voting higher taxes, France could have contested mastery of the seas more successfully and expanded its empire rather than losing it. The possible gains are doubtful, however, since the population of France was three or four times that of England (and 10 times greater than that of the Netherlands), so that intercontinental trade would have needed to have been larger by the same proportion to have had the same per caput effect. French development was not held back by high taxes, the inability to enforce commercial contracts, or royal interference with private credit.⁵⁷ Good government was not cheap nor did it require a parliament.

Likewise, literacy was generally unimportant for growth. What the regression coefficients of literacy measure is its marginal value. The national adult literacy rate reached 50 per cent when labourers learned to read. Their ability probably had no economic pay-off, and Reis has argued that they

⁵⁵ Allen, *Enclosure*, pp. 55–77.

⁵⁶ Wrigley, 'Urban growth'.

⁵⁷ Hoffman et al., *Priceless markets*.

learned to read in order to study religious tracts and enjoy pulp fiction rather than as an investment.⁵⁸ The finding of a negligible economic return on the margin is consistent with literacy's having a high value to some merchants and scientists but to few others. This view is consistent with Mitch's argument that schooling had little pay-off during the industrial revolution, and Sandberg's observation that literacy was widespread in backward parts of northern Europe such as Sweden.⁵⁹

These findings, so jarring to modern expectations, gain plausibility in the light of recent research on science and technology.⁶⁰ Mokyr, for instance, has argued that the 'knowledge economy' is a recent phenomenon. Its origins lie in the scientific revolution of the seventeenth century, but it became significant on a broad scale only in the nineteenth. Approaching the matter from a different direction, Goldin and Katz have traced the origins of 'capital-skills complementarity' to the early twentieth century.⁶¹ Mass literacy was irrelevant to economic growth before these developments.

The results of this article are much more akin to the findings of recent work on the British industrial revolution. Crafts and Harley have argued that productivity growth was limited to agriculture and a few leading industrial sectors.⁶² Most growth came from structural transformation including the remarkable release of labour from English farming. The openness of the economy to international trade was important in explaining this outcome. It might be noted that other historians—including Pomeranz, Frank, and Inikori—have also emphasized the importance of the international economy, although their theoretical frameworks are very different.⁶³ These conclusions all have echoes in the themes of this article.

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APPENDIX I: Data

See spreadsheet datafile.xls in table A1.

The variables are:

agland: agricultural land (thousands of hectares)

pop: population (millions)

urbpop: urban population

agpop: agricultural population

⁵⁸ J. Reis, 'Human capital, immaterial goods, and the standard of living in pre-industrial Europe' (paper delivered at a conference on new evidence on the standard of living in pre-industrial Europe and Asia, Arild, Sweden, 2000).

⁵⁹ Mitch, 'Role of human capital'; Sandberg, 'Impoverished sophisticate'.

⁶⁰ Mokyr, *Gifts of Athena*.

⁶¹ Goldin and Katz, 'Technology-skill complementarity'.

⁶² Crafts and Harley, 'Output growth'; Crafts and Harley, 'Simulating the two views'; Crafts and Harley, 'Precocious industrialization' (see above, n. 53).

⁶³ Pomeranz, *Great divergence*; Frank, *ReOrient*; Inikori, *Africans and the industrial revolution*.

protopop: rural, non-agricultural population
 wage: real wage
 agout: index of agricultural output (England in 1500 = 1)
 agtfp: TFP in agriculture (see appendix II)
 spanemp: dummy variable for Spanish empire
 encl: proportion of agricultural land enclosed
 manprod: index of productivity in textile manufacturing
 urbratlg: lagged value of urbanization rate
 literate: proportion of adults who were literate
 eng18: dummy variable for England in eighteenth century
 popgrow: ratio of population to its level a century earlier
 dbd: dummy variable for Black Death in that century
 d30: dummy variable for Thiry Years War in Germany
 popgrowlg: lagged value of population growth
 prince: dummy variable for nonrepresentative government
 imports: real value of imports from Asia and Americas
 exports: real value of exports to Asia and Americas
 trade: imports plus exports

