Pessimism Preserved:

Real Wages in the British Industrial Revolution

By

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Abstract

The paper compares Feinstein's and Clark's consumer price and real wage indices for the British industrial revolution. The sources for their weights and component price series are evaluated. While some of Clark's innovations are improvements, many of his changes degrade the price index. A new price index is developed using the best components of Clark's and Feinstein's. This index is much closer to Feinstein's than to Clark's. The implied growth in real wages is also close to Feinstein's and contradicts Clark's 'optimistic' view of rising working class living standards during the industrial revolution.

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The standard of living of British workers during the industrial revolution is one of the great questions of economic history. There have been many attempts to measure the trend in real wages. Lindert and Williamson (1983) was a turning point, for they were the first to treat the problem comprehensively with the tools of modern economics. They derived an economy wide nominal wage index and computed a cost of living index based on worker's budget shares and corresponding prices. They supported the 'optimistic view' that real wages rose rapidly after Waterloo. Optimism was always controversial, however, and Feinstein's 'Pessimism Perpetuated' (1998) swung the balance in the opposite direction with his (surprisingly optimistic!) conclusion that the average real wage rose by about 30% between 1780 and 1850. The 'pessimism' of the title was warranted, however, since real wage growth equalled only half of the increase in output per worker over the same period (62%) and occurred entirely post-1830 with the preceding fifty years exhibiting real wage stagnation. Allen's (2001) comparison of British and continental living standards corroborated this conclusion by applying a different weighting scheme to many of the same price series. Recently, however, Clark (2005) has argued that real wages grew much more rapidly than Feinstein and Allen thought.[1] He has brought new prices sources and methods to bear on the problem, so his conclusion deserves careful consideration. The purpose of this paper is to review the data and methods used in these inquiries in order to compute the best possible real wage index with the evidence currently at hand. Despite incorporating much of Clark's new material, the result confirms Feinstein's picture of real wage trends between 1770 and 1860. Pessimism is preserved.

A frequent question in economic history is how to measure the standard of living. In a time of rising prices like the Napoleonic Wars, for instance, the historian wants to know whether wages also rose enough to allow workers to live as well as they did before. The question is answered by computing the' real wage' which is the ratio of the money wage to the consumer price index. If money wages rose faster than prices, then workers pulled ahead of inflation and the real wage, by this definition, was also rising. The first step in any real wage inquiry is to measure the course of money wages. In this respect, there is consensus between Lindert, Williamson, Feinstein and later writers. All of the differences among Feinstein, Clark, and Allen come down to differences in the price index. This paper will, therefore, concentrate on the cpi and accept Feinstein's nominal wage series for real wage calculations.

Measuring the rate of inflation raises index number problems that recur in many areas in economic history. Measurement is an issue because consumers buy many things, and their prices inflate at different rates. These differences must be collapsed into 'the' rate of inflation. There are three aspects to this problem–measuring the prices of the various goods and services that consumers bought, choosing the appropriate formula to aggregate these prices, and choosing the weights to use in that formula. All of these questions require good information. Choosing the index number formula also involves making assumptions about the view point from which prices are aggregated. The same or analogous problems arise in measuring the rate of economic growth during the industrial revolution or in combining inputs in order to measure total factor productivity.

The first step in this research was to assemble a data base of prices in order to replicate both Clark's and Feinstein's calculations. With that information in hand, one can

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[1]Clark (2001) has also proposed a new consumer price index and real wage index for farm workers. It suffers from some of the same problems as the JPE index, in particular, the substitution of wheat prices for bread prices before 1816.

then see why they reached different conclusions.

Feinstein's data base had to be assembled from his data descriptions.[2] Feinstein's descriptions are detailed, but it is not always clear how he combined information from multiple sources. Fesinstein's data derive largely from so-called 'institutional' sources–the purchase accounts of hospitals, colleges, and government departments. There has always been some concern that these prices differ from the retail prices paid by ordinary consumers (Ashton 1949). Nevertheless, the series that I have put together based on Feinstein's descriptions provide a very accurate reconstruction of his price index.

Clark's work is based on a vast number of data points: "90,000 quotes of the prices of 49 commodities, and 20,000 quotes of housing rents" (Clark 2005, p. 1321). The housing rents are new information derived from returns made by English charities to the Charity Commission detailing their property and its value (Clark 2002b). Some of the 90,000 prices represent new information compiled from sources like church wardens' accounts, but most of these data are recycled from standard institutional sources. Clark's treatment of this information is novel, however. Instead of choosing representative series and splicing them together to form a grand series running from 1209 to 2004, Clark regressed the price of each kind of commodity onto dummy variables representing time periods, location, units of measurement, and various product types. The coefficients of the time dummies became his price series for the good.[3] Clark published ten year averages of the subindices of his cpi. He has not yet provided me with annual series of the subindices. However, the average value over ten year intervals of his cpi is very closely approximated by substituting the ten year averages of the component indices, and that information provides a platform for the analysis.

The first question to ask is: Why do Feinstein and Clark differ? There are three possibilities. The first is the formula used. In the present case, the alternatives include a Laspeyres index with spending shares specified (Feinstein), a Laspeyres index with quantities of goods specified (Allen), and a geometric index with shares specified (Clark). These formula differences were not important; i.e. a geometric index using Feinstein's shares differs only a little from his Laspeyres index. The second possible difference is in the weights, and the third is in the price series that are being aggregated. Figure 1 throws some light on their importance, for it includes Clark's and Feinstein's price indices plus a geometric index using Clark's prices and Feinstein's weights. Clark's price index is the highest in the 1770s and

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[2]I have not located the appendices referred to in Feinstein (1998), and the discussion of sources in the printed text is limited. However, Feinstein (1995, pp. 35-6) gives complete sources for an earlier version of the index. I rely on that. Comparison of the two papers suggests that the sources of much of the index remained the same. It should be noted that I could not reconstruct one of Feinstein's series, namely, sugar. Feinstein (1995, p. 36) gives the source for 1780-1805 as GRS, series 42. However, series 42 in Gayer, Rostow, and Schwartz is not the price of sugar, and the sugar price series they give only starts in 1790. I have, instead, used the price of powder or Lisbon sugar purchased by the Lord Steward's Department (Beveridge 1965, pp. 430-1) for the period 1780-1850 extended by the series that Feinstein cities for the remainder of the period. This price series moves very closely to Clark's.

[3]Greg Clark has provided me with a spreadsheet with anual prices series for many commodities, for which I am grateful.

Feinstein's is the lowest. The newly computed index is roughly midway between the two. This shows that differences in weights and in prices played roughly equal roles in explaining the difference between the two price indices.

It is tempting to push this procedure further and identify exactly which prices account for the difference between Clark and Feinstein. The most important issue is the change in the price level between the 1770s and the 1860s, for that determines the long run rise in the measured real wage. Table 1 gives an overview of the differences between Feinstein's and Clark's price indices for this period. The table shows average values for the 1770s of index numbers computed with various price series. In all cases, the corresponding averages for the 1860s are 1.00. At the bottom of the table is Feinstein's index (recalculated from the subindices he reports). This stood at 0.685; in other words, Feinstein's figures indicate that the price level in the 1770s was 68.5% of its value in the 1860s. Next above this is the geometric version of the Feinstein index using my reconstructions of his price series. This stood at .697 in the 1770s. The increase reflects the shift from a linear to a geometric formula and any differences in the price series aggregated. The top two lines of the table show two versions of Clark's index. .779 is my recalculation of his index from the subindices he published. .787 is the corresponding value when his category of 'drink' is disaggregated into 'beer' and 'tea' and the index recalculated using his price series for these commodities. It is not evident why this recalculation changes the index as much as it does. The most important point is that Clark's indices show less inflation between the 1770s and the 1860s that do Feinstein's. With Clark's calculations, it was easier to 'stay ahead of inflation,' which is why he concluded that real wages rose faster than Feinstein found.

The entries in the middle of Table 1 show the effect of shifting from Feinstein's price series to Clark's. Begin with the geometric version of Feinstein's index recalculated with my reconstructions of his price series (.697). If the index is recalculated using Clark's index for grain and potatoes instead of Feinstein's series for bread and potatoes, the value of the index in the 1770s rises to .727 and is marked in Table 1 as 'grain & potatoes'. This change is substantial compared to the difference between the Feinstein and the Clark cpi's. If Feinstein's cheese, milk, and butter series are replaced with Clark's 'dairy' series, the cpi rises to .739 and is labelled 'dairy.' The effects are cumulated in Table 1, so the value .739 includes the effect of changing both the 'grain and potatoes' and the 'diary' series. Continuing up the arrow on the left shows the effect of replacing more and more of Feinstein's series with Clark's. Evidently, the fuel series has a large impact on the result, while the light, meat, sugar, and rent have negligible or only small effects.

All of these substitutions discussed so far have the effect of raising the value of the cpi in the 1770s, and, indeed, their effect, by itself, is enough to turn Feinstein's index into Clark's. However, the arithmetic is more complicated because some of Clark's series inflate more rapidly than Feinstein's and, therefore, lower the measured rate of inflation. The downward arrow tracks these substitutions. Clearly, the use of Clark's beer or clothing series pushes the average value of the consumer price index back to about .73 in the 1770s. This value is about midway between Clark's and Feinstein's indices for the period and shows that the total effect of all of the substitutions of price series accounts for about half of the difference between Clark and Feinstein. Most of the rest is account for by differences in weights as indicated in Figure 1.

Table 1 adds two things to Figure 1. First, it shows which prices played an important role in generating differences in measured inflation rates and which ones were unimportant. Clearly, the most important series were grain & potatoes, dairy, fuel, beer, and clothing.

Lighting and meat played minor roles, while differences between Feinstein and Clark in the measurement of tea and sugar prices were of negligible consequence. Second, the proper question is not whether Feinstein's index or Clark's index is best. Something can be learned from each. The important question is which individual price series should be combined to get the most reliable measure of inflation during the industrial revolution. Answering this question requires close attention to the commodities involved and the use of as much collateral evidence as possible. Most of this paper is concerned with that inquiry. However, Table 1 summarizes the results by putting a (C) or an (F) after each commodity to indicate whose series is preferred. The designations 'Allen', 'porter,' and 'Tucker' point to other series that are substantially similar to the Clark or Feinstein series indicated and which are more explicitly founded on experience.

The remainder of the paper will consider the evidence relating to weights and then to prices. Finally, a new consumer price index will be presented that incorporates the best weights and series currently available.

Weights

Before considering price series, I will consider weights (Table 2). Clark uses one set of weights for his index, while Feinstein shifts between three sets as the industrial revolution progresses. These shifts on Feinstein's part do not look very consequential, however, since his cpi can be replicated very closely simply using the weights for the midperiod. I will concentrate on the differences between those weights and Clark's.

