"Relative Prices as Clues to Global Divergence, 1500-1870"

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ABSTRACT

It is time for the historical comparison of relative wages and prices to move beyond labor, grain, and silver into other sectors of the economy.

New data from a long-term project suggest that Northwest Europe had distinctive patterns of relative prices since the sixteenth century or earlier. In addition to being a region of high wages and rents, and cheap silver, Northwest Europe was also a region with the world's most expensive staple food grains vis-à-vis some of the world's cheapest non-food industrial goods. The inter-continental differences in the ability of ordinary workers to buy food grains were not so great, but the ability to buy and use four groups of non-staples -- certain luxury goods, certain capital goods, schooling, and certain military goods -- was much greater in Northwest Europe.

Any popular intuition about the sources of Northwest Europe's growth advantage would, if correct, leave certain relative-price fingerprints. Some intuitions receive more support from price history than others. The evidence casts doubt on the importance of agricultural revolution in that part of the world. It also raises questions about hypotheses emphasizing the role of population and labor supply. It tends to support hypotheses emphasizing productivity shocks in the Industrial Revolution core sectors.

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A SIMPLE BUT USEFUL METHOD

To extract as much information as possible from an imperfectly documented past, economic historians must strive to use all of the main kinds of information available to them. These come in four types:

(1) randomized natural experiments, the econometric "gold standard" of causal identification;

(2) econometric estimates on panel or cross-sectional econometric samples where the models fail to pass tests of instrument exogeneity and power;

(3) non-econometric quantitative comparisons; and

(4) non-quantitative historical data.

Each of the four kinds of evidence has a contribution to make, because each trades weaknesses for strengths. Their scientific reliability in identifying causality runs in the order shown here, from (1) to (4). Yet the empirical breadth and suggestive power of their respective databases run in the opposite order. The price of achieving the highest scientific standard, that of randomized natural experiments, is its narrowness, both in the counterfactual question answered and in the historical context covered. While the supply of randomized experiments will grow, it will always be a small share of history. To avoid discarding most of the human record, we must supplement the best narrow tests with use of shakier testing of larger ranges of experience. This paper emphasizes the third technique, namely non-econometric quantitative comparisons, for illuminating the sources of differences in real incomes.

A simple non-econometric quantitative method can help us decide whether, or why, Northwest Europe was far ahead of other regions in the height of the Industrial Revolution Era, between about 1795 and about 1820. The vast debate over these issues involves assertions about differences over both time and space. Over time, to what extent and why was the Northwest Europe of the Industrial Revolution Era more productive of incomes than the same region in earlier centuries? Over space, how much did the incomes of Northwest Europe exceed those of other regions, and why? To amass as much circumstantial evidence as possible, we should go beyond just guesstimating the relative incomes from such indirect clues as real wages, tax returns, urban population shares, and health indicators. We should also subject each

competing theory to tests of its side-predictions about economic outcomes other than just the levels of incomes themselves.

Fortunately, several kinds of quantitative evidence are now accumulating rapidly. The kind emphasized in this paper is the testimony of differences in relative prices of between output sectors and between factors of production. Thanks to recent efforts to convert price measures from different regions and centuries into common metric and monetary units, we can now test each theory's ability to explain both spatial and temporal differences. These relative-price fingerprints help us to identify those sources of growth that have made one historical experience differ from another. Hundreds of such historical price series from around the world are now downloadable as spreadsheet files.[1]

This paper is hardly the first to emphasis the usefulness of extending relative-price clues beyond the real wage rate. Indeed, it is part of a current team effort, including the Global Price and Income History Group and the International Institute for Social History (IISG), in which the leading interpretive uses of relative prices are those of other team members. For example, Robert Allen has used the ratios of capital user costs, fuel costs, wages, and other input prices to help explain Britain's classic technological breakthroughs.[2] Jan Luiten van Zanden has emphasized the skilled-wage premium and the real price of books as clues to the higher incomes of Northwest Europe since the late fourteenth century.[3] Philip Hoffman has used the plummeting price of Western armaments relative to the prices of inputs into military production to help explain the emergence of Western military superiority.[4] Gregory Clark has used the ratios of input prices to output prices to reveal the relative rates of productivity increase in different sectors.[5]

Long before this current team effort, William Beveridge, a pioneer in the Carnegie-funded International Price Commission of the 1930s-1950s, tried to coax scholars away from the cost-of-living index alone, and toward a deeper range of relative prices by pointing out a *fifty-fold* shift in a steel/wheat price ratio:

> In the study of modern prices, determination of the 'general level' of prices and its movements has bulked largely, perhaps at times too largely.... In the present work the emphasis is different. Price[s] for single commodities, rather than index-numbers for commodities in combination, are the main objective....

> At Hinderclay in Suffolk, before the Black Death, wheat was being sold at prices varying with the harvest but ranging about 5s. a quarter; steel was being bought for ploughshares and other implements, at prices ... ranging about 6 d. a lb., that is to say at £50 and upwards per ton. To-day a normal price for wheat is about 50s. a quarter, and for steel is about £10 a ton. While the price of wheat has multiplied ten times, that of steel has fallen to a fifth, and a quarter of wheat will buy fifty times as much steel as it once did. The contrast between the wheat age and the steel age could hardly have been better illustrated.[6]

What Beveridge sought to illustrate with a dramatic change over time should also be applied to geographic differences in relative prices at a point in time, if we are to understand global divergence.

The underlying global fact is that growth never occurs evenly in all sectors and for all kinds of factor incomes. The real-world sources of growth typically arise in individual sectors or individual factor markets, causing conspicuous changes in relative prices. We should abandon accounting exercises that treat the entire economy as a single sector producing an all-purpose good called GDP.

This essay exploits history's imbalances in sectoral change and factor supply growth to educate our choice between competing interpretations about the sources of growth in Northwest Europe, particularly in England-Wales and Holland. We begin with an abstract sketch of a simple method for comparing different interpretations' implied predictions about relative prices, by using the observed ratios in those prices across time and space. To force each interpretation to pass all the easily available tests, let us contrast Northwest Europe with many other places in the late eighteenth century and the early nineteenth, and with its own experience in earlier centuries. To choose other places for contrasts, let us follow the recent "great divergence" literature to some extent, contrasting early modern Northwestern Europe with places in India, China, and Japan. We shall also contrast Northwest Europe with Poland-Russia and Mediterranean Europe.

Three key limitations of the power of the relative-price tests need to be previewed here. First, such fingerprinting cannot yield a proper quantitative accounting that measures the contributions of multiple sources of growth. We simply lack the data necessary to achieve such statistical identification.[7] Rather, the present method can only offer *qualitative* suggestions, based on whether each theorized force, *taken alone*, predicts the *right directions* of changes in relative prices. Second, some of the "data" estimates are young enough to allow a skeptic to

argue against the data rather than against the theory. Any apparent contradictions between a theory and the data might be the fault of the data, and any apparent support from the data might result from errors shared by theory and data. Such pessimism may seem strained, but it cannot be ruled out definitively. Finally, future work must incorporate a type of scarcity evidence not presented here, namely evidence that a particular product was not even available in a particular region and time. The testimony of non-existence will speak more loudly of scarcity than a recorded high price, although this paper does not develop such supplementary evidence.