APPENDIX II: Total factor productivity in agriculture

TFP in agriculture was estimated as follows. First, the logarithm of output per agricultural worker was regressed on the logarithm of the land-labour ratio for those 41 observations in which productivity was manifestly low. Excluded were all observations for Belgium, the Netherlands, and for England in 1700, 1750, and 1800. The estimated regression was:

$$\ln p = -3.19 + .29 * \ln tagl$$

$$(-7.82) \quad (5.75)$$

In this equation $\ln p$ is the logarithm of output divided by the agricultural population and $\ln tagl$ is agricultural land divided by the agricultural population. The t -ratios are shown in parentheses. R^2 was .45. This equation was used to predict output per worker for all observations in the sample including those excluded from the estimation. The index of TFP in agriculture is the ratio of actual output per worker to output per worker predicted by the regression equation.

Ideally, capital per worker should also be included as an independent variable in this regression, but data to measure it are not available for all of the countries and time periods. However, when the productivity indices derived here can be compared with indices of TFP based on fuller information, there are no major discrepancies.⁶⁴ That is the warrant for referring to these productivity indices as TFP.

Table A1 begins overleaf.

⁶⁴ e.g. for England as in Allen, 'Tracking'.

Table A1. Datafile

| Country | year | agland | pop | urppop | agppop | protrop | wage | agout | agfp | spanemp | endl | manprod |
|----------------------|------|--------|------|--------|---------|---------|------|----------|----------|---------|------|---------|
| Germany | 1400 | 20879 | 7 | 0.78 | 4.976 | 1.244 | 9.4 | 2.311579 | 1.030026 | 0 | 0.25 | 1 |
| | 1500 | 20879 | 10.5 | 0.86 | 7.712 | 1.928 | 9.5 | 3.08313 | 1.000846 | 0 | 0.25 | 1 |
| | 1600 | 20879 | 12.5 | 1.06 | 8.6944 | 2.7456 | 5.2 | 2.699845 | 0.803655 | 0 | 0.25 | 1 |
| | 1700 | 20879 | 13 | 1 | 8.64 | 3.36 | 3.9 | 2.469117 | 0.738317 | 0 | 0.25 | 1 |
| | 1750 | 20879 | 16 | 1.4 | 10.22 | 4.38 | 3.9 | 3.01759 | 0.799159 | 0 | 0.25 | 1 |
| | 1800 | 20879 | 21.5 | 2.02 | 13.2464 | 6.2336 | 4.1 | 4.716973 | 1.035621 | 0 | 0.25 | 1 |