The most striking difference between Clark's and Feinstein's weights is the share of spending on carbohydrates (bread, flour, oatmeal, potatoes), which Clark puts at 27% and Feinstein at 39%. Most of this difference of 12 percentage points comes down to bread and flour: Clark gives them a share of 18.5%, while Feinstein puts them at 29.9%. The remainder of the carbohydrate category consists of oatmeal, potatoes, peas, and rice, and the differences in the way Clark and Feinstein treat these items is of no great consequence. So the first question about weights concerns the share of bread and flour–Should it be closer to 19% (Clark) or 30% (Feinstein)?

The second issue about weights concerns the non-carbohydrates. Since Feinstein puts more weight on carbohydrates, he must put less on other categories of spending. The difference in the share of carbohydrates is largely accounted for by Clark's putting much greater weight (10%) than Feinstein (1%) on salt, spices, lighting, soap, services, and tobacco. Which is preferable?

I begin with the first question: the share of spending on carbohydrates. Clark derives his weight of 27% through an unsatisfactory combination of sources. In his Table A3, Clark presents three sets of weights implied by contemporary sources, and 27% is the average of 12.5% (taken from Vanderlint 1734, pp. 76-7), and 37.8% (for 1787-96) and 29.7% (1840-54). The later two figures are worthy of consideration since they are derived from Horrell's (1996, pp. 568-9, 577) analysis of family budget surveys from the period (although how Clark got these figures from Horrell's tables is not explained). Vanderlint's figure, however, is patently too low and is not evidence at all: It is a figure constructed by Vanderlint in a fanciful calculation deployed in a polemic about the importance of Britain's domestic market. Vanderlint concocted an annual budget that he claimed characterized 7/8ths of the British population. This is not remotely accurate since the annual income that Vanderlint gives his 'typical' labouring family (£54 -10 s - 4 d) exceeded the household income of 86% of the English population according to Gregory King's social table of 1688. Indeed, the poorest half

of the population lived on an average annual household income of only £10 - 10 s (Deane 1979, pp. 6-7). Overstating income this drastically implied that Vanderlint's 'average' family spent a great deal of money on British manufactures (the point of his pamphlet) but, by the same token, led to an understatement of the true proportion spent on bread. The frivolous character of the budget can also be seen from his comments that the annual cost of 'Repairs of Household-Goods' was "guess'd, to make the Pence even". The cost of women's clothing was "guess'd at" as was the cost of men's. Vanderlint's budget is not a serious source of information regarding consumer spending and averaging its figures with some potentially reliable data simply biases down the answer.

Unfortunately, it is not enough simply to leave out Vanderlint's figure and use averages from late eighteenth and nineteenth century surveys of working class spending. While these surveys provide valuable information, none of them "can be accepted exactly as they stand. Some items, notably expenditure on drink and clothing, are omitted or greatly understated, and Horrell's sample is not sufficiently representative of the main urban centres to provide a reliable figure for the share of rent." (Feinstein 1998, p 635 n 33) Extraneous information must be used for these estimates. In general, it is important to work out the macro implications of spending shares and examine whether they are consistent with the overall supply of the goods in question. This is not an exact exercise, but it does have important implications for the weights.

We can perform this exercise for bread and flour by multiplying their spending shares by an up-dated version of Deane and Cole's (1969, pp. 143, 152) economy-wide wage bill. This 'wage bill' equals Deane and Cole's estimate of the occupied population multiplied by the average earnings of manual workers[4]. Multiplying the wage bill by the spending shares gives total spending on bread and flour. Implicit in this calculation is the assumption that the income elasticity of demand for bread and flour was zero at incomes above the earnings of the average manual worker. That assumption was true for these items according to MacKenzie (1921), who reconciled economy-wide food availability with the spending patterns of the various quartiles of the income distribution. For many items, however, middle and upper class consumption per head exceeded that of the working class, in which case, this procedure would understate demand.

Following Feinstein (1998, p. 635), I divide the spending on bread and flour between the two in a 2:1 ratio. I assume that the flour was used for home-baked bread. Dividing spending on bread by its price gives total bread consumption from which one can calculate the required volume of wheat, and similarly for flour. Figure 2 plots implied wheat consumption using Clark's spending share on bread and flour (18.5%) and the trend line of available wheat supply (production plus net imports)[5]. These estimates are lower than those of other writers (eg Brunt nd). Clark's estimates of wheat demand are very much lower than the trend line. Feinstein's shares, on the other hand, imply excessive levels of demand, at

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[4]For consistency with the rest of the study, I have replaced Deane and Cole's estimates of average annual earnings with values obtained by extrapolating Deane & Cole's 1851 value for average annual earnings back to 1801 using Feinstein's index of nominal earnings.

[5]The trend lines are calculated from production estimates and imports for 1750, 1800, and 1850 developed in Allen (2005). These calculations are refinements of Holderness (1989).

least for the eighteenth century. Taking a wheat bread and flour share of 28.5%, slightly less than Feinstein's, implies fairly plausible results for most of the period as shown in Figure 2. This is the value used in the new index proposed here.

We can do analogous calculations with other food expenditures. These calculations provide only a weak test of the assumptions since the income elasticities of noncarbohydrates were greater than one according to Mackenzie (1921). In the event, implied food demand falls short of food availability.

The calculations of food demand highlight an important time trend in food shares. As Figure 2 indicates, implied demand rose above food availability at the end of the period. The only way to reconcile the demand calculation with the agricultural production and trade data is to reduce the share spent on bread starting in the 1840s. A similar discrepancy occurs with all of the foods. It is noteworthy that Feinstein did reduce his food share in this period (Table 2), and the change is warranted by the aggregate calculations.

The upshot of these considerations is to accept a modified version of Feinstein's spending shares. Average shares are used throughout, a procedure that can be rationalized on the assumption that spending shares changed in response to price changes in a pattern that can be summarized by a translog expenditure function. I use a share of spending on wheat bread and flour (28.5%) that is somewhat less than Feinstein's and ten percentage points above Clark's. He gave salt, spices, and tobacco each a one percent share in spending, but there is little evidence to support these assignments[6], and I have set them to zero. I also follow Feinstein in setting the expenditure share on lighting at a smaller value than Clark. He is correct, however, that workers spent some money on services (midwives, funerals, and so forth), and I have followed him in giving it a weight of 2.5%.

Price Series

Half of the difference between Feinstein and Clark comes down to the prices that are aggregated rather than to the weights used to average them. Since Clark has expanded the price sources and processed them in an innovative way, there is reason to expect that his price series are more reliable. Sometimes that is true. In some cases (for instance, potatoes, meat, sugar, tea) Clark's procedures make no difference, and I will not review them here. In the cases where they make a difference, the result is sometimes an improvement in the consumer price index. At other times, Clark's new methods degrade the index. I begin with non-foods where Clark's innovations are more often improvements, and then consider foods, where his methods often less successful.

Rent

The rent of housing has been difficult to measure and consequently a subject of debate (Figure 3). Feinstein inferred it by dividing an estimate of the total rental value of British dwellings by the number of inhabited houses. The former was the result of a long series of apportioning calculations based on poor law tax assessments and income tax returns for occasional years. Clark has approached the subject with his Charity Commission data base.

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[6]The main use of salt was for homemade bread. Batchelor (1808 , p.74) gives a recipe, which implies that spending on salt for this purpose often amounted to less than 0.1% of the Deane & Cole style wage bill.

This shows rents actually received for many houses owned by English charities. The two sources are in close agreement that rent rose by a factor of two and a half between the 1770s and the1860s. There is disagreement about the timing of the increase, however. Clark's index concentrates the increase during the French Wars, while Feinstein's makes it a more gradual. This difference has implications for the timing of real wage change but not for the growth in real wages over the industrial revolution as a whole.

Clark's index looks the more reliable regarding the timing of the increase since it is based on rents actually received for houses rather than tax assessments, which may not have been adjusted as rapidly as the property market changed. The French Wars saw rapid price and wage inflation, so it would be a great surprise if house rents were not also rising briskly. Farm land rents certainly jumped up in the same period (Allen 1992, p. 172, Clark 1998a, 1998b, 2002a, Norton, Trist, and Gilbert 1891, Solar 2004, Turner, Beckett and Afton 1997). Clark's index is consistent with these expectations–and so looks the more reliable–while Feinstein's gives every indiction of an administrative process and calculation algorithm that lagged behind the rental market.

Clothing

One area where Clark's methods make a significant improvement is in the measurement of clothing prices. This has long been a stumbling block. An important early benchmark was Tucker's (1936) work, which was based on McCulloch's (1880, pp. 1138-1140) summary of the accounts of Greenwich hospital. These included the prices paid for 'a suit of clothes,' 'a pair of shoes,' 'a hat,' and 'pair of stockings' from 1729 to 1868. Tucker combined these prices in an unexplained way and took some account of similar prices from other hospitals to form an index of the price of clothing. This index has been used by some investigators and criticized by others. A big unknown is whether the quality and character of the items changed over time and whether and to what extent they incorporated new materials like cotton. The belief that the suits and stockings were of unchanging quality has led investigators to create an index of the price of clothing from time series of the prices of wool and cotton cloth (Lindert and Williamson 1983, Crafts 1985). Feinstein's index seems to be of this character, although he also compared the price of trousers from various sources. There is no uniformity in the results of these investigations.

Figure 4 compares Clark's index to Tucker's and Feinstein's. What is remarkable is the close agreement between Clark and Tucker and the difference between them and Feinstein. But who should we go with?

To investigate the question, I have explored the other approach and tried to construct an index of clothing prices from the prices of cloth and labour. Thus turns out to be unsatisfactory since almost any price trend can be created with minor changes in weights. In Figures 5 and 6, index A closely follows Feinstein's, while index B is not a bad approximation to Tucker's. In both indices, labour accounts for half of the costs. The only difference between the two is in the weights given to cotton and woollen cloth. In Index A cotton was weight at .12 from 1770 to 1784 and .15 thereafter with the corresponding weights for wool being .38 and .35. In contrast, Index B was constructed by weighting cotton at .075 from 1770 to 1799 and .15 thereafter. These minor differences in weighting lead to major differences in the trends of the indices since cotton cloth was falling so rapidly relative to other prices. We do not have adequate information about working class spending to discriminate between these possibilities. For this reason, the attempt to construct a clothing

price series from cloth prices is doomed to fail. A clothing price index must be based on clothing prices. That leaves Tucker and Clark as the only options. Fortunately, they concur, and the index presented here will be based on Tucker.

Fuel

The market for fuel was unusual in Britain during the industrial revolution. Unlike many products where prices were uniform across the country (Crafts 1982), fuel prices varied significantly. Coal was far cheaper near the coal fields than it was in London and the south generally. Wood and turf were also burnt for heat, but their importance was declining. These variations complicate the measurement of fuel prices.