A mixture of history, common sense, undergraduate economics, and general-equilibrium reasoning yields the price implications of this paper. The general-equilibrium reasoning introduces ideas that are not obvious, but they make sense when presented. Since different sectors of the economy use inputs in very different proportions, any shift in output can have magnified effects on the demand for different inputs. Agriculture is relatively land-intensive; manufactures make intensive use of capital, skills, and sometimes fuel; and different service sectors emphasize either common labor or skills. On the product demand side, a key reality is Engel's Law and its curvature: A rise in incomes per person shifts demand away from staple foods, with their income elasticity dropping from a high fraction down to zero for the upper-class ranges in the nineteenth century.[8]

Such simple tools help us fashion the predictions in Table 1, where the first panel (Part I) presents the implications of some standard building blocks, and the second (Part II) translates leading hypotheses about the early modern era and the Industrial Revolution era into their combined price implications. The organizing device here is to imagine a contrast between a Context A, which has a higher income per capita, and a lower-income Context B that is at least hundreds of kilometers and/or at least a quarter century from A – an historical difference that is sufficient for exogenous forces to have more than a spurious or transitory effect.

A cast of familiar candidates for explaining the differences between contexts appears in the more abstract Part I. Most are supply-side forces that have been noted by historians and economists as intermediate variables, even though their scholarly interpretations start from deeper causes. Places differ, and times differ, in their supplies of inputs such as land, labor, skills, capital, and materials purchased from other places. They also differ in their sector-specific productivities and the input-saving biases of their technology. As the first panel of Table 1 reminds us, the supply of an input or output should lower its relative price and the price

of substitutes, yet raise the price of any complements. Demand shifts should have the opposite price effects.

Deeper causes must underlie these generic proximate sources of growth, of course. Ultimately we seek to choose between such deeper causes as institutions, geography, culture, diseases, and war. To plumb these depths efficiently, let us first apply relative-price evidence to several popular hypotheses about exogenous forces that shaped those proximate growth influences, taking these hypotheses in the order in which they appear in the second half of Table 1.

FINGERPRINTING SOME POPULAR INTERPRETATIONS

A. The Agricultural Revolution

A long historiography has argued that Northwest Europe's industrialization owed much to institutional changes and technological improvements in agriculture. Clearer property rights and improved techniques of cultivation and of animal husbandry are believed to have supplied more food, and perhaps more labor. Some of the improvements seem to have offered farm families a fuller year of employment,[9] while other improvements may have released more labor and capital to the rising towns and industries. As Tony Wrigley and others have rightly emphasized, urbanization itself is an indicator that the countryside and/or food imports must have been able to feed a greater population of non-agricultural producers.[10] Other scholars, however, have questioned the extent to which agricultural productivity in Northwest Europe rose rapidly enough, and exogenously enough, to justify belief in an Agricultural Revolution.[11]

The relative-price evidence reinforces skepticism about the contribution of high or rising agricultural productivity to the relative prosperity of Northwest Europe in the late eighteenth century and the early nineteenth. Over the sixteenth-eighteenth centuries, domestic agricultural prices throughout Northwest Europe rose relative to most other final-product prices, including the prices of imported tropical foods, luxury manufactures, fuels, capital goods, paper, and books. Agricultural product prices also rose relative to the prices of non-land inputs, especially labor and capital, suggesting that agricultural productivity was not a dominant exogenous shift in the growth process.[12]

The global contrasts in relative prices for the sixteenth through eighteenth centuries also fail to reveal food abundance in Northwest Europe. On the contrary, that corner of the world stands out as having a distinctive food scarcity. This fact warns that the relative prosperity of different regions should not be judged by comparing their grain wages, i.e. the ability of a day of labor to buy food. As others have noted, using the grain wage as a prosperity proxy makes Poland, Russia, the North American colonies, or even the Yangzi delta region look nearly as prosperous as England or the Netherlands.[13] Table 2 reinforces this impression with its comparisons of wheat (and rice) prices with the wage rate of common labor. If there is a systematic difference between regions in workers' purchasing power, it does not show up so clearly in their ability to buy grain.

The recent debate over the Great Divergence in Eurasia contains further clues about Europe's lack of productivity advantage in agriculture. Scholars have added direct productivity comparisons suggesting that parts of China and India had nearly the same average rural incomes and productivity as Northwest Europe as late as the eighteenth century. Note that the measures showing parity or near-parity for India or the Yangzi Delta emphasize the ability of ordinary folk to buy *staple grains* and, to a lesser extent, their ability to buy cloth.[14] Had the contrasts focused more on the ability to buy durable goods, they would have shown a greater relative ability of those in Northwest Europe to buy non-foods, as will be suggested in Tables 3-6 below. In terms of real wages, the Eurasian Great Divergence had already occurred before the middle of the eighteenth century in terms of the ability to buy non-foods such as wood, fuel, books, paper, and metal goods – even though the Yangzi Delta, in particular, could provide its working families with as much grain and cloth.[15]

B. Better Health and Nutrition

A second intuition linking food and people to the prosperity of Northwestern Europe believes that somehow this region developed health advantages, perhaps with the help of better nutrition, and these advantages allowed them to work more productively.[16] On this issue the evidence is mixed, though further relative-price tests might help in the future.

One premise of the emphasis on better health is certainly valid: Northwest Europeans lived longer by the end of the eighteenth century than in earlier centuries, and lived longer than the populations of other regions.[17] So is another: As we shall see in connection with the next

popular hypothesis, English hours per worker did rise somewhat between the mid-seventeenth century and the early nineteenth, suggesting a desire and ability to work more for pay. The relative-price evidence is more mixed, however. As stated in Table 1 above, the better health and extra labor should have depressed wage rates per hour or per day. This prediction is reinforced by Engel's Law, which should have translated extra income and expenditure into a shift in demand away from food. Price movements do not deliver any ironclad refutation of the hypothesis that better health raised work and incomes, but the rising relative scarcity of staple food raises questions about underlying mechanisms.

C. The Industrious Revolution

Another strong contender for explaining the extra productivity of Northwest Europe in the run-up to industrialization is Jan de Vries's influential Industrious Revolution hypothesis. Focusing on the Netherlands and England between about 1650 and 1800, De Vries has argued that households developed stronger tastes for New Luxuries and traded away free time to work longer hours at specialized and repetitive labor for the extra pay needed to buy those luxuries. The extra work triggered Adam Smith's two famous interdependent developments, the division of labor and the extent of the market.[18]

Two premises of this view appear to be correct. Conspicuously, Western Europeans raised their demand for a whole range of new luxury (highly income elastic) products. Some, such furniture and timepieces and art objects, were durables produced in the region itself and showed up in probate inventories at death. Others were non-durables shipped in from eastern and western tropics, such as tea, coffee, chocolate, sugar, and tobacco. There is also evidence in favor of the other key premise, namely that households worked longer hours, exchanging more of their time for the means to buy those extra goods. An ingenious use of court testimony allowed Joachim Voth to estimate that the working-age English added annual work hours by perhaps 18 percent between 1750 and 1830. Alternative measures by Clark and Van der Werf yield smaller increases, but the "working hypothesis", so to speak, is still that the English somehow managed to work more.[19]

Yet further exploration of this theme must first decompose the Industrious Revolution into its social parts and then use price data to illuminate its causal antecedents and its consequences. Two questions immediately arise: (1) Who were buying which new luxuries,

and were they the same social groups that supplied the extra labor? And (2) in what sense was their new consumption and labor supply an exogenous event?