| Spain | 1400 | 21883 | 6 | 1.58 | 3.536 | 0.884 | 10.1 | 1.933762 | 1.088806 | 0 | 0.2 | 1 |
| | 1500 | 21883 | 7.5 | 1.38 | 4.896 | 1.224 | 10.7 | 2.370132 | 1.054748 | 0 | 0.2 | 1 |
| | 1600 | 21883 | 8.7 | 1.85 | 5.48 | 1.37 | 7.8 | 2.245574 | 0.920317 | 1 | 0.2 | 1 |
| | 1700 | 21883 | 8.6 | 1.75 | 5.4115 | 1.4385 | 9 | 2.552234 | 1.056617 | 1 | 0.2 | 1 |
| | 1750 | 21883 | 9.6 | 2.05 | 5.9645 | 1.5855 | 8.4 | 2.537206 | 0.978935 | 1 | 0.2 | 1 |
| | 1800 | 21883 | 13 | 2.54 | 8.2634 | 2.1966 | 6.3 | 3.110416 | 0.948114 | 1 | 0.2 | 1 |
| France | 1400 | 34567 | 12 | 1.29 | 8.568 | 2.142 | 7.5 | 3.498912 | 0.915337 | 0 | 0.5 | 1 |
| | 1500 | 34567 | 17 | 1.49 | 12.408 | 3.102 | 8.7 | 5.630037 | 1.126998 | 0 | 0.5 | 1 |
| | 1600 | 34567 | 19 | 2.05 | 12.882 | 4.068 | 6.8 | 4.98534 | 0.971236 | 0 | 0.5 | 1 |
| | 1700 | 34567 | 22 | 2.7 | 13.896 | 5.404 | 6.3 | 5.607982 | 1.034302 | 0 | 0.5 | 1 |
| | 1750 | 34567 | 24.5 | 3.11 | 14.973 | 6.417 | 5.4 | 6.475272 | 1.13152 | 0 | 0.5 | 1 |
| | 1800 | 34567 | 28.3 | 3.65 | 16.762 | 7.888 | 5.7 | 7.475945 | 1.204022 | 0 | 0.5 | 1 |
| Italy | 1300 | 20905 | 11 | 2.29 | 6.968 | 1.742 | 6.9 | 2.723976 | 0.951219 | 0 | 0 | 1 |
| | 1400 | 20905 | 8 | 1.93 | 4.856 | 1.214 | 7.75 | 2.344516 | 1.062936 | 0 | 0 | 1 |
| | 1500 | 20905 | 10 | 2.21 | 6.232 | 1.558 | 8.2 | 2.674996 | 1.012625 | 0 | 0 | 1 |
| | 1600 | 20905 | 13.3 | 3 | 8.034 | 2.266 | 7.99 | 3.627469 | 1.142844 | 0 | 0 | 1 |
| | 1700 | 20905 | 13.4 | 3.03 | 7.8812 | 2.4888 | 6.95 | 3.474022 | 1.1098 | 0 | 0 | 1 |
| | 1750 | 20905 | 15.5 | 3.49 | 9.1276 | 2.8824 | 5.1 | 3.445574 | 0.989866 | 0 | 0 | 1 |
| Austria ^a | 1800 | 20905 | 18.5 | 4.06 | 10.6856 | 3.7544 | 3.3 | 3.265904 | 0.83722 | 0 | 0 | 1 |
| | 1400 | 18619 | 5.4 | 0.28 | 4.096 | 1.024 | 13.5 | 2.227734 | 1.179479 | 0 | 0.2 | 1 |
| | 1500 | 18619 | 6.6 | 0.32 | 5.024 | 1.256 | 10.9 | 2.45897 | 1.12364 | 0 | 0.2 | 1 |
| | 1600 | 18619 | 8 | 0.39 | 5.6314 | 1.9786 | 4.2 | 1.767712 | 0.743513 | 0 | 0.2 | 1 |
| | 1700 | 18619 | 9.2 | 0.44 | 5.9568 | 2.8032 | 5.3 | 2.375581 | 0.959423 | 0 | 0.2 | 1 |
| | 1750 | 18619 | 10.7 | 0.78 | 6.5472 | 3.3728 | 6.5 | 3.210348 | 1.210937 | 0 | 0.2 | 1 |
| | 1800 | 18619 | 14 | 1.11 | 7.9918 | 4.8982 | 5.1 | 3.523441 | 1.150638 | 0 | 0.2 | 1 |