Figure 7 shows Clark's and Feinstein's series, which differ greatly. Feinstein's shows the price of fuel rising over the industrial revolution,[7] while Clarks shows it falling. In an effort to decide between these two series, I constructed the third from commercial and industrial sources. It is a roughly weighted average of the prices per BTU of coal and charcoal in both London and northern England. This series moves in sympathy with Clark's series and in stark contrast to Feinstein's. I use the weighted average of energy prices in the real wage index presented in this paper.

lighting

While Clark improved on Feinstein in measuring the prices of housing, clothing, and fuel, the same cannot be said of light. Both Clark and Feinstein show the price of lighting falling between the 1770s and the 1860s, but Clark's series falls the fastest (Figure 8). In this case, he explains why:

> Light prices are proxied by a mixture of prices for gaslight, oil, and candles for the years after 1815 and for oil and tallow candles alone before then. Gaslight prices are measured by the average cost of a cubic foot of gas. The inclusion of gaslight, which fell rapidly in price from the 1810s to the 1860s, makes light prices relatively much higher in earlier years than in the Phelps Brown-Hopkins or Feinstein cost-of-living series (Clark 2005, p. 1328)

The problem here is that gas was used primarily for street lighting in the first half of the nineteenth century (Gledhill 1981). Gas was not an expenditure in working class budgets. It is worth remembering that Horrell's spending category that corresponds to 'lighting' was actually 'soap and candles'. Figure 8 also shows the price index of 'soap and candles' that Clark (2001) reports in his study of farm workers' earnings. It has the same trajectory as Feinstein's series, as does Allen's (1992, p. 324) series, which is also shown. These series are based on prices of candles reported by Beveridge (1965, pp. 146-7) and McCulloch (1880,

[7]Feinstein's series is based on Flinn's (1984, pp.303-4) and Church's (1986, p. 54) index numbers of the price of coal. The former includes London prices and pithead prices, while the latter includes only pithead prices. Neither series includes wood, which was still burnt for domestic fuel in the north in the eighteenth century.

pp. 1138-40) for Eton College and Greenwich Hospital. The price of gas should not be used to deflate working class income, and Feinstein was right to leave it out.

Foods

While Clark improved the measurement of the prices of most non-food groups, the same cannot be said of his treatment of foods. For most foods categories, Feinstein's methods are superior.

dairy products

The prices of milk, cheese, and butter are combined to form the price of dairy products. Figure 9 shows that Clark's series exceeds Feinstein's in the 1770s and 1780s while they have identical values in the 1860s. Which is more plausible? In this case, we can check them against agricultural prices. An index of the prices of milk, cheese, and butter was constructed using the prices Clark reports in his agricultural data base[8]. As Figure 9 indicates, that series is very similar to Feinstein's. The farm prices confirm the institutional prices, and, therefore, the Feinstein index is preferred.

In the case of dairy products, Clark's regression approach may have let him down. Run enough regressions, and you're bound to find some spurious coefficients. Sampling variation may be behind Clark's overestimate of dairy prices in the 1770s and 1780s.

Beer

Beer is heavily weighted in the consumer price index, so its price has a significant impact on inflation and real wages. Beer is also a commodity for which Feinstein and Clark present very different indices (Figure10): Feinstein's shows only a mild upward trend, while Clark's rises dramatically. The matter deserves particular attention since Clark (2005, p. 1328) claims "that a major improvement of this index over previous indices is that I have been able to compile from churchwarden and other accounts a series of beer prices by the gallon." Does Clark's new information lead to a better index than Feinstein's?

We are in a good position to assess Clark's contribution since we have very substantial histories of the brewing industry that summarize wholesale and retail beer prices in London, which was a major production centre and market (Mathias 1959, pp. 110-1, 369, 546, Gourvish and Wilson 1994, pp. 602-3). I begin with Feinstein's. Figure 11 shows that his series has a similar pattern to both the retail price of porter (the price per quart charged in pubs) and the wholesale price per barrel paid by the publicans. Feinstein's series, in other words, is consistent with the history of the London beer market.

Why is Clark's series so discrepant? The answer appears to be that Clark's data for this period exclude the excise tax on beer. Before October, 1830, an excise of 8 to 10 shillings per barrel was assessed, and this amounted to about one quarter of the value. After 1830, there was no excise. As Figure 12 indicates, Clark's beer price series tracks the price net of tax. This is a producer price, not a consumer price. Clark's series would be appropriate for measuring total factor productivity change in brewing but is not the right price concept for a consumer price index. In the index presented here, I measure beer prices with

[8]Available at http://www.iga.ucdavis.edu/clarkdata.html

the retail price of porter, inclusive of any excise duty.

Price series: carbohydrates

An important reason that Clark computed a lower rate of inflation than Feinstein is because his price series of carbohydrates inflated less rapidly. Figure 12 contrasts Clark's 'farinaceous' index with a comparable index constructed from Feinstein's sources. Clark's is significantly higher in the 1770s and 1780s and that is an important reason why his rate of real wage growth is higher. There are two reasons why Clark measures a lower rate of inflation for carbohydrates, one of which is an improvement and one of which is not.

The improvement that Clark makes is in the measurement of oatmeal prices.[9] Figure 13 shows Clark's oatmeal price index and an index of the price of oats based on the London Gazette price reports (Mitchell and Deane 1971, pp. 488-9). Clearly, there is little to chose between these series. The figure also shows the price of oatmeal purchased by Greenwich Hospital–apparently Feinstein's principal source. The peaks and troughs of these series coincide as do their levels after the late 1820s. Before that, the Greenwich series is much lower than the others. Why the Greenwich series jumps up to a higher level in the late 1820s is unknown, but such an unexplained jump invalidates it as a measure of the oatmeal price.

Clark's other innovation is in the measurement of the price of bread before 1816. While we have abundant evidence about the retail price of bread in this period (Petersen 1995, pp. 276-306), Clark rejected the bread price data in the belief that quality of bread between roughly 1760 and 1816 was lower than it was before or after. Instead of using bread prices to measure the price of bread, he used a regression equation to interpolate the price of bread from the price of wheat. This was supposed to provide an indicator of the price of 'constant quality' bread.

Clark's claim raises a number of issues that can be investigated, but, at the outset, it is important to emphasize that Clark's position suffers from a fatal flaw: The London bread price series that is commonly used in consumer price indices is the Assize Price of Wheaten Bread. This was a standard specified by the 1757 Bread Act and made from flour with a 70% extraction rate (Petersen 1995, p. 276). The price series for bread used by Feinstein and Allen in their consumer price indices is a price series for a product of constant quality. Clark's objection cannot apply. The remaining discussion is concerned with contextualizing Clark's claim and showing that the evidence he adduces for it has other explanations.

To begin with, Clark provides no direct evidence that bread quality was substandard in this period–the argument is an indirect inference from price trends. There is, however, much contemporary comment regarding bread quality. The main factor determining bread quality was the fineness of the flour that was baked. When flour was made, the ground wheat was sifted to remove bran and course material. The more that was removed, the whiter the flour and the bread. The coarsest brown bread was made with flour with an 85% extraction

[9]This paragraph is based on conjecture. Feinstein (1998) did not report his source for oatmeal prices, nor did he include oatmeal in the early version of his index that does report full sources (Feinstein 1995). I have recomputed the food subindex in Feinstein (1998), and the recomputation is closest if I use the Greenwich Hospital price of oatmeal rather than alternatives. Feinstein frequently used Greenwich Hospital data.

rate, i.e. only 15% of the coarsest material was removed after grinding. The finest flour had an extraction rate of less than 70%. The grade known as Wheaten Bread was made with flour with a 70% extraction rate, while Standard Wheat Bread was made with flour of 75% extraction rate. Consumers could easily identify the extraction rate of the flour used in bread by its colour and texture.

Bread was sold according to grade, and grades were defined by the Assize of Bread in terms of flour extraction rates. In the late eighteenth century, there was an effort to force consumers to eat bread made with coarser flour. The impetus came not from bakers but from Parliament concerned about the grain supply. The 1757 Act that redefined the Assize created a new category called 'household bread' to be made with flour with an 80% extraction rate, and the act tried to force half of the bread to be made at this grade. The act was a failure. Consumers refused to buy the coarse bread at the prices prescribed, and bakers found it more profitable to make purer white bread. The result was a general rise in the quality of bread–not the decline postulated by Clark (Petersen 1995, pp. 102-3).

In view of this history, we must be sceptical about Clark's indirect argument that bread quality declined, and, indeed, there are many difficulties with it. Clark (2005, p. 1326-7) began by pointing to a breakdown of the navy's cost of turning wheat into bread which indicated that "wheat constituted 92 percent of the costs of bread." The Naval costs excluded capital costs, and, in any event, were far less than costs in the commercial sector where wheat represented only half to two-thirds of the cost of bread making. There were economies of scale in bread production, but their realizeation depended on consumers' accepting cold bread. That was not a problem for the Navy, but it was for English consumers who preferred warm bread and patronized small, high cost bakeries (Petersen 1995, pp. 74-7). The Naval costs are not relevant to the commercial sector, but from them Clark concluded that the prices of bread and wheat should have moved in a fixed proportion. They did not. From 1770 through the French Wars, the ratio of the price of bread to the price of wheat was much less than it was before or after as Figure 15 indicates. From this, Clark concluded: "This would not be possible if the bread were of constant quality."

There are, however, other explanations for the price trends. There were two stages in the conversion of wheat to bread–milling the grain into flour and then baking the flour into bread. By the eighteenth century, these operations were undertaken by different firms. The bread-wheat price ratio was the result of developments in both industries. Figure 16 shows the ratios of the price of bread to the price of flour and the price of flour to the price of wheat. Their product equals the bread/wheat ratio shown in Figure 15.

Figure 16 shows the ratio of the price of flour to the price of wheat. The flour price is that paid by the Navy for bread making. This series is virtually identical to the price paid by Greenwich Hospital for flour for the same purpose. Beveridge (1965, p. 543) regard this flour of unchanging quality with an extraction rate of less than 75%.

The price of flour fell with respect to the price of wheat from the middle of the seventeenth century to the end of the eighteenth. This decline was the result of technical improvements in milling (the boulter, double grinding, improved gearing) and increases in the geographical extent of the market that increased competition (Petersen 1995, pp. 52-7). The result was a low ratio of flour to wheat prices in the late eighteenth century. This was a proximate cause of the low ratio of the price of bread to the price of wheat.

The second factor affecting the bread-wheat ratio was the ratio of the bread price to the flour price. This ratio went through a cycle shown in Figure 16. It was about 1.1 in the second half of the seventeenth century and again in the second half of the eighteenth. The

1710s through the 1750s were the golden age for bakers when the ratio of bread to flour prices lept up to 1.3. This period of high mark-ups immediately followed the 1709 Act that redefined the Assize of Bread. The medieval act had specified a uniform baker's allowance that was added to the price of wheat to set the price of bread. The 1709 Act allowed local magistrates to determine the mark-up in light of local costs (Petersen 1995, p. 100). The result was unprecedented rent-seeking and a high ratio of bread to wheat prices. These abuses ended after1757 when a new act reformed the Assize again. At that point, the ratio of the price of bread to the price of wheat returned to its pre-1709 value. From 1794 through 1816, the ratio was very low. After 1816, it returned to a value of about 1.2.