Real purchasing power was becoming more unequal from the sixteenth century to the end of the eighteenth in the three leading countries of Northwest Europe, with wages rising moderately over the period as a whole.[20] Middle-class families could indeed afford to shift toward the consumption of new luxuries. If their extra consumption was the result of rising rents and profits, e.g. in response to population growth, we should expect to see rising prices of luxuries. That did happen in the case of cinnamon and beef, but time series are lacking on any other luxury commodities that rose as fast as the price of wheat or bread. Working-class families' main luxuries were, aside from shifting to higher qualities of a wide range of goods, those newly introduced imports of sugar and tea. Given that the most visible New Luxuries for the working classes were falling in relative price, we should be prepared for the possibility that the new consumer behavior was an endogenous response to new supplies, and not a separate exogenous event. Finally, the combination of greater labor supply and moderately increasing real wages suggests that the new labor supply did not dominate labor markets enough to depress wages in a "revolutionary" way. It is still not clear that the income growth and wage movements of the eighteenth century and early nineteenth owe much to a new Industrious Revolution.

D. Energy and the Great Divergence

Unlike the first three popular hypotheses, the cheap energy view is unambiguously supported by recent relative-price data regarding the contrasts between Europe and Asia. Kenneth Pomeranz's view that Northwest Europe benefitted from cheaper energy supplies seems vindicated. Table 3 shows that fuel was cheaper in Northwest Europe, especially in Britain, from the sixteenth century to the nineteenth.

While this advantage persisted over those centuries, its importance rose dramatically, even without major discoveries of new coal deposits and without any great efficiency gains in coal mining. The importance of a static coal-based price advantage grew dramatically for reasons external to the coal sector. The competing wood-based fuels soared in real cost by the late seventeenth century. Transport costs from the pitheads to London dropped later, as did taxes on coal. Several energy-using sectors also achieved key breakthroughs, famously allowing

them to switch to coal. The redesign of houses and fireplaces allowed more domestic coal use; the iron industry developed coal- and coke-using techniques; and steam engines also raised demand. As a result, coal became increasingly crucial to Britain's productivity advantage over other regions, even though any cost-cutting improvements were offset by the rise of demand and seam depletion.[21] The ability of the Netherlands and France to share in these lower energy costs was dictated in large part by low transport costs.

E. Industrial Revolution

Relative prices can also help to develop the often-told tales about why and when the famous "wave of gadgets" swept through Northwest Europe, especially Britain. It is in the industrial sphere that the price drops over these centuries, and the price differences between Northwest Europe and other regions, seem most dramatic, as Beveridge had already noted in that comparison of steel and wheat. These great differences are often hard to quantify, because of the extreme heterogeneity of modern industrial goods, such as clothing, ships, guns, and buildings. Yet in a few cases, industrial goods were sufficiently similar over time and space to allow real-price comparisons.

Tables 4 through 6 bravely show the relative (wheat) prices of basic cloth, medium-sized nails, and reams of writing paper. For these three products, at least, Northwest Europe enjoyed increasingly cheap industrial goods. Table 4 hints at a considerable cheapening of cloth relative to wheat even before the revolutionary breakthroughs in cotton textiles. In the case of paper (Table 5), even though China led in its early invention, after 1500 it was in France and Spain that writing paper was most affordable.[22] Our fragmentary returns suggest that the affluent and literate had to pay much more for writing paper in Eastern Europe, India, China, and the Americas. Table 6 suggests that nails were also cheapest in Atlantic Europe -- at first in Spain and then, after 1600, in England and Sweden. They were more expensive elsewhere. Russia remained an area of high nail prices until the nineteenth century, because poor transport and other institution barriers held up its eventual comparative advantage in iron products. The same plunging of Northwest European prices for modern industrial goods has been shown for other goods by other authors. Dutch and English books plunged in real price after the development of the printing press in the fifteenth century. Armaments dropped in price even faster than the metals that went into their manufacture.[23] Such dramatic price declines for industrial goods,

relative to the prices of their inputs, are one way of revealing the advance of total factor productivity.

A related use of relative-price history, already exploited by a number of authors, is the contrast of relative inputs prices across historical settings to suggest why a particular technique or innovation was more profitable in one setting than in another. Most recently, Robert Allen has used the historic differences in a wage/capital-cost ratio to explain why the spinning jenny was adopted in Britain rather than in France or India. Doing so serves to reinforce the argument that technological improvements are made endogenously, in response to relative input prices. This does not dismiss the alternative emphasis, e.g. in Joel Mokyr's writings, that much of the application of useful knowledge awaits the appearance of a great mind that sees the opportunity.[24] One would hardly expect a highly productive innovation to be applied in a setting where it raised costs by shifting heavily toward relatively expensive inputs. The two approaches -- Allen E.1 and Mokyr's E.2, in the short-hand of Table 1 above – are almost observationally equivalent, and both seem correct in their focus on the interplay of enlightenment and relative prices in the fastest-innovating sectors.

EMERGING RELATIVE-PRICE PATTERNS

The new global history of relative prices is still just opening up, helped by metrologists' conversion of historical units of measurement into common metric units, and by the continued rise of electronic media for data gathering and processing. Even this early in the enterprise, one can see rough patterns in the stories that relative prices have to tell about the 1500-1870 era. These patterns are:

(1) World differences in output and consumption per capita were dominated by supply-side forces, especially those in a few industrial sectors. Differences in final-product demand show less exogeneity.

(2) The global outlier, with the most distinctive relative-price pattern was Northwest Europe, a fact inviting us to explore just *when* that distinctiveness emerged.

The first pattern is that the comparison of relative prices seems to underline the importance of supply-side differences in industrial sectors. The clearest new evidence comes from these sectors, not from differences in agriculture or from the price implications of labor supply. Among the cases studied so far, relative prices differed most globally, and were most dynamic, in relatively narrow new Industrial-Revolution sectors like energy, paper, metals, and armaments.

The supply-side theme may be even broader than just its embodiment in the price effects of Industrial Revolution. Beyond this, it seems harder to find geographic differences in apparent consumption and output that reflect output-*demand* differences. As historians we are conditioned to insist that different cultures had different tastes, and that these must have had profound impacts on their entire regional economies. Can we document this natural suspicion? It might be difficult, since the clearest cases of large differences in product demand are ones in which the quantities consumed were negatively correlated with relative price, suggesting a dominance of supply-side differences. The best-known case of huge inter-regional consumption differences is that rice was, and is, much more heavily consumed in Asia, in contrast to Europe's staples based on wheat, rye, barley, and oats. Before we imagine that this was an exogenous difference in tastes, however, we must confront the fact that rice consumption is so *negatively* correlated with its price relative to the drier-field grains. Appendix A develops this contrast, showing that the relative price was lower in Asia, and in a few Western localities where rice could be supplied (e.g. Italy and some of North America's Atlantic colonies). By contrast, rice was most expensive where it was most a luxury and a rarity, as in Russia. It may be that regions shared similar basic preferences, but adapted to clear differences in supply.