Note: ^a Austria includes Hungary and Czechoslovakia

Table A1. Datafile, continued

| Country | year | agland | pop | urbpop | agpop | protopop | wage | agout | agtp | spanemp | encl | manprod |
|-------------|------|--------|----------|----------|----------|----------|------|----------|----------|---------|------|---------|
| Poland | 1400 | 20403 | 2.75 | 0.12 | 2.104 | 0.526 | 9 | 1.148022 | 0.959225 | 0 | 0 | 1 |
| | 1500 | 20403 | 4 | 0.24 | 3.008 | 0.752 | 8.2 | 1.496169 | 0.965448 | 0 | 0 | 1 |
| | 1600 | 20403 | 5 | 0.38 | 3.3726 | 1.2474 | 6.5 | 1.432937 | 0.851068 | 0 | 0 | 1 |
| | 1700 | 20403 | 6 | 0.26 | 3.7884 | 1.9516 | 5.2 | 1.924188 | 1.050931 | 0 | 0 | 1 |
| | 1750 | 20403 | 7 | 0.31 | 4.1478 | 2.5422 | 6.7 | 2.0884 | 1.068279 | 0 | 0 | 1 |
| | 1800 | 20403 | 9 | 0.43 | 5.0563 | 3.5137 | 3.8 | 2.930787 | 1.299189 | 0 | 0 | 1 |
| England | 1300 | 13798 | 5 | 0.22 | 3.824 | 0.956 | 5.9 | 1.651504 | 0.998477 | 0 | 0.45 | 1 |
| | 1400 | 13798 | 2.5 | 0.2 | 1.84 | 0.46 | 7.8 | 0.917306 | 0.941125 | 0 | 0.45 | 1 |
| | 1500 | 13798 | 2.5 | 0.18331 | 1.853352 | 0.463338 | 9.3 | 1 | 1.020617 | 0 | 0.45 | 1 |
| | 1600 | 13798 | 4.408602 | 0.425 | 3.027538 | 0.956065 | 5.5 | 1.22625 | 0.877734 | 0 | 0.47 | 1.35 |
| | 1700 | 13798 | 5.208333 | 0.8841 | 2.853994 | 1.470239 | 6.9 | 1.779346 | 1.329161 | 0 | 0.71 | 1.7 |
| | 1750 | 13798 | 6.041667 | 1.394112 | 2.695577 | 1.95197 | 8.8 | 2.248834 | 1.75067 | 0 | 0.75 | 1.7 |
| Netherlands | 1800 | 13798 | 9.0625 | 2.60838 | 3.22706 | 3.22706 | 7.5 | 2.47054 | 1.688644 | 0 | 0.84 | 1.7 |
| | 1500 | 2306 | 0.95 | 0.28 | 0.536 | 0.134 | 11.4 | 0.312059 | 0.281979 | 0 | 1 | 1 |
| | 1600 | 2306 | 1.5 | 0.52 | 0.7252 | 0.2548 | 9.5 | 0.416902 | 1.376459 | 0 | 1 | 1.35 |
| | 1700 | 2306 | 1.9 | 0.74 | 0.7888 | 0.3712 | 9 | 0.532103 | 1.653221 | 0 | 1 | 1.7 |
| | 1750 | 2306 | 1.9 | 0.69 | 0.7986 | 0.4114 | 9.9 | 0.642213 | 1.977598 | 0 | 1 | 1.7 |
| | 1800 | 2306 | 2.14 | 0.73 | 0.8742 | 0.5358 | 8 | 0.682051 | 1.967334 | 0 | 1 | 1.7 |
| Belgium | 1400 | 1718 | 1 | 0.39 | 0.5795 | 0.0305 | 12.1 | 0.456203 | 1.921865 | 0 | 0.5 | 1 |
| | 1500 | 1718 | 1.25 | 0.35 | 0.72 | 0.18 | 11.7 | 0.540278 | 1.945474 | 0 | 0.5 | 1 |
| | 1600 | 1718 | 1.5 | 0.44 | 0.7844 | 0.2756 | 11.6 | 0.53405 | 1.807561 | 0 | 0.5 | 1.35 |
| | 1700 | 1718 | 1.7 | 0.52 | 0.8024 | 0.3776 | 9.2 | 0.520204 | 1.732055 | 0 | 0.5 | 1.7 |
| | 1750 | 1718 | 2.3 | 0.51 | 1.1814 | 0.6086 | 10.4 | 0.78136 | 1.966903 | 0 | 0.5 | 1.7 |
| | 1800 | 1718 | 3 | 0.65 | 1.457 | 0.893 | 8 | 0.878779 | 1.887879 | 0 | 0.5 | 1.7 |