The income of bakers fluctuated in line with the ratio of bread to flour prices. Figure 17 shows the real annual income of a baker processing seven sacks of flour per week–typical throughput for a commercial baker. The income is the value of the bread produced less the costs of flour, yeast, salt, wood, hired labour, and the rental value of the commercial premises–the 'profit,' in other words, on which the baker lived. Deflation expresses the income in the purchasing power of 1688. Between 1684 and 1688, a baker's income averaged £44 a year–not far off the £45 per year that Gregory King assigned to 'Shopkeepers & Tradesmen' in 1688 (Deane 1979, p. 6). Income rose to £103 in the first half of the eighteenth century. Bakers made very high incomes exploiting the procedures of the 1709 Assize of Bread. From 1757, when the new Assize was enacted, until the 1790s, real income dropped back to the seventeenth century level of £62. The important point is that there is no evidence that baker's incomes in the late eighteenth century were being squeezed by regulation and, hence, no reason to suppose that bread quality was being cut.

The position of bakers deteriorated dramatically between the French Revolution and Waterloo. Wheat prices shot up and so did wages and other costs. The Assize of Bread allowed the bread price to rise with the wheat price, but not in response to other cost increases. The result was a collapse in profitability in the baking industry. This was the proximate cause of the repeal of the Assize of Bread. After it was repealed, profitability was restored as bread prices were maintained after Waterloo even as costs fell. Bread markets were localized, so collusion was easy, and that was probably a factor in raising profits. Certainly the real profits earned in the 1820s and 1830s were greater than those earned in the late eighteenth century.

The upshot of this discussion is that there is no reason to assume that bread prices in the 1770s and 1780s were low because the quality of bread was low. Low prices then reflected the high efficiency of milling wheat into flour and the elimination of the extremely high incomes earned earlier in the eighteenth century. Consumers could buy good quality bread at prices we can ascertain, so those prices should be used in the consumer price index.

New Cost of Living and Real Wage Indices

This review of Feinstein's and Clark's work points the way towards more reliable cost of living and real wage indices by combining the best elements from both. The choice of component prices has already been indicated. A geometric index was calculated with the weights shown in Table 2. The result are the price and real wage indices shown in Figures 18 and 19 and tabulated in Appendices I and II. Despite including many components of Clark's index, the results are far closer to Feinstein's than to Clark's.

The real wage history shown in Figure 19 preserves Feinstein's pessimism. The overall growth in real wages from the 1770s to the 1850s was much lower than growth in

output per worker. While real wages grew in the eighteenth century and again after 1830, there was a distinct pause in that advance from the mid 1790s to the early 1830s. Indeed, the wage plateau is even more pronounced with the new index than it was with Feinstein's. Constancy of the real wage in this period underlay the belief of classical economists that workers would be left behind as capitalism developed.

Figure 19, however, calls into question some of the explanations for the constant wage advanced by classical economics. In particular, the growth of the real wage in the late eighteenth century means that the real wage in the early nineteenth century was not a 'subsistence wage.' It could not have been, for it was clearly above the 1770s level! Indeed, British wages during the industrial revolution were very high by international standards (Allen 2001), again calling into question explanations couched in terms of subsistence. Why industrializing Britain went through this phase of constant real wages and rising inequality is a theme explored elsewhere (Allen 2007).

The Economic and Biological Standards of Living

Different social scientists measure the standard of living in different ways. Real incomes is one, and the results presented here support a sombre judgement. Other indicators are even more pessimistic, in particular, the 'biological standard of living' showed a downward trend over the first half of the nineteenth century. This is the common finding in studies of stature (Floud, Wachter, and Gregory 1990, Johnson and Nicholas 1995, Nicholas and Oxley 1993, Nicholas and Steckel 1991 Komlos 1993), which reached a low point in the second quarter of the nineteenth century. This finding is consistent with the evolution of agricultural production and food imports, for their statistics indicate that per capital calorie consumption was lower in 1850 than in 1800 (Allen 2005). Urban life was particularly bad. Overcrowding is a common theme, and public health a calamity. Szreter and Mooney (1998) found that the expectation of life at birth declined in large cities–again in the second quarter of the nineteenth century.

A drop in height is easier to reconcile with the plateau in the real wage reported here than with Clark's overly optimistic view of rising living standards, but the question remains: why did a constant real wage lead to less food consumption, overcrowding, and shorter people? The answer is that real income was only one factor; trends in relative prices were another. The price indices that have been aggregated here changed with respect to each other, and those changes in relative prices contributed to many of the social problems of the period.

There were several critical changes in relative prices. One series rose dramatically during the industrial revolution–both absolutely and relative to all of the others. That series was the rent of housing. As British cities expanded, growing labour demanded bid up the price of housing and land, and much of the income gain was transferred to urban landowners. Faced with a rising cost of housing, workers responded by reducing their consumption: the result was overcrowding. The were limits as to how far this process could be pushed, and those limitations meant that rising rents translated into a rising share of income spent on housing as Feinstein documented (Table 2). Rising housing prices were responsible for crowded urban housing and the health problems that ensued.

A second relative price change of great consequence was the history of manufactured goods prices–in particular cotton textiles–and food. The prices of clothing and textiles fell with respect to food. The underlying causes were the mechanization of textile production in

conjunction with slower productivity growth in agriculture and the Corn Laws that kept agricultural prices high. Consumers responded to this price change by shifting their expenditures from food to clothing. A drop in per capita calorie consumption and a decline in stature were the result.

Table 1

Comparison of Feinstein and Clark CPIs, 1770s

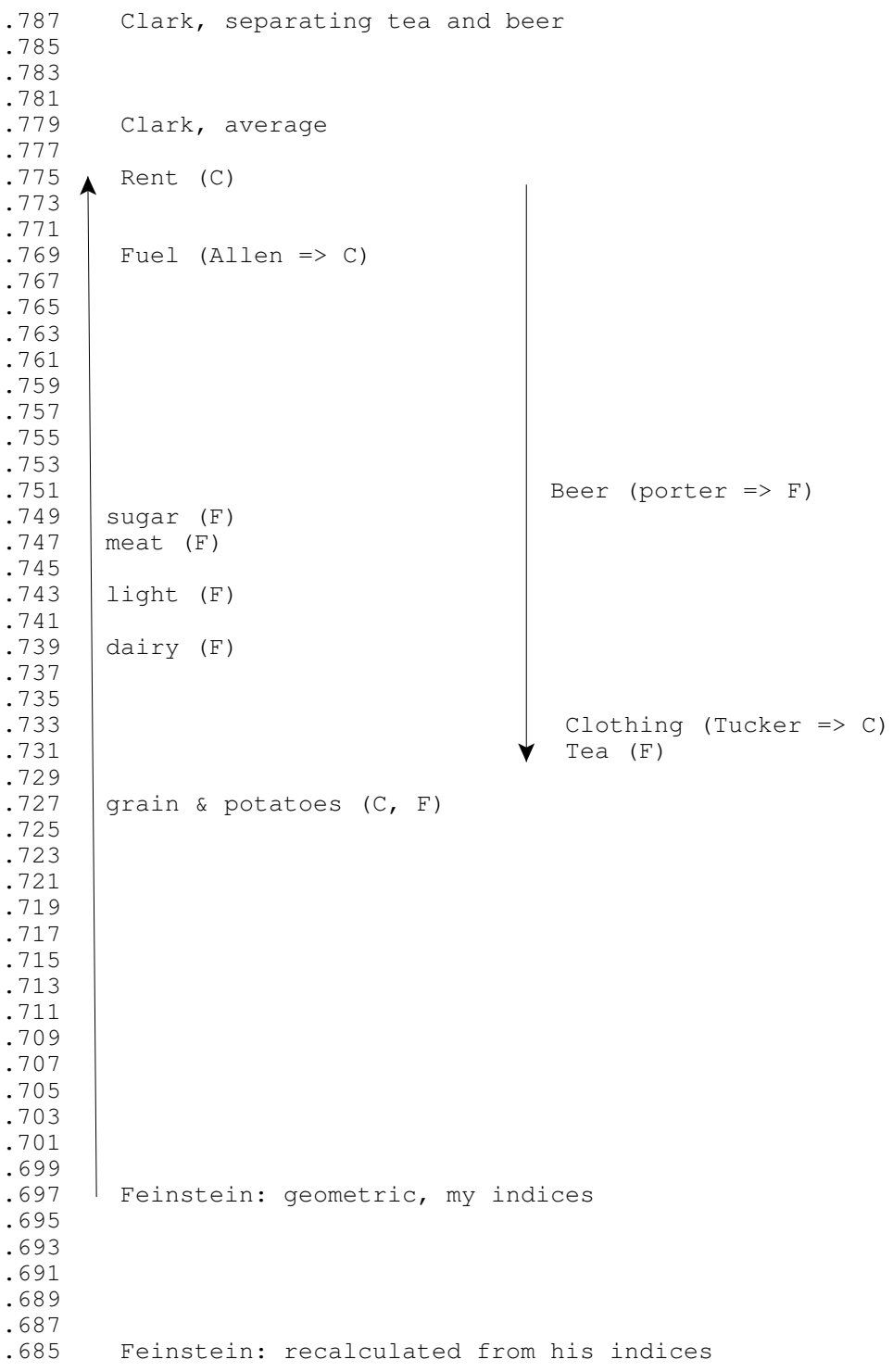


Table 2

Weights

	Clark	Feinstein			Allen
		1788/92	1828/32	1858/62	
food	60.5	69	65	61	62.5
beer	6.5	10	11	12	11.0
tobacco	1.0	0	0	0	0.0
fuel	5.0	4	4	4	4.0
light/soap	4.5	1	1	1	1.0
clothing	12.0	6	8	9	8.0
rent	8.0	10	11	13	11.0
services	2.5	0	0	0	2.5
food breakdown					
carbohydrates					
Bread	18.5		16.25		19.0
Flour			13.65		9.5
Oatmeal	2.0		4.55		4.0
Barley	1.0		0		0
Peas	1.0		0		.5
Potato	4.0		4.55		4.0
rice	.5		0		0
meat					
Beef	11.0		2.60		2.6
Mutton			2.60		2.6
Pork/bacon			5.20		5.2
Fish	.5		0		0
Eggs	.5		0		0
dairy					
Milk	4.0		4.55		4.55
Butter	5.0		2.60		2.60
Cheese	2.5		1.95		1.95
sugar	4.5		4.55		4.0
tea/coffee	3.5		1.95		2.0
salt	1.0		0		
spices	1.0		0		

Sources: Feinstein (1998, p. 635), Clark (2005, p. 1327)