The other pattern is that the locus of the most striking global contrasts was between Northwest Europe and the other regions. Northwest Europe tended to have a distinctive pattern of relative prices, with some things dearer there than in most regions and other things cheaper there. The prices in Northwest Europe relative to any other place tended to be greatest for land and housing, next greatest for unskilled labor, followed by skilled labor, staple foods, then by luxury and capital goods, and least for interest rates and the user cost of capital. To express this heuristic idea in shorthand,

The likely ranking of the **(Northwest Europe / other place) price ratios**

in terms of any accounting unit looks like this for anytime from the middle of the sixteenth century to the middle of the nineteenth:

purchase prices of housing and land
> rents on housing land
> wages for unskilled labor
> wages for skilled labor
≥ staple food prices
> prices of luxury goods and capital goods
> interest rates and the user cost of capital.

Starting at the top of this ranking, the rents and especially the purchase prices of housing and land were probably the types of prices that were highest in Northwest Europe. This is not easy to document, since real estate is so heterogeneous and so dependent on location factors. Rather its clearest evidence is historical rather than geographic, as we shall see shortly.

The clearest geographic contrast between Northwest Europe and other regions lies at the very bottom of the heuristic price ranking: This region clearly had the greatest supply of lendable funds per capita and the lowest interest rates from the sixteenth century on, as other authors have pointed out.[25] Future work can supplement these indicators of the supply of lending and capital services with other indicators, such as the income velocity of money, that suggest the tightness of credit where interest-data are lacking.

In the middle of this heuristic price ranking, this paper has sought to re-shape scholarly thinking about wages and prices. Past writings have emphasized the high grain wages achieved by England and the Netherlands from the seventeenth century on, yet the global divergence debate has challenged this – and with good reason, as we noted in connection with the grain wages in Table 2. While it is probable that an English or Dutch craftsman in the building trades could buy staple food grains more easily than his counterpart in the Lower Yangzi or Japan, this contrast is not really so clear.[26] Instead, I have argued, we need to stress the divergence across

the lower gap of this ranking: Northwest Europe stood out much more in the cheapness of its luxuries and capital goods (and capital services), relative to the price of staples.

What are the unifying sources of this pattern in the overall price-ratio rankings? It may result from a combination of economic development and density or age of settlement. Economic development, and the property institutions that have accompanied it, would raise site rents enormously and make lending and capital extremely cheap. It also tends to reduce skill premia, as Jan Luiten van Zanden has emphasized, so that "wages for unskilled labor > wages for skilled labor", in the shorthand used here.[27] Eventually, with the help of a fuller historical geography of relative prices, the development and density patterns can be tested and applied to settings outside the data set.

The next immediate step toward firming up the present interpretations is to turn our gaze from global geography to historical movements: *When* did Northwest Europe acquire this distinctive price pattern? Was it introduced around 1500 by the Vasco de Gama era of explorations? Or by some differential impact of the Black Death around 1350? Or did it arise even earlier? Pursuing the movements over time offers us more tests of the hypotheses already slightly tested above.

Fortunately, a rich supply of clues has built up in these decades since the International Price History Commission began its work. Philip Hoffman and co-authors have already summarized evidence showing the emergence of some of these price patterns after the sixteenth century.[28] Ideally, one would like to examine triple ratios: what happened to an inter-commodity price ratio such as (other good / wheat), between regions (Northwest Europe / another place) over time (later date / earlier date)? While Tables 2-6 offer some clues in a few cases, we gain a clearer initial overview by looking at a particularly clear set of related movements, namely those for England alone, as summarized in several works and data sets by Gregory Clark. Later research needs to look at some of the more dramatic movements in English relative prices and explore which other places had similar movements.

Over the five hundred years from Bruce Campbell's benchmark year of 1290 to 1790, on the eve of war and Malthus's *Essay*, England underwent the relative-price transformations summarized in Table 7 and in Figures 1 and 2. To interpret the results, we should first ask of each series: Did its rise or fall between 1290 and 1790 match what the heuristic ranking would have led us to expect, if the English economy became more "developed"? The answer seems to

be affirmative for housing and farmland rents, near the top of our chain of relative-price inequalities. Since 1390, i.e. since the aftermath of the Black Death, housing and land rents at least doubled relative to the price of wheat. That is, the economic development and population growth over these four hundred years did push English rents up toward what might have been the world's highest level. Real rents also rose dramatically after 1600 in Northern France and in Holland.[29] So for rents, Northwest Europe's high levels of real rents around 1790 arose sometime after the explorations of Vasco de Gama and Columbus, though presumably not because of them.

For fuels, Figure 1 and Table 1 suggest that the fuel supply advantage of England during the Industrial Revolution did have analogues in earlier centuries, but with significant movements across the early modern era. The price paths for firewood and coal confirm two famous century-long movements: Both fuels became more expensive across the seventeenth century (here 1590-1690) as the supply of forests dwindled, yet both dropped across the eighteenth century (1690-1790), thanks to the already-mentioned improvements in transport. As for the era before 1590, the trends were mixed, suggesting that whatever fuel advantage Britain had by 1590 might have persisted over earlier centuries.

The long view from England also confirms that the movement of wages did *not* rise dramatically in terms of their ability to buy wheat across the early modern centuries and the Industrial Revolution era. Rather, Figure 1 and Table 1 remind us again that craftsmen in 1790 had a lower grain wage per day than their counterparts in earlier centuries. Thus, the sweep of English history plants the same suggestion as the recent scholarly contrasts with Asia: Northwest Europe in the Industrial Revolution was not richer in terms of staple food, relative to earlier centuries or to other regions. For this reason, the heuristic ranking sketched above speaks only in soft terms about patterns in the grain wages for craftsmen ("wages for skilled labor $\geq$ staple food prices", with no assertion of a strict inequality).

For luxury goods and capital goods, the cheapness that blessed England in the Industrial Revolution was clearly a product of developments since the thirteenth century. Figure 2 and Table 1 show dramatic drops for nails, iron, paper, and cloth that echo Beveridge's remark about the dramatic fall in the in the steel/wheat price ratio since the thirteenth century. Could anything like this have happened outside of Northwest Europe over the same five hundred years? The question remains open, though the materials cited in this paper suggest that the

proximate causes of differences in output price ratios were close to the luxury and capital-goods sectors.

In all likelihood, the root causes of the inter-regional Great Divergence, and of the Little Divergence between Northwest Europe and the rest of Europe, had much to do with those two classic sources of capital supply: a greater willingness and ability to lend financial capital, and a greater willingness and ability to man[30]ufacture real capital goods. Economic historians are still puzzling over just how early this event occurred, especially on the financial front. As Clark and Van Zanden have both noted, interest rates were falling radically in Northwest Europe across the thirteenth and fourteenth centuries. If the great decline in interest rates had occurred only in the fourteenth century, we might have leaned toward a story featuring the Black Death as a negative labor supply shock that gave ordinary families the ability to save. Yet as both authors make clear, interest rates fell even more sharply in the century or so *before* the Black Death. Our research on the sources of what made Northwest Europe so different by the Industrial Revolution need to trace relative-price movements, particularly those relating to the supply of funds, back into the Middle Ages.

Table 1. Fingerprints: Relative-Price Clues for Testing Hypotheses In the History of Growth and Divergence

Each entry's arrow (=>) gives a predicted consequence of this force's being more present in Context A than in Context B.