Table A1. Datafile, continued

| Country | year | <i>urbanitg</i> | <i>literate</i> | <i>eng18</i> | <i>popgrow</i> | <i>dbd</i> | <i>d30</i> | <i>popgrowlg</i> | <i>prince</i> | <i>imports</i> | <i>exports</i> | <i>trade</i> |
|----------------------|------|-----------------|-----------------|--------------|----------------|------------|------------|------------------|---------------|----------------|----------------|--------------|
| Germany | 1400 | 0.1 | 0.06 | 0 | 1.5 | 0 | 0 | 1.5 | 1 | 0 | 0 | 0 |
| | 1500 | 0.1111429 | 0.06 | 0 | 1.190476 | 1 | 0 | 1.190476 | 1 | 0 | 0 | 0 |
| | 1600 | 0.081905 | 0.12 | 0 | 1.190476 | 1 | 0 | 1.04 | 1 | 0 | 0 | 0 |
| | 1700 | 0.0848 | 0.19 | 0 | 1.04 | 0 | 0 | 1.538462 | 1 | 0 | 0 | 0 |
| | 1750 | 0.080766 | 0.27 | 0 | 1.538462 | 0 | 0 | 1.34375 | 1 | 0 | 0 | 0 |
| | 1800 | 0.0875 | 0.35 | 0 | 1.34375 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Spain | 1400 | 0.25 | 0.09 | 0 | 0 | 1.25 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1500 | 0.263333 | 0.09 | 0 | 1.25 | 0 | 0 | 1.16 | 1 | 0 | 0 | 0 |
| | 1600 | 0.184 | 0.4 | 0 | 1.16 | 0 | 0 | 0.988506 | 1 | 191.3043 | 0 | 191.3043 |
| | 1700 | 0.212644 | 0.2 | 0 | 0.988506 | 0 | 0 | 1.060465 | 1 | 89.79592 | 12.6 | 102.3959 |
| | 1750 | 0.208016 | 0.2 | 0 | 1.060465 | 0 | 0 | 1.354167 | 1 | 141.9555 | 41.85417 | 183.7897 |
| | 1800 | 0.213542 | 0.2 | 0 | 1.354167 | 0 | 0 | 1 | 161.9632 | 137.9737 | 299.9369 | 299.9369 |
| France | 1400 | 0.09 | 0.07 | 0 | 0 | 0 | 0 | 1.416667 | 0 | 0 | 0 | 0 |
| | 1500 | 0.1075 | 0.07 | 0 | 1.416667 | 0 | 0 | 1.117647 | 0 | 0 | 0 | 0 |
| | 1600 | 0.087647 | 0.14 | 0 | 1.117647 | 0 | 0 | 1.157895 | 0 | 0 | 0 | 0 |
| | 1700 | 0.107895 | 0.21 | 0 | 1.157895 | 0 | 0 | 1.057955 | 1 | 983 | 517.44 | 1500.44 |
| | 1750 | 0.1115072 | 0.29 | 0 | 1.057955 | 0 | 0 | 1.155102 | 1 | 3370.506 | 1897.933 | 5268.439 |
| | 1800 | 0.126939 | 0.37 | 0 | 1.155102 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Italy | 1300 | 0.22 | 0.1 | 0 | 0 | 0 | 0 | 0.727273 | 0 | 0 | 0 | 0 |
| | 1400 | 0.208182 | 0.1 | 0 | 0 | 0 | 0 | 1.25 | 1 | 0 | 0 | 0 |
| | 1500 | 0.24125 | 0.09 | 0 | 0.727273 | 0 | 0 | 1.33 | 1 | 0 | 0 | 0 |
| | 1600 | 0.221 | 0.14 | 0 | 1.25 | 0 | 0 | 1.007519 | 1 | 0 | 0 | 0 |
| | 1700 | 0.225564 | 0.18 | 0 | 1.007519 | 0 | 0 | 1.361445 | 1 | 0 | 0 | 0 |
| | 1750 | 0.225841 | 0.2 | 0 | 1.361445 | 0 | 0 | 1.193548 | 1 | 0 | 0 | 0 |
| | 1800 | 0.225161 | 0.22 | 0 | 1.193548 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Austria ^a | 1400 | 0.05 | 0.06 | 0 | 0 | 0 | 0 | 1.222222 | 0 | 0 | 0 | 0 |
| | 1500 | 0.051852 | 0.06 | 0 | 1.222222 | 0 | 0 | 1.212121 | 0 | 0 | 0 | 0 |
| | 1600 | 0.048485 | 0.11 | 0 | 1.212121 | 0 | 0 | 1.15 | 1 | 0 | 0 | 0 |
| | 1700 | 0.04875 | 0.16 | 0 | 1.15 | 0 | 0 | 1.304878 | 1 | 0 | 0 | 0 |
| | 1750 | 0.048286 | 0.19 | 0 | 1.304878 | 0 | 0 | 1.308411 | 1 | 0 | 0 | 0 |
| | 1800 | 0.072897 | 0.21 | 0 | 1.308411 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