Figure 1

Comparing Feinstein's and Clark's CPIs

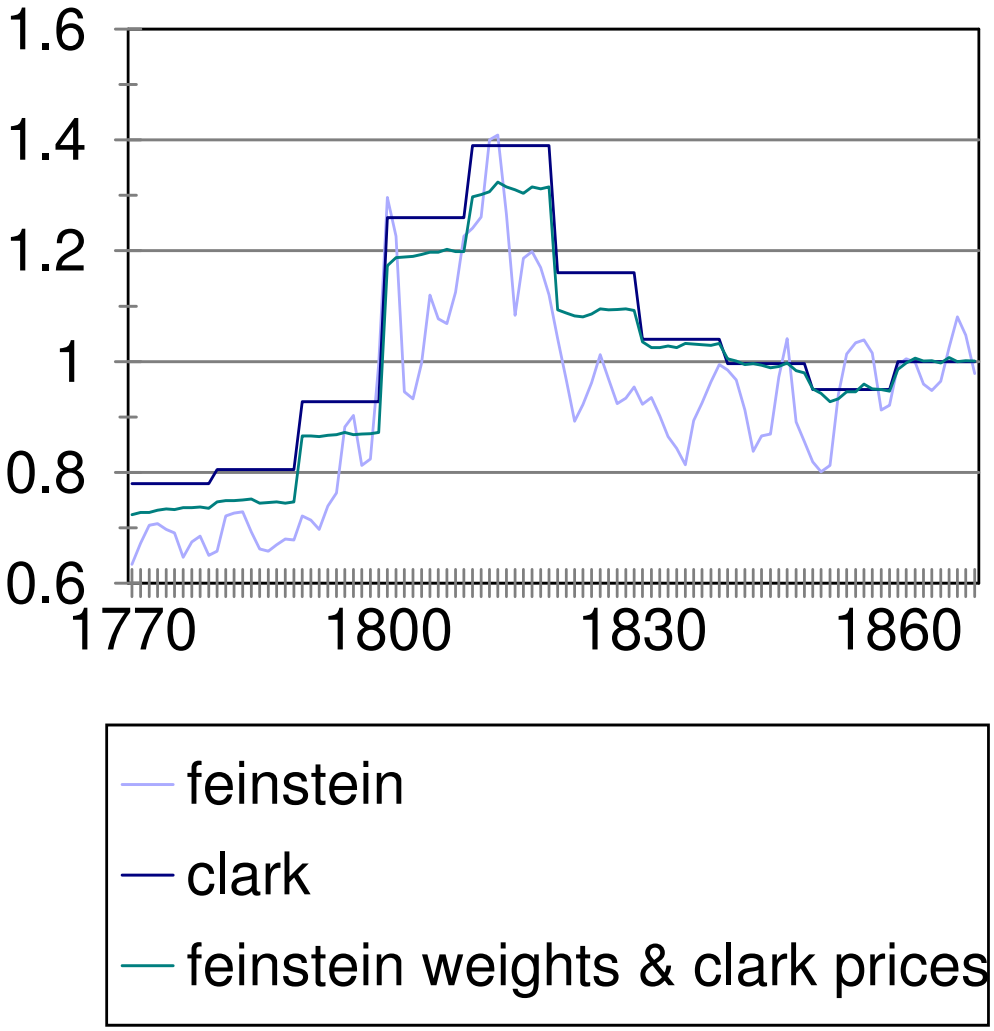


Figure 2

The Demand and Supply of Wheat

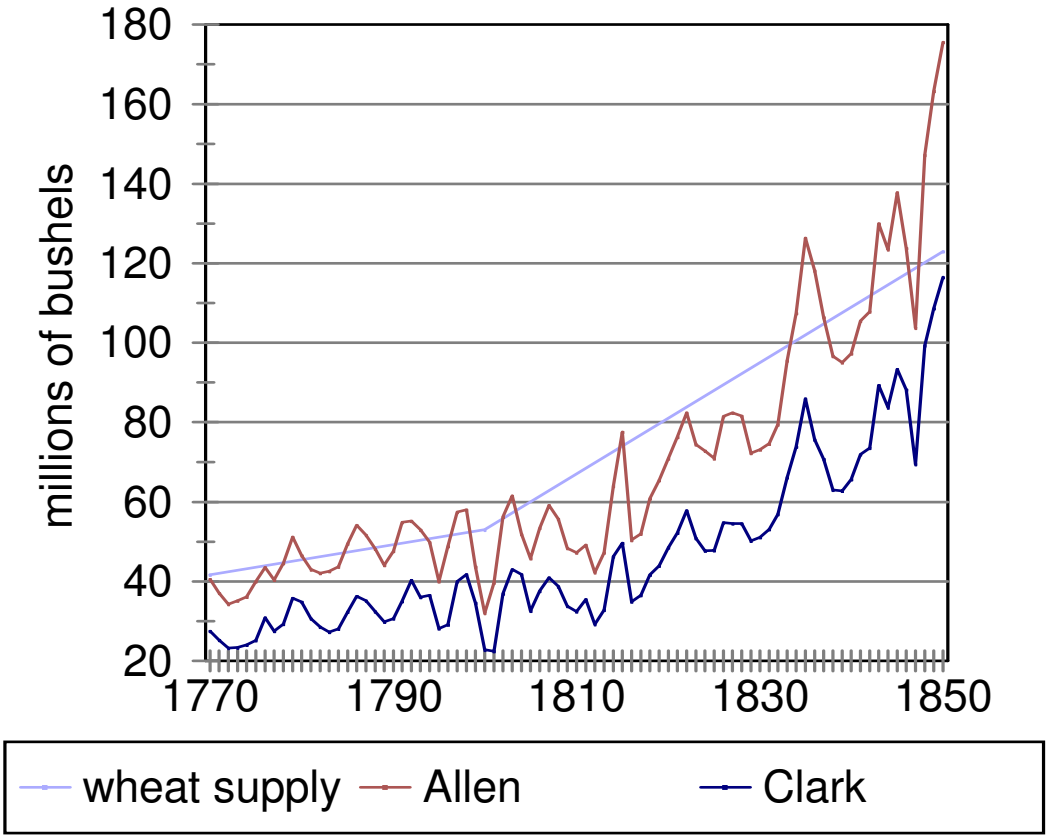


Figure 3

House Rent

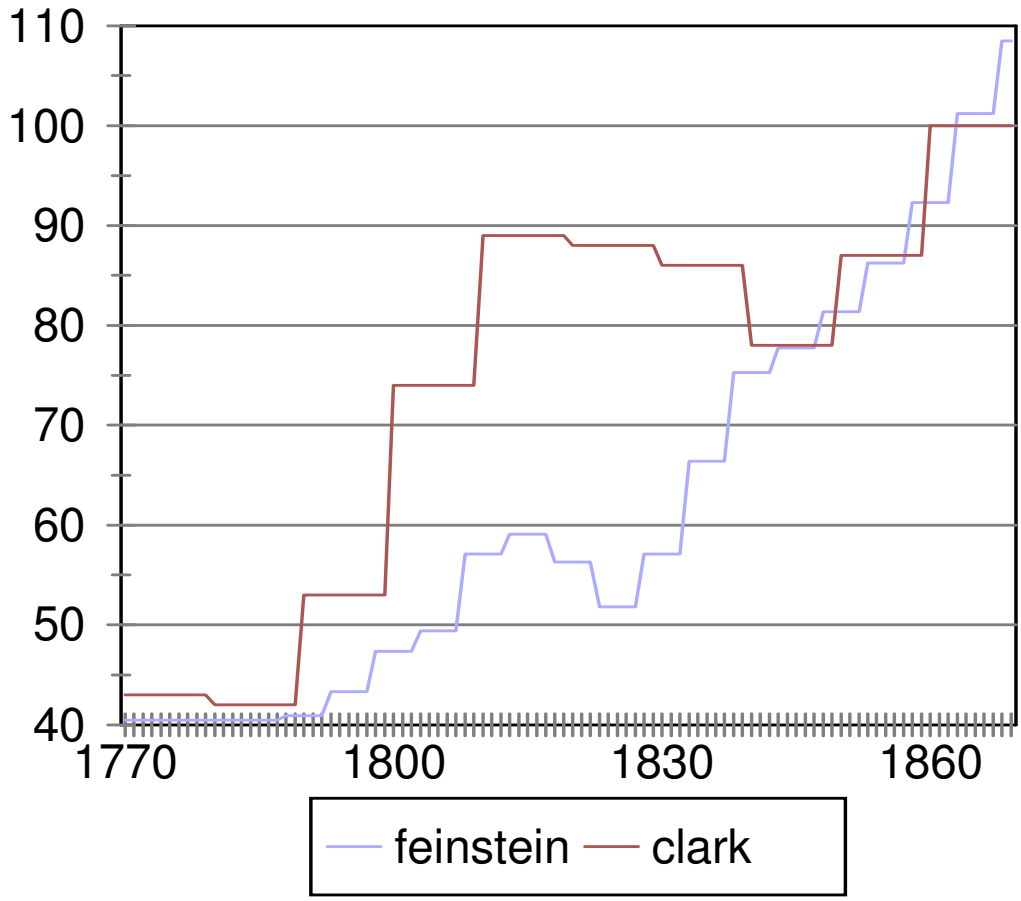


Figure 4

Clothing Price Series

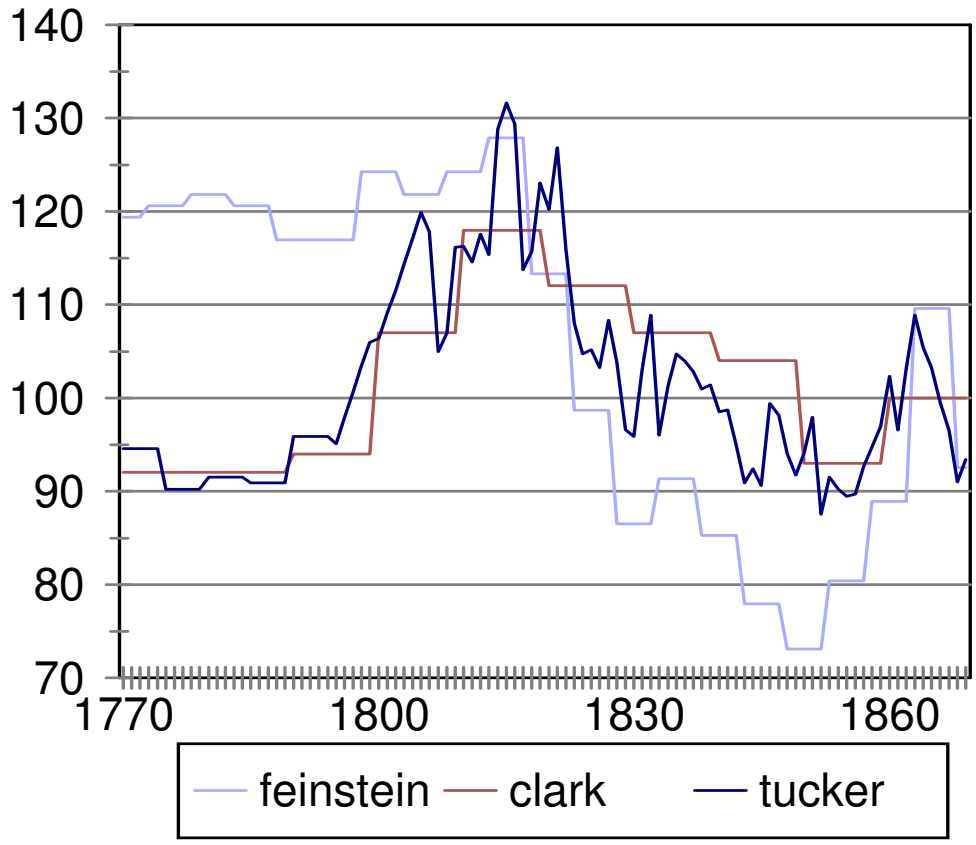


Figure 5

Mimicking Feinstein's clothing index