PART I. Generic proximate sources of growth => price implications

A. Input supply changes

A.1 More land usable in agriculture => lower rents/prices per hectare-season in agriculture for land of given quality, lower (relative) prices for agricultural product, higher real wage.

A.2 More labor supplies, e.g. due to (a) greater population, (b) lower dependency ratio, (c) better fitness for work, or (d) greater preference for work and earning => Lower wage rates, higher farm rents/prices, and higher prices for staple food products.

A.3 Greater supplies of skills per worker, e.g. due to greater supply of schooling or apprenticeships => Lower skilled-wage premium.

A.4 Greater supply of capital services, e.g. due to greater lending supply or lower costs of producing capital goods => lower interest rates, lower price of capital-intensive products.*

A.5 Greater supply of input materials, e.g. raw cotton => lower prices on these, and lower prices on the outputs of the sector using them intensively.

B. Input-neutral productivity advances, by sector

Such advances can occur in any output sector. The ten output sectors featured in this paper are: *Primary sectors* – (1) staple foods, (2) other agriculture, (3) wood, (4) fuel, and (5) other minerals. *Manufacturing sectors* – (6) textiles and apparel, (7) luxury consumer goods, and (8) capital goods. *Other sectors* – Foreign supply of (9) imports, and (10) commercial enterprises. Omitted are other private services and government.

C. Input biases in technical change

C.1 Land-saving (or land-augmenting)

C.2 Capital-saving

C.3 Labor-saving

C.4 Skill-saving

C.5 Material-saving

D. Product demand shifts

Shifts toward any sector's output => rise in its relative price

E. Money supply expansion

Exogenous money growth => No relative-price effects in the long run, but a relative rise in the more flexible prices (e.g. primary-product prices) in the short run.

(*The implications for other input prices are less clear, since they depend on input complementarities versus substitutabilities.)

(Table 1, continued)

PART II. Some popular hypotheses about the early modern era => price implications

A. The Agricultural Revolution
=> Lower prices of agricultural products

B. Better Health and Nutrition
=> Lower wage rates per hour or day, higher relative prices of staple foods

C. The Industrious Revolution (De Vries)
=> Lower wage rates per hour or day, higher relative prices of "New Luxuries"

D. Energy and the Great Divergence
=> Lower fuel prices per BTU

E. Industrial Revolution
E.1 Relative input supplies invited breakthroughs (Allen)
=> very cheap output per input in a few industrial sectors,
invited by high wages, cheap capital, cheap fuel
E.2 Relatively exogenous enlightenment (Mokyr)
=> very cheap output per input in a few industrial sectors

Table 2. The Wheat Wage of Common Labor, 1500 - 1870

kilograms of wheat per day
(Asian rice prices converted to wheat prices at 1 kg rice = 1.3 kg wheat; see App. A)

	1500	1550	1600	1650	1700	1750	1790	1820	1870
The Americas									
West Virginia, farm							25.9	20.1	
Maryland, farm							11.0	8.1	
Lima					1.7	3.7			
Potosí (Bolivia)						13.0	16.9		
Europe									
Lisbon						7.3	4.6		
Porto							2.6	3.1	
Barcelona	9.3	6.4	4.6			4.5	3.1		
Andalucia			7.0	5.5	8.4	5.5	6.0		
N. Castile		6.3				6.0	3.8		
Valencia	12.1	12.3	6.8						
Valladolid	7.7	4.2							
Paris	10.6	5.3	4.8	4.2	5.6	6.0	6.6	7.3	10.5
Strasbourg	19.5	13.0	6.2	8.4	5.6				
London	10.8	4.9	6.7	7.4	10.6	14.4	9.4	9.5	15.5
S. England	8.6	6.9	4.5	4.6	6.0	9.1	7.0	8.2	11.8
Amsterdam	10.9	5.8	6.0	7.6	8.5	11.8	8.2		
Antwerp	8.0	9.8	6.6						
Münster	6.9	6.8							
Frankfurt AM	7.5	4.8	4.2	7.5					
Augsburg					3.8	3.8	2.5		
Vienna		11.9	5.2	6.4	5.6	5.4			
Istanbul	10.6	6.1	5.2	6.9	10.0	6.3	6.2	8.9	6.7
Wallachia								14.8	
Sopron	11.8	11.0	7.5	8.0	8.1	9.1			
Sweden, farm						4.6	4.0	4.9	5.8
Gdansk					7.2	6.3	4.7		
Poznan		18.2	10.4						
Warsaw		16.5		11.3	7.7	5.5	8.0		
Lviv							3.7		
Moscow			12.6	5.6	5.6				10.9
Novgorod-St. P.					5.0	5.3			
North Dvina				3.5					
Asia									
Agra 1595 / Pune			*4.9*					1.2	
"India"			5.2	4.5	4.3				2.5
Southern India			7.4	4.2	5.1	2.7	2.3		
Java								2.7	3.6
"China"			3.9		3.6		2.0		
"Japan" 1880-84 farm									3.9
Kyoto/Hiroshima						2.8	2.2	3.1	2.3

Notes to Table 2:
These estimates were made before 2004, and need re-editing, using data from the subsequent literature and from data recently posted at http://gpih.ucdavis.edu. The common labor wages refer either to unskilled general labor or to laborers in the building trades, except where “farm” is noted here.

Table 3. The Real Price of Energy, 1500 - 1850 (Robert Allen)

Price per BTU, deflated by the price of a local consumer bundle, relative to the bundle price of 1.000 in Strasbourg 1745-1754

	Averaged over the half-century starting in						
	1500	1550	1600	1650	1700	1750	1800
Europe							
Madrid		7.17	6.49	7.06	6.07	5.98	6.28
Paris			5.50	5.39	6.95	6.65	
Strasbourg	2.08	2.54	2.38	2.69	3.34	4.30	5.93
London, coal	3.36	3.08	2.63	3.56	3.93	3.96	3.84
NE England coast, coal	0.35	0.57	0.60	0.48	0.54	0.75	
Western England, coal	0.69	0.69	0.63	0.58	0.63	0.65	0.50
Amsterdam, peat	4.04	3.01	4.09	3.70	4.21	4.87	7.08
Amsterdam, wood			2.55	3.39	3.57	4.23	5.67
Amsterdam, coal							4.57
Florence	4.73	4.79	5.02		6.10	5.13	6.38
Vienna	2.34	2.65	2.15	2.72	3.20	3.31	2.76
Gdansk	5.35	6.06	4.60	4.54	4.96	6.99	6.01
Lviv	6.34	6.26	7.83	6.09	7.03	6.38	
Asia							
Puna						13.12	10.78
Canton					5.14	7.66	
Beijing					10.85	9.41	7.11

Source for Table 3: Allen (2009a, 101-102), *q.v.* for a fuller list of places and fuels, starting in 1400-1449.