Note: ^a Austria includes Hungary and Czechoslovakia

Table A1. Datafile, continued

| Country | year | <i>arbitrag</i> | <i>literate</i> | <i>eng18</i> | <i>popgrow</i> | <i>dbd</i> | <i>d30</i> | <i>popgrowlg</i> | <i>prince</i> | <i>imports</i> | <i>exports</i> | <i>trade</i> |
|-------------|------|-----------------|-----------------|--------------|----------------|------------|------------|------------------|---------------|----------------|----------------|--------------|
| Poland | 1400 | 0.04 | 0.06 | 0 | 1.454545 | 0 | 0 | 1.454545 | 0 | 0 | 0 | 0 |
| | 1500 | 0.043636 | 0.06 | 0 | 1.454545 | 0 | 0 | 1.25 | 0 | 0 | 0 | 0 |
| | 1600 | 0.06 | 0.11 | 0 | 1.25 | 0 | 0 | 1.2 | 0 | 0 | 0 | 0 |
| | 1700 | 0.076 | 0.16 | 0 | 1.2 | 0 | 0 | 1.088889 | 0 | 0 | 0 | 0 |
| | 1750 | 0.057388 | 0.19 | 0 | 1.088889 | 0 | 0 | 1.285714 | 0 | 0 | 0 | 0 |
| | 1800 | 0.044286 | 0.21 | 0 | 1.285714 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| England | 1300 | 0.04 | 0.06 | 0 | 0.5 | 1 | 0 | 0.5 | 1 | 0 | 0 | 0 |
| | 1400 | 0.044 | 0.06 | 0 | 0.5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | 1500 | 0.08 | 0.06 | 0 | 1 | 0 | 0 | 1.763441 | 1 | 0 | 0 | 0 |
| | 1600 | 0.073324 | 0.19 | 0 | 1.763441 | 0 | 0 | 1.181402 | 1 | 0 | 0 | 0 |
| | 1700 | 0.096402 | 0.35 | 1 | 1.181402 | 0 | 0 | 1.118571 | 0 | 1956 | 656 | 2612 |
| | 1750 | 0.127922 | 0.48 | 1 | 1.118571 | 0 | 0 | 1.5 | 0 | 3512 | 2094 | 5606 |
| | 1800 | 0.230751 | 0.53 | 1 | 1.5 | 0 | 0 | 1.2520 | 0 | 12188 | 24708 | 24708 |
| | 1500 | 0.28 | 0.1 | 0 | 0 | 0 | 0 | 1.578947 | 0 | 0 | 0 | 0 |
| | 1600 | 0.294737 | 0.4 | 0 | 1.578947 | 0 | 0 | 1.266667 | 0 | 0 | 0 | 0 |
| | 1700 | 0.346667 | 0.53 | 0 | 1.266667 | 0 | 0 | 1 | 0 | 1928.542 | 204.82 | 2133.362 |
| Netherlands | 1750 | 0.367447 | 0.6 | 0 | 1 | 0 | 0 | 1.126316 | 0 | 2144.195 | 256.1754 | 2400.371 |
| | 1800 | 0.363158 | 0.68 | 0 | 1.126316 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1400 | 0.39 | 0.12 | 0 | 0 | 0 | 0 | 1.25 | 1 | 0 | 0 | 0 |
| | 1500 | 0.39 | 0.1 | 0 | 1.25 | 0 | 0 | 1.2 | 1 | 0 | 0 | 0 |
| | 1600 | 0.28 | 0.23 | 0 | 1.2 | 0 | 0 | 1.133333 | 1 | 0 | 0 | 0 |
| | 1700 | 0.293333 | 0.36 | 0 | 1.133333 | 0 | 0 | 1.352941 | 1 | 0 | 0 | 0 |
| Belgium | 1750 | 0.299542 | 0.43 | 0 | 1.352941 | 0 | 0 | 1.304348 | 1 | 0 | 0 | 0 |
| | 1800 | 0.221739 | 0.49 | 0 | 1.304348 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

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