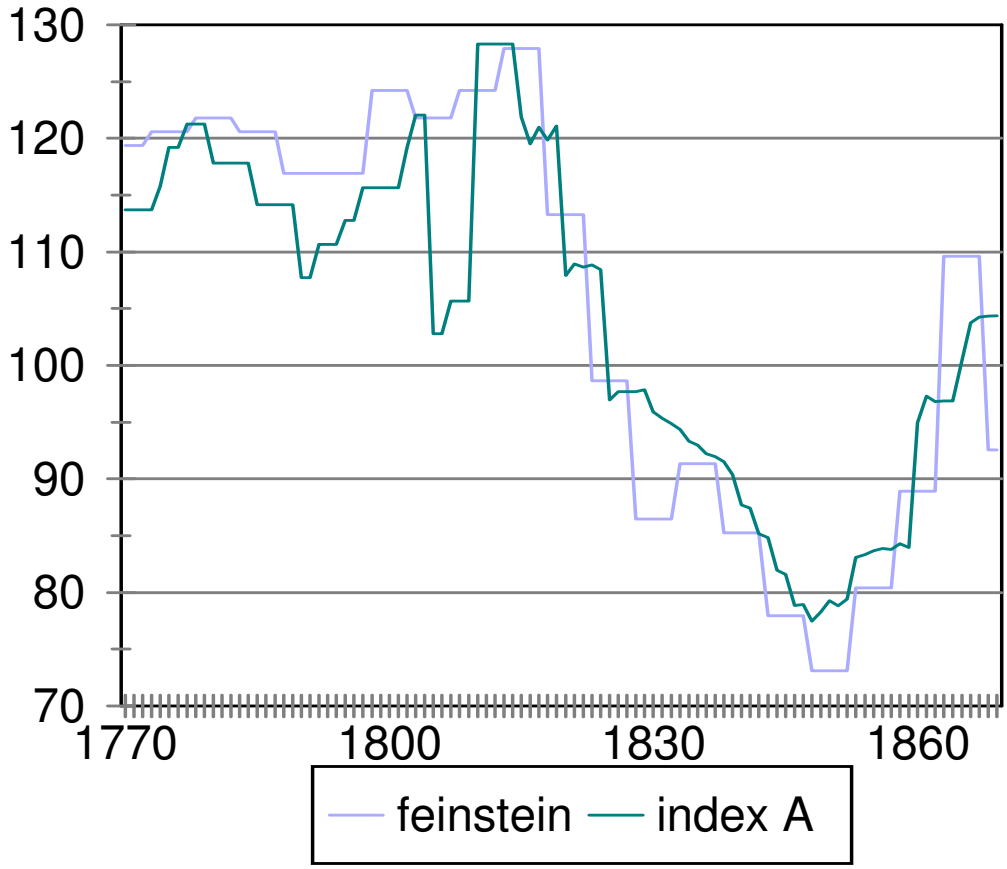


Figure 6

Mimicking Clark's and Tucker's clothing indices

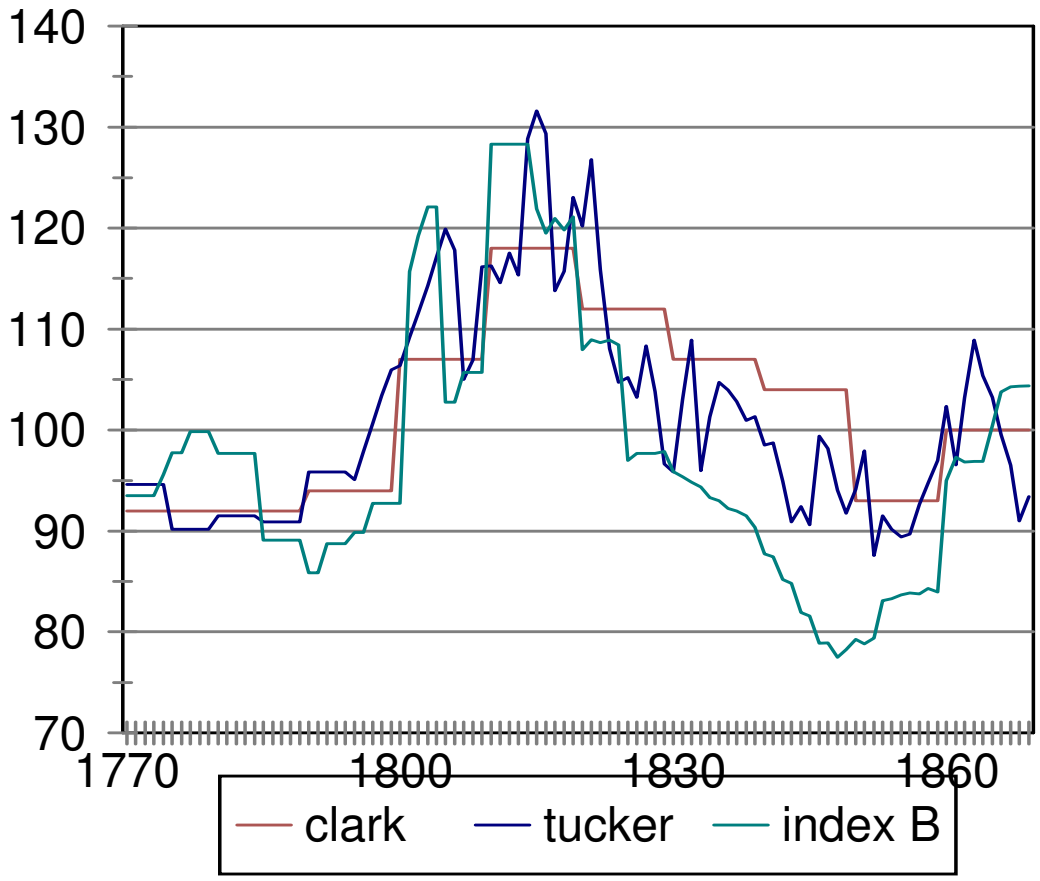


Figure 7

Fuel Price Series

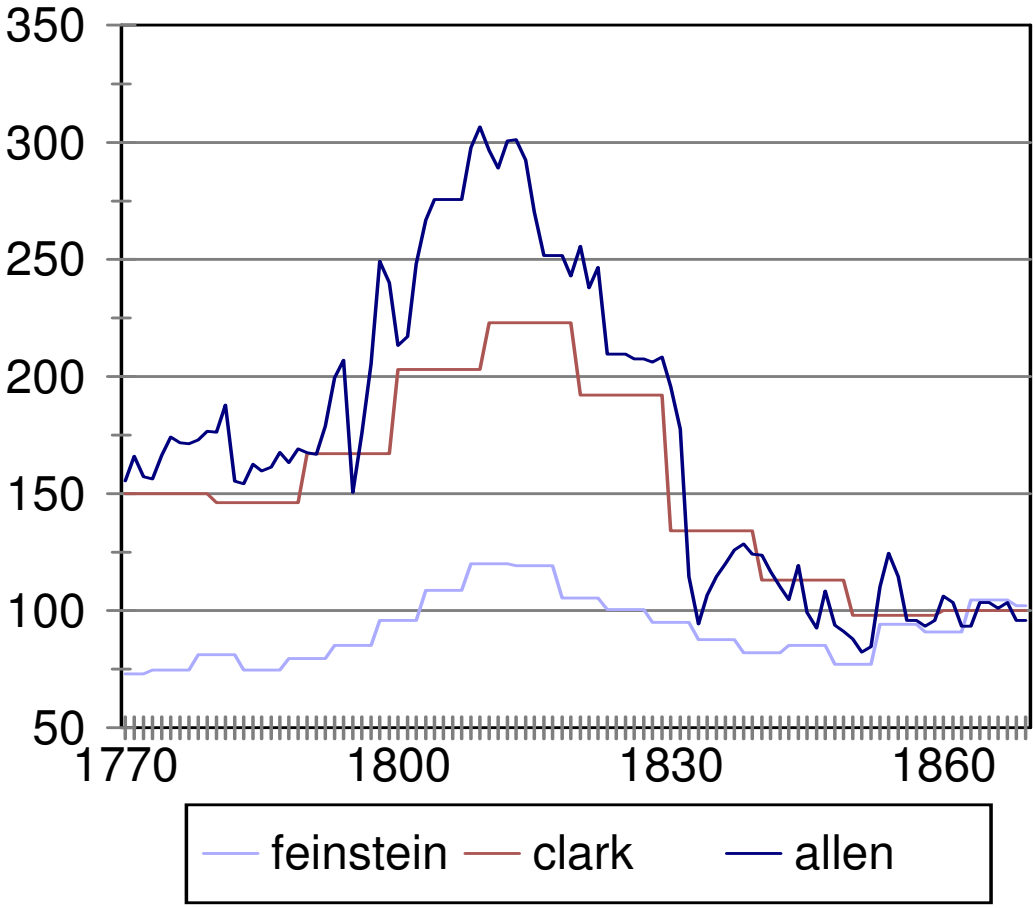


Figure 8

Lighting Price Series

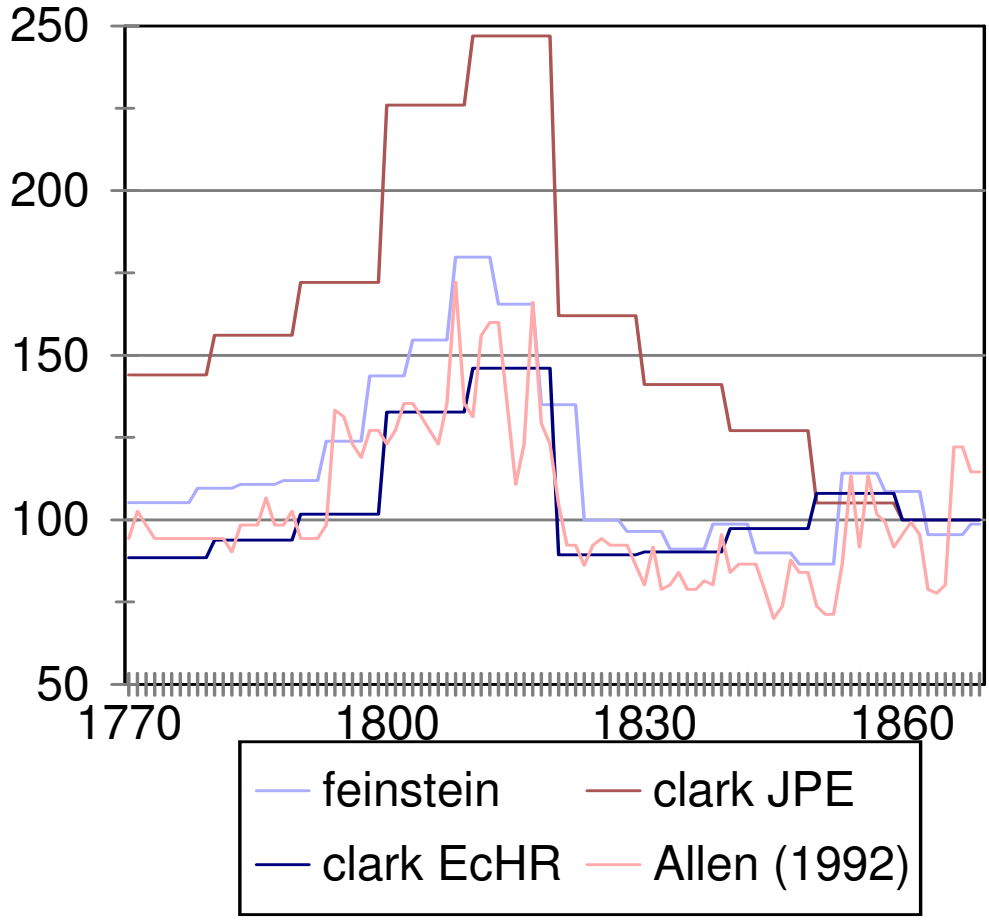


Figure 9

Dairy Price Indices