Table 4. The Wheat Price of Cloth, 1500 - 1870

In kg of wheat per square meter

	1500	1550	1600	1650	1700	1750	1790	1820	1870
Europe									
Paris, cotton				7.1	12.5				
Paris, linen	12.8	7.8	4.7	3.8	4.5	6.8	6.6		4.3
England, navy			11.8	9.9	14.2	13.3			
England						4.6			
N. Italy						12.3			
Istanbul, woolen	333		344				85.5	80.0	
Istanbul, London cloth						80.3	41.9	9.2	
Asia									
Agra 1595			5.3						
China, late 17th c.					5.5				
Japan 1880-84									2.9

Notes to Table 4:
These estimates were made before 2004, and need re-editing, using data from the subsequent literature and from data recently posted at http://gpih.ucdavis.edu. Data for England, Northern Italy, Agra, China, and Japan are from Allen (2004a). English navy cloth (one square meter): Navy stores (Beveridge) / Clark's wheat series. "1600" = 1619-1628, and "1750" = 1732-1738. Istanbul prices from Pamuk (2000). "1500" = 1485-1493, and "1550" = 1551-1559.

Table 5. The Wheat Price of Writing Paper, 1500 - 1870
in kilograms of wheat per ream (about 480 sheets)

	1500	1550	1600	1650	1700	1750	1790	1820	1870
The Americas									
Arequipa (Peru)				208	339	257			
Potosí (Bolivia)					284	181			
Europe									
Barcelona	37	26	25		23	22	24		
New Castile		58	36	43	50	40	26		
Old Castile		86	51	81					
Paris		14					21	24	7
England	98	86	46	41	*48*	*45*	*42*	*48*	*42*
London (Eton)	61	70	34	33	*38*				
Holland	93	40	43	47	56	67	40		
Frankfurt AM		64	60	75					
Augsburg					26		32		
Vienna		115	38	38	46	31			
Sopron		157	155	109	125	88			
Gdansk					51	51	37		
Warsaw				251	143	92	106		
Poznan		425	218						
Wroclaw		62	29						
Krakow		153		140		234			
Lviv							120		
Moscow			200	304	112	204	137		
Novgorod-St. P.			1525				65		
North Dvina		1176	222				100		
Asia									
Pune (India)								99	
Canton 1704					491				

Notes to Table 5:
These estimates were made before 2004, and need re-editing, using data from the subsequent literature and from data recently posted at http://gpih.ucdavis.edu. The high prices for Spanish America apparently refer to imported paper.

Table 6. The Wheat Price of Nails, 1500 - 1870

in kilograms of wheat per 100 medium nails

	1500	1550	1600	1650	1700	1750	1790	1820	1870
Europe									
New Castile	7.0	7.6	7.1	5.9					
Old Castile	4.5	10.9	6.2	7.9					
London	13.5	10.9	5.6	3.6	4.5	6.0	3.9		
Sweden						6.3	3.8	3.0	2.1
Istanbul			6.6		11.9	8.4	7.2	6.2	2.8
Moscow			51.3	14.9	10.8	7.5	8.9		
North Dvina			195		7.6				
Asia									
Canton 1704					48.0				
Osaka (6" nails, 1830)								3.3	

Notes to Table 6:

These estimates were made before 2004, and need re-editing, using data from the subsequent literature and from data recently posted at http://gpih.ucdavis.edu.

Table 7. Indices of the Wheat Prices of Other Commodities in England, 1290-1790

(1790 = 1.00)

	1290	1390	1490	1590	1690	1740	1790
Beef				1.18	1.42	1.09	1.00
Beer (strong)		1.92	1.98	0.86	1.54	1.55	1.00
Bricks	0.96	3.53	1.66	1.34	1.20	1.21	1.00
Butter	2.70	2.05	1.79	1.49	1.83	1.40	1.00
Coal	0.87	1.05	1.12	1.34	1.80	1.47	1.00
Cloth, linen	3.39	5.18	2.96	2.27	1.83	2.01	1.00
Eggs	0.89	0.97	0.89	1.02	1.65	1.26	1.00
Farmland rents			0.25	0.33	0.72	0.88	1.00
Firewood	3.20	3.30	2.86	1.57	2.63	1.85	1.00
Housing rents	0.85	0.49	0.63	1.01	1.77	1.48	1.00
Iron-manuf.	4.69	5.87	3.27	2.54	2.09	1.72	1.00
Milk		1.56	1.50	1.09	1.60	1.15	1.00
Nails	9.17	10.98	8.17	4.26	2.65	1.70	1.00
Sugar				1.69	1.05	0.87	1.00
Paper-foolscap	6.45	7.91	3.55	1.51	1.51	2.00	1.00
Salt	0.98	1.20	0.95	0.65	0.72	1.44	1.00
Wheat flour				1.22	1.67	1.15	1.00
Wage, farm	1.27	3.10	1.73	1.16	1.49	1.22	1.00
Wage, craft	1.58	2.63	1.69	1.09	1.59	1.30	1.00
Wage, bldg laborer	1.13	2.67	1.98	1.10	1.62	1.23	1.00
Not relative to wheat:							
Wage ratio, craft/labor	2.09	1.52	1.31	1.52	1.51	1.63	1.54
Real rate of return on capital	9.7	4.5	3.8	4.2	5.5	4.6	2.6

Sources and notes to Table 7:

Gregory Clark's price series 1209-1914 (available at http://gpih.ucdavis.edu), plus Clark (1988) on rates of return and Clark (2002) on real farmland rents. For farmland rents, the deflator covers a wide range of agricultural products, and not just wheat.

In cases where figures were unavailable for the benchmark years shown, or where the benchmark year's price was not representative of nearby years, the following substitute years or averages were used:

For beer (strong), "1390" was actually 1401

For bricks, "1290" was an average of 1285 and 1295.

For butter, "1390" is the 1386-1394 average and "1490" is 1486-1494.

For coal, "1290" averages available years 1281-1296, and "1390" is 1386-1394.

For cloth, eggs, firewood, iron, and nails, "1390" is 1386-1394.

For farmland rents, "1490" is 1500-1539, "1590" is 1580-1599, "1690" is1690-1699, "1740" is 1740-1749, and "1790" is 1790-1799.

For housing rents, "1290" is 1291-1299 and "1390" is 1386-1394.

For milk, "1390" is 1392-1395 and "1490" is 1491-1492.

For paper (foolscap), "1290" is 1357 and "1390" is 1395-1399.

For all wage rates, the "1790" base is an average for 1796-1794.