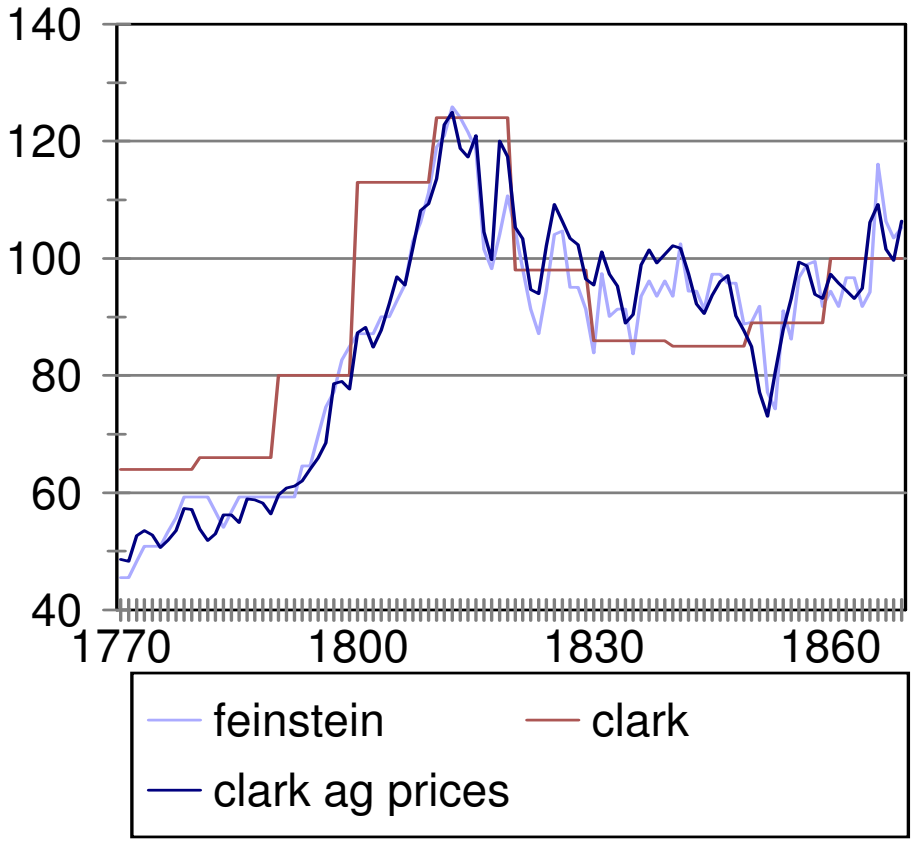


Figure 10

Beer price indices

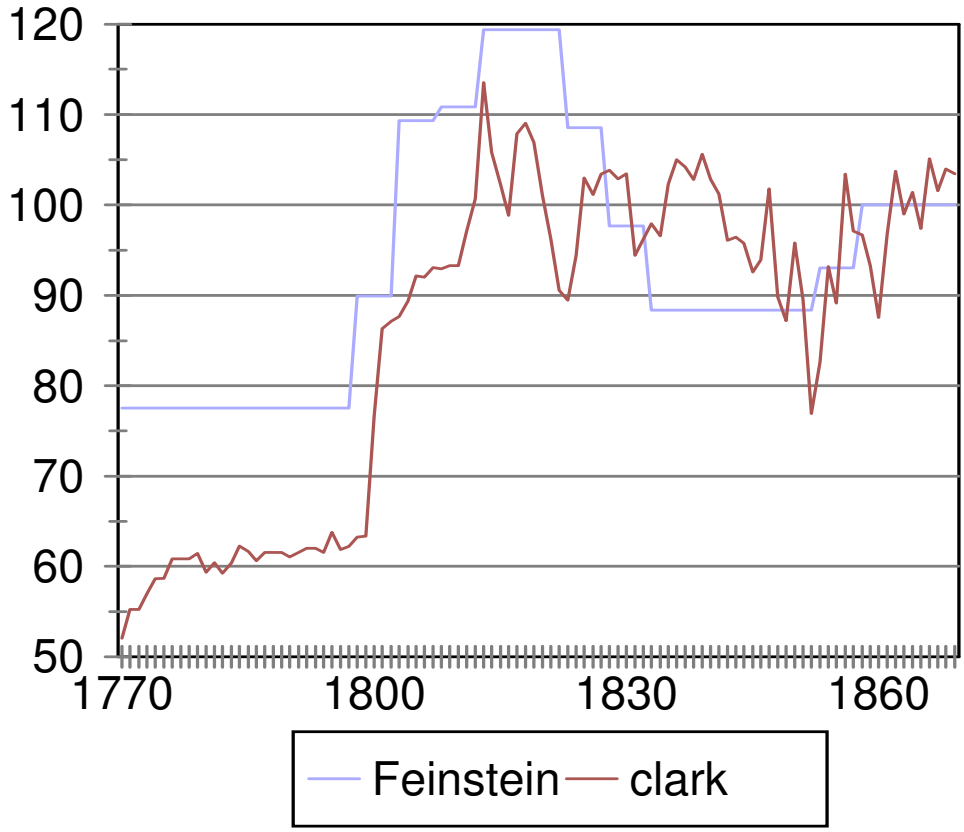


Figure 11

Comparison of Feinstein beer series to market prices

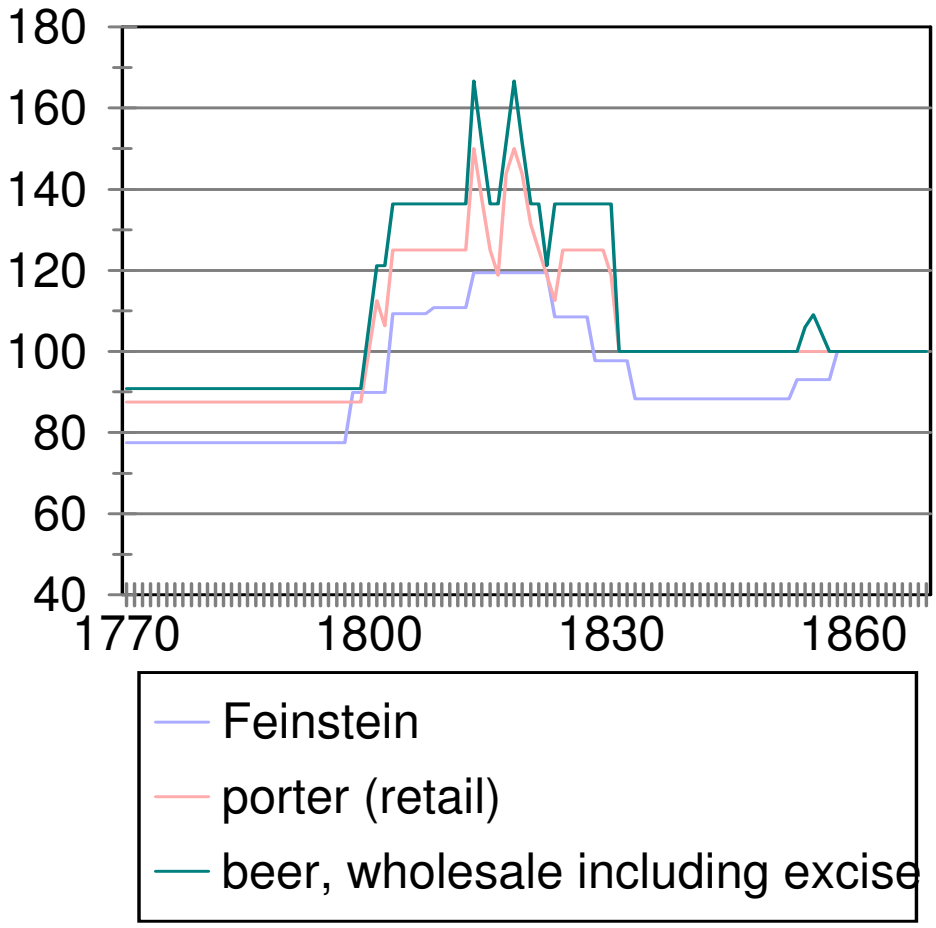


Figure 12

Comparison of Clark beer price series to market price

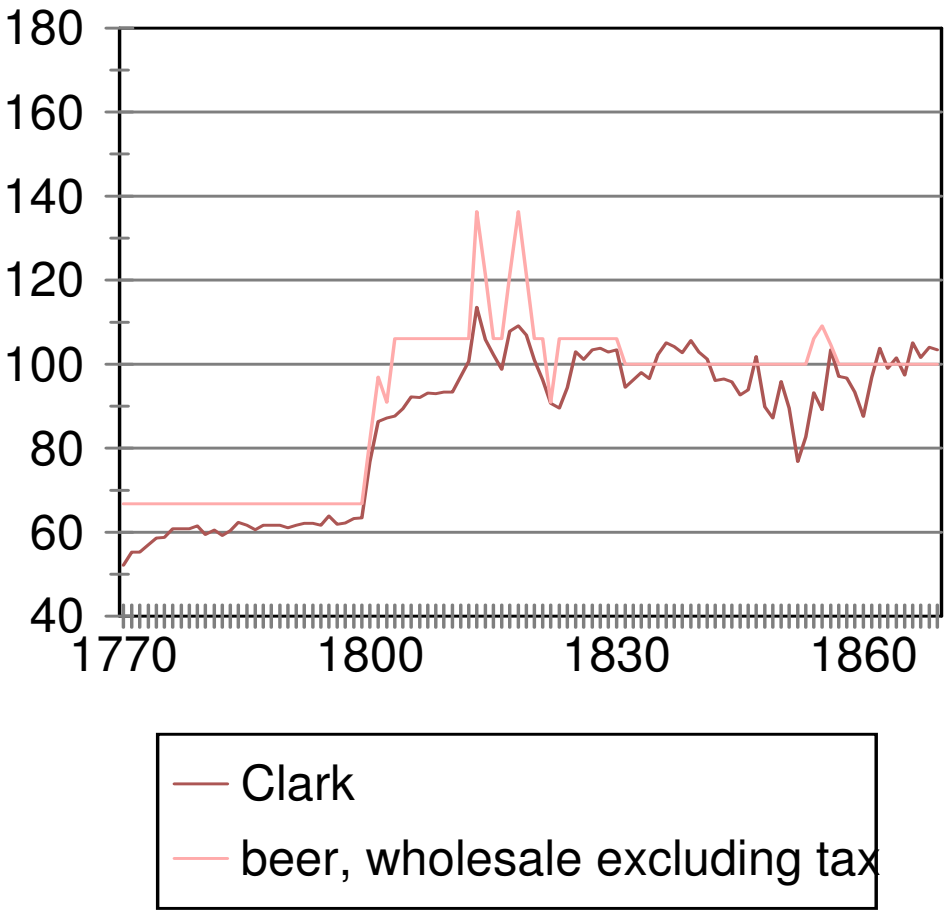


Figure 13