Figure 1. Movements in the Wheat Price of Selected Inputs, England 1290-1790

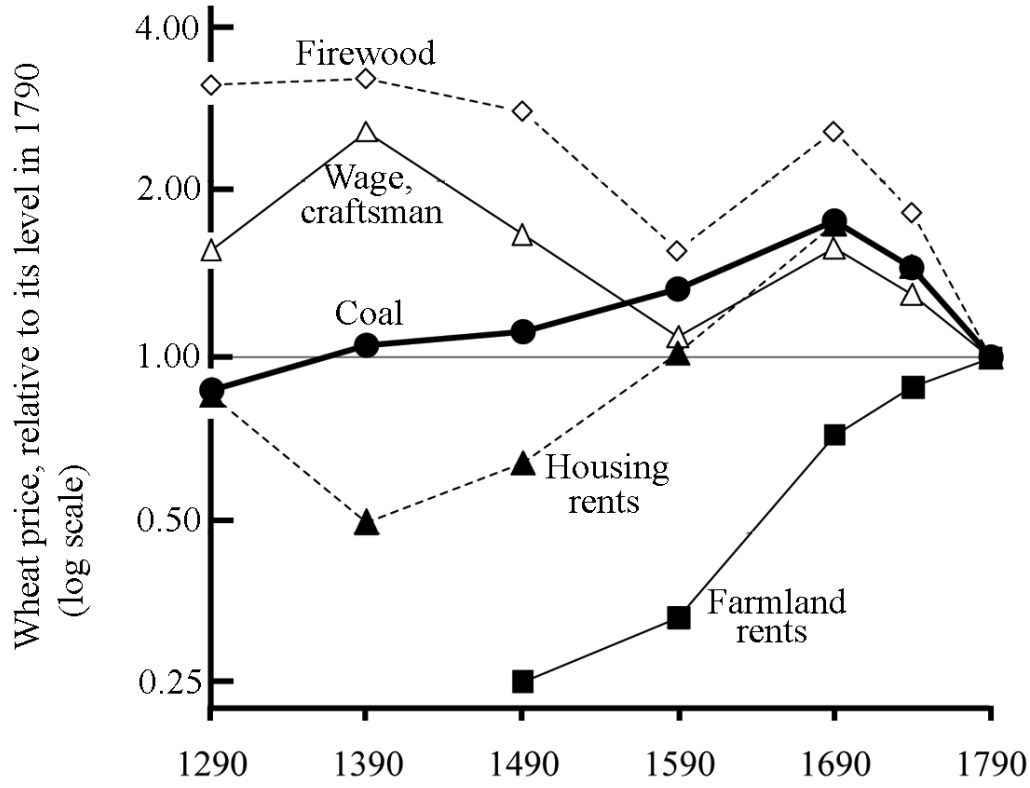
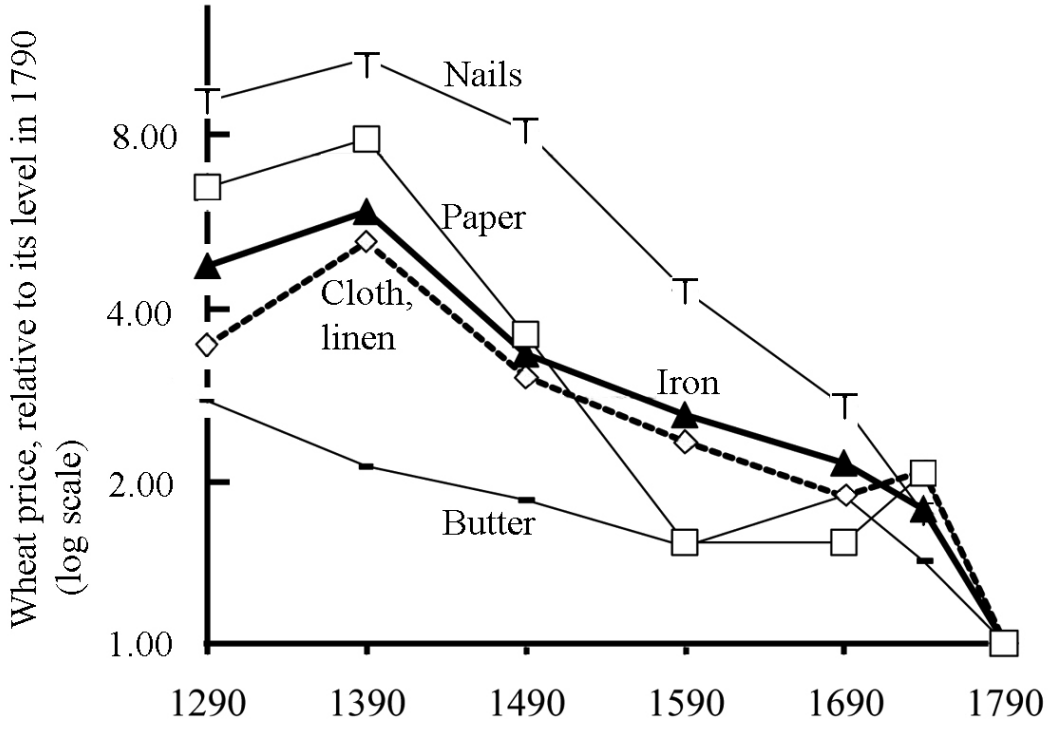


Figure 2. Movements in the Wheat Prices of Some Non-Staples, England 1290-1790



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Appendix A. Rice versus Wheat: Their Nutrition Ratios and the Geography of Their Price Ratios

A. The Rice/Wheat Nutrition Ratios

The relative nutritional contents of rice and wheat have been estimated in Robert C. Allen, Jean-Pascal Bassino, Debin Ma, Christine Moll-Murata, and Jan Luiten van Zanden, forthcoming.

	Unit (metric)	Calories per unit	Grams of protein per unit
Rice	kg	3620	75
Wheat flour	kg	3390	137

Sources: The caloric and protein content are based on …. US Department of Agriculture (USDA) National Nutrient Database for Standard Reference, http://www.nal.usda.gov/fnic/foodcomp/cgi-bin/list_nut_edit.pl.

To find the wheat equivalent in each kilogram of wheat flour, we follow Beveridge (1939) p. 541. According to Beveridge, the **flour/wheat weight ratio** was 0.86 kg flour per kg of wheat. This implies that each kilogram of wheat would supply 3390/0.86 = 3930 calories per kilogram of wheat, and 137/0.86 = 159.3 grams of protein per kilogram of wheat, assuming that 100% of the calories and protein in the wheat flour come from the wheat.

So in terms of **calories, the rice/wheat ratio** for kilograms is 3620/3930 = 0.921. Whereas in terms of **protein, the rice/wheat ratio** for kilograms is 75/159.3 = 0.471.

Of course, converting wheat into flour, and especially into bread, costs more in other inputs than does the preparation of rice for consumption. That is, rice is closer to being a final consumable product, especially if it is polished rice. It is presumably for this economic reason that both of these nutrition-based ratios of rice to wheat are well below the price ratios in areas where both rice and wheat products are the basic staples.

B. Historical Rice/Wheat Price Ratios

The geography of rice/wheat price ratios can be traced roughly, using data from the seventeenth century to the early 20th. Table A.1 draws on data sets downloadable from http://gpih.ucdavis.edu.

Table A.1. Rice/Wheat Price Ratios from around the World, From the Seventeenth Century to the Early Twentieth

Rice/wheat Price ratio	Place, and the years averaged	Source and notes
	East Asia	
0.813	Korea, 1856	Jun and Lewis
1.255	Korea, 1870-99	Jun and Lewis. The seasons are generally not the same for rice and wheat.
1.200	Beijing, 1745-54	Data used in Allen *et al.,* forthcoming, derived by converting via wheat flour.
1.353	Beijing, 1913-1923	Data used in Allen *et al.,* forthcoming.
1.163	Sichuan, 1905	Data used in Allen *et al.,* forthcoming, derived by converting via wheat flour.
2.000	Canton, 1752	Van Dyke
1.163	Canton, 1745-54	Data used in Allen *et al.,* forthcoming.
	India	
0.693	South India, 1861-89	Allen and Studer, and the sources cited there.
0.589	East India, 1650-99	"
0.682	East India, 1700-49	"
1.281	East India 1750-99	"
1.119	East India, 1800-49	"
0.851	East India, 1850-99	"
0.938	West India, 1611-45	"
0.947	West India, 1761-99	"
0.888	West India, 1800-49	"
0.881	West India, 1850-99	"
1.261	North India 1861-99	" ; the average is for the United Provinces.
	Eastern Europe	
3.954	Istanbul, 1471-90	Sevket Pamuk; converting via wheat flour.
2.328	Istanbul, 1650-97	Sevket Pamuk.
2.649	Istanbul, 1750-98	"
2.452	Istanbul, 1814-45	"
2.380	Istanbul, 1851-63	"
24.253	Moscow, 1694-1704	Boris Mironov.
16.457	Moscow, 1704-14	"
13.487	Moscow, 1750s	"
15.994	Moscow, 1760s	"
6.846	St. Petersburg, 1760s	"
6.218	St. Petersburg, 1790s	"

	Western Europe	
1.071	Milan, 1701-49	Aldo de Maddelena.
1.201	Milan, 1750-99	"
1.483	Milan, 1800-49	"
1.474	Milan, 1850-59	"
4.149	Paris, 1752-88	Philip T. Hoffman, using the "Wheat 1" series
4.973	Paris, 1752-88	Philip T. Hoffman, using the "Wheat 2" series
	North America	
0.866	Mass., 1781-1800	Carroll Wright.
1.095	Mass., 1801-50	"
1.344	Mass., 1851-60	"
1.950	Penn., 1720-49	Bezanson *et al.*
1.535	Penn., 1750-99	"
1.331	Penn., 1800-49	"
2.126	Penn., 1850-96	"
3.175	San Fran., 1852-99	Thomas Senior Berry.

Note: This table omits some available figures for Spain and Portugal, for which the rice price series contain some anomalies that need further investigation.

ENDNOTES

[1] See group members' websites, in Davis, Amsterdam, and Oxford: (http://gpih.ucdavis.edu, http://www.iisg.nl.hpw, and http://www.economics.ox.ac.uk/members/robert.allen/WagesPrices.htm, with links to still more sites available as "related sites" on the gpih.ucdavis.edu site.
[2] Allen (2009a, 2009c).
[3] Van Zanden (2009a; 2009b, especially 23, 155, 183).
[4] Hoffman (forthcoming 2010; in progress).
[5] Clark (1987, 1988, 1999) and Clark and Jacks (2007).
[6] Beveridge (1939, xxv-xxvi). This passage was also cited in Cipolla (1956, 52), to dramatize the same point about relative prices. The wheat prices of iron and copper also declined in northern India between 1595 and 1861-1870, though only by 24 percent for iron and 88 percent for copper (Moosvi 1987, 332).
[7] Thus far, the best econometric estimations of sources of urban growth and wage growth for the medieval and early modern period are DeLong and Shleifer (1993) and Allen (2003). Acemoglu, Johnson, and Robinson (2002, 2005) present the best sweeping econometrics of growth rates in Angus Maddison's estimates of income per capita since 1500.
[8] The general-equilibrium interaction featuring sectors' input intensities is formalized and applied, using three sectors and four inputs, in Williamson and Lindert (1980, 217-254). For estimates on the bend in the Engel curve toward flatness at high incomes, an idea dating back to Adam Smith, see Clark, Huberman, and Lindert (1995).
[9] Timmer (1969).
[10] Wrigley (1967), DeVries (1984), Hohenberg and Lees (1985).
[11] On England see, for example, Clark (1999) and the earlier works cited there. Robert Allen's latest review of the agricultural revolution (2009a, pp. 78-79) concludes that

> "There is some truth in the standard [agricultural revolution] narrative, but causation ran more strongly in the opposite direction. London and the proto-industrial sectors were the engines of growth. Their expansion raised wage rates and drew labour out of agriculture …. The agricultural revolution was the result of the growth of cities and manufacturing."

[12] See Hoffman *et al.* (2005, especially Table 6.4), and Tables 5 and 6 of this paper.
[13] Note, for example, the high grain wages for Eastern Europe in Van Zanden (1999),
[14] See Pan (1997); Li (1998); Pomeranz (2000, 2005); Parthasarathi (2005); Allen (2009b); and Bassino, Fukao, and Takashima (2010).
[15] For real-wage contrasts between China, Japan, India, and Europe from 1730 on, see Allen *et al.* (forthcoming).
[16] For the most recent overview relating to England, see Harris *et al.* (2010).
[17] For summaries of life expectancy and infant mortality, see Hoffman *et al.* (2005), and the downloadable listing of estimates at http://gpih.ucdavis.edu/Evidence.htm.
[18] De Vries (1994, 2008).
[19] Voth (2000), Clark and Van der Werf (1998).
[20] On rising real inequality, see Hoffman *et al.* (2005). The reference to "wages rising moderately over the period as a whole" is an averaging of the different recent appraisals of the

evidence on English real wages. Even Charles Feinstein's (1998) "pessimistic" appraisal of real wage movements over the 1780-1850 period got a net gain of over 30 percent. Robert Allen (2009a), Gregory Clark (2005), and Hersh and Voth (2009) all report higher gains than did Feinstein, to which Hersh and Voth have added a 15% welfare gain for the 1650-1800 period based on the introduction of the new mass consumption items sugar, tea, coffee, and tobacco.

[21] Hyde (1977), Clark and Jacks (2007), and Allen (2009a, 80-105).

[22] One might wonder what held the price of paper higher in England and the Netherlands from 1700 on. In the case of England, the war with France in the 1690s shut off imports of French paper, and the growth of domestic supply may have been further retarded by the new excise tax on paper.

[23] Van Zanden (2009, 183), Clark (2007, 253-254), Hoffman (forthcoming 2010).

[24] Allen (2009c), Mokyr (2002).

[25] The global contrasts in interest rates are well sketched by Clark (1988, 273-274); Homer and Sylla (1991); Clark (2007, 167-175); and Van Zanden (2009, 22-31). Important inferences for human investments are developed by Van Zanden (2009, 159-165), and Allen (2009c) draws implications for the implicit rental on physical capital.

On the cheapness of capital goods, Chad Jones (1994) has pointed the way by noting that both theory and international data suggest a strong link between the relative cheapening of capital goods and the rate of overall economic growth. In a postwar sample of 65 countries, Jones found that a cheaper supply of capital goods, relative to consumer goods, significantly raise the rate of subsequent economic growth, with or without econometric adjustments for data limitations and for simultaneity. His key policy implication was that choosing a tax system that is more lenient to the capital goods sector is better for growth. Bill Collins and Jeffrey Williamson (2001) have shown economic historians how differences in this capital price nexus may help to explain growth performance, by drawing on the experience of eleven countries between 1870 and 1950.

[26] See, for example, the parity in the grain wages of London and Kyoto craftsmen in the sixteenth century, as documented by Bassino, Fukao, and Takashima (2010, Figure 5).

[27] For hints of the global history of skilled-wage premia, see Van Zanden (2009a, 2009b) and Freeman and Oostendorp (2000).

[28] See the extensive commodity and country detail in Hoffman *et al.* (2005, Table 6.4).

[29] On France and Holland, again see Hoffman *et al.* (2005, Table 4 and Figure 6.2).

[30] Again, see Clark (1988, 273-274); Clark (2007, 167-175); and Van Zanden (2009, 22-31).