Price Indices of Carbohydrates

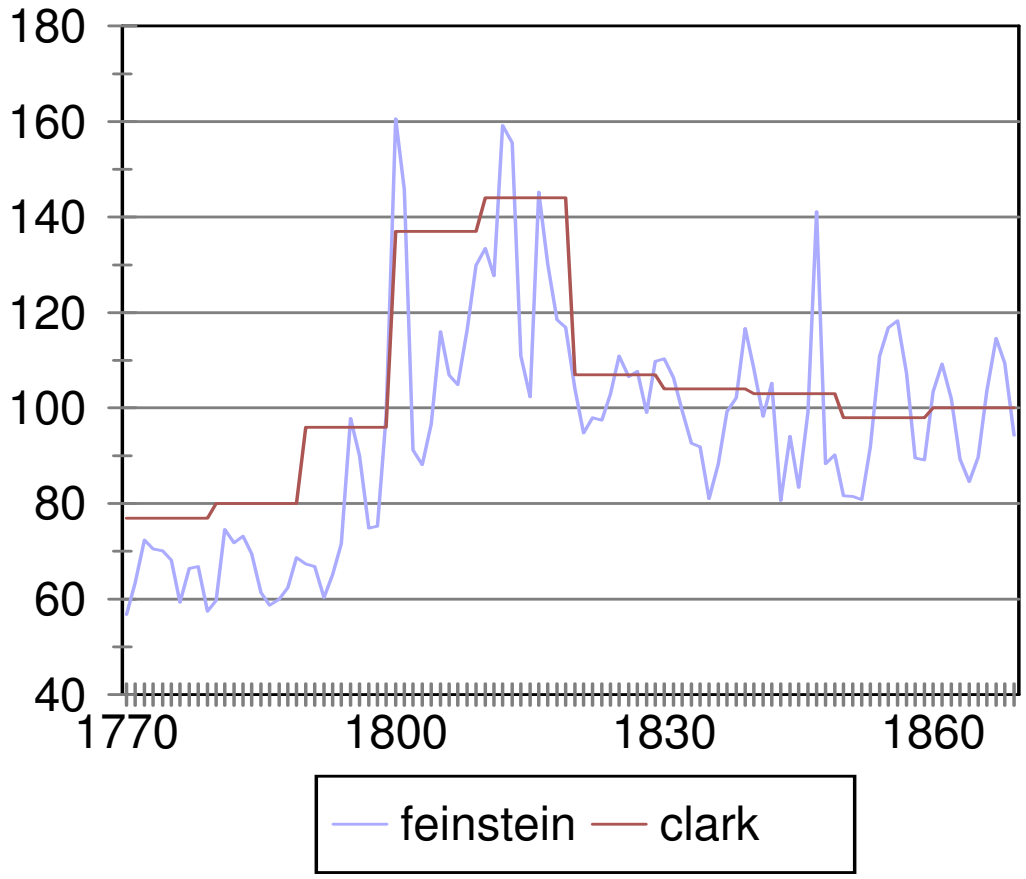


Figure 14

Price Indices of Oatmeal

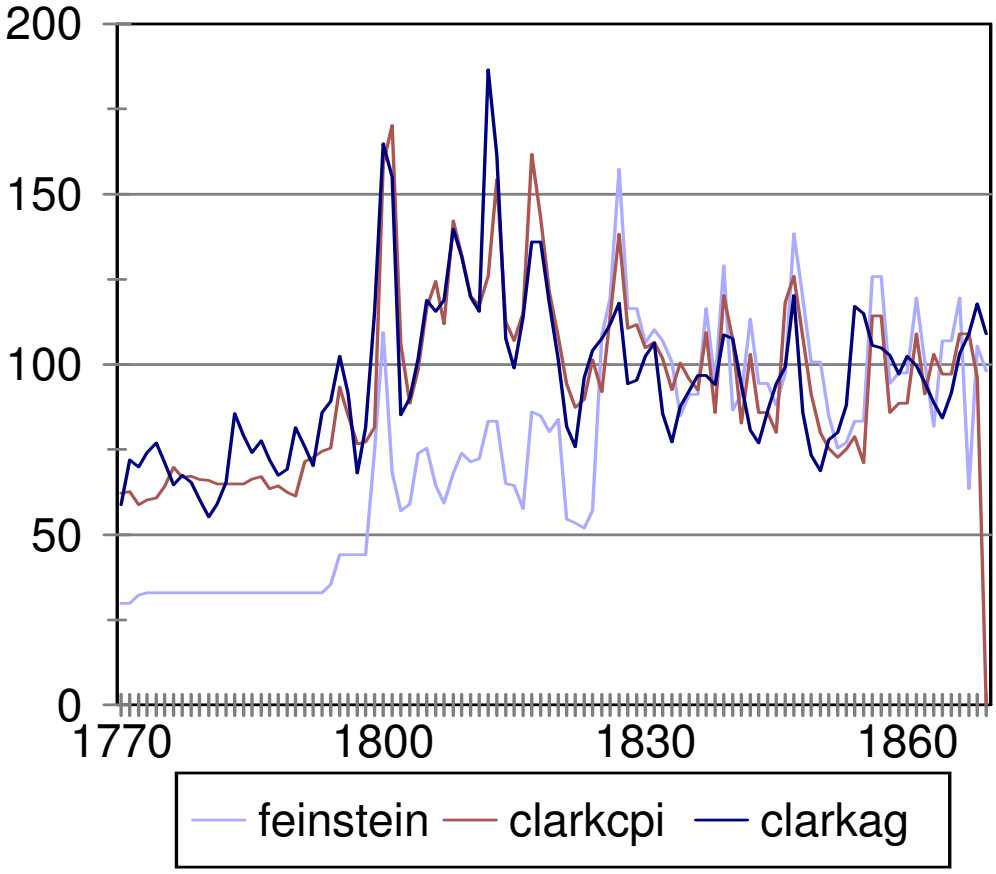


Figure 15

Ratio of the Price of Bread to the Price of Wheat
(Five year moving average)

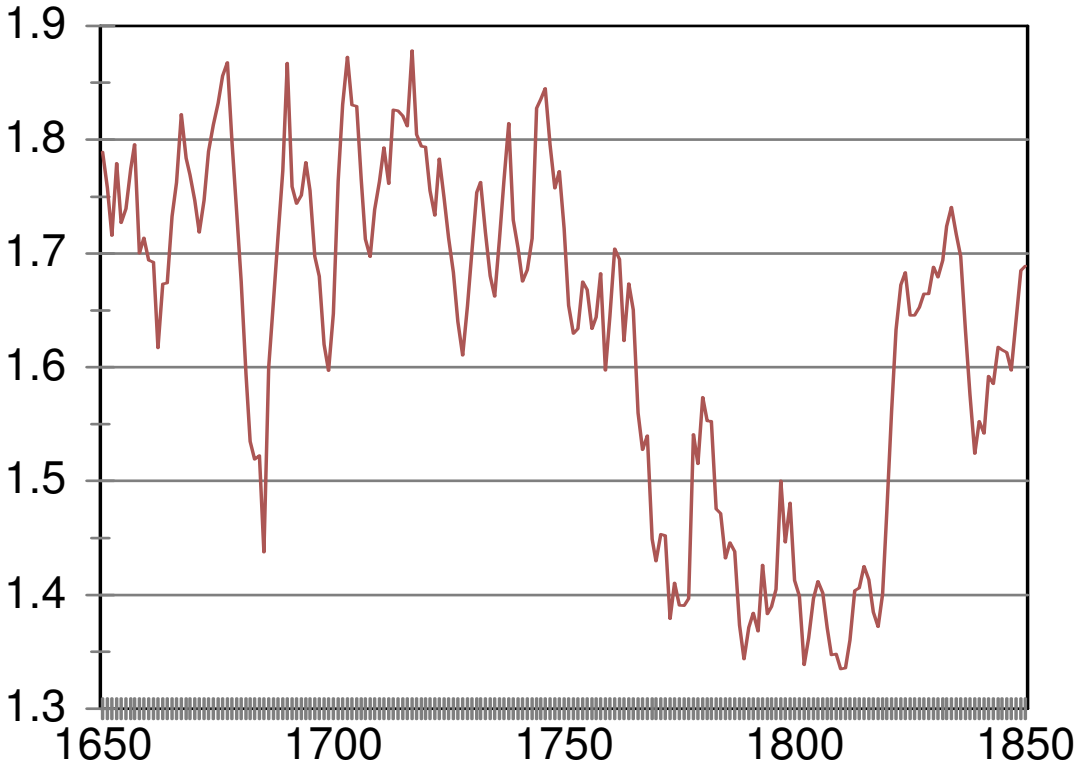


Figure 16

Bread, flour, and wheat price ratios
(Five year moving averages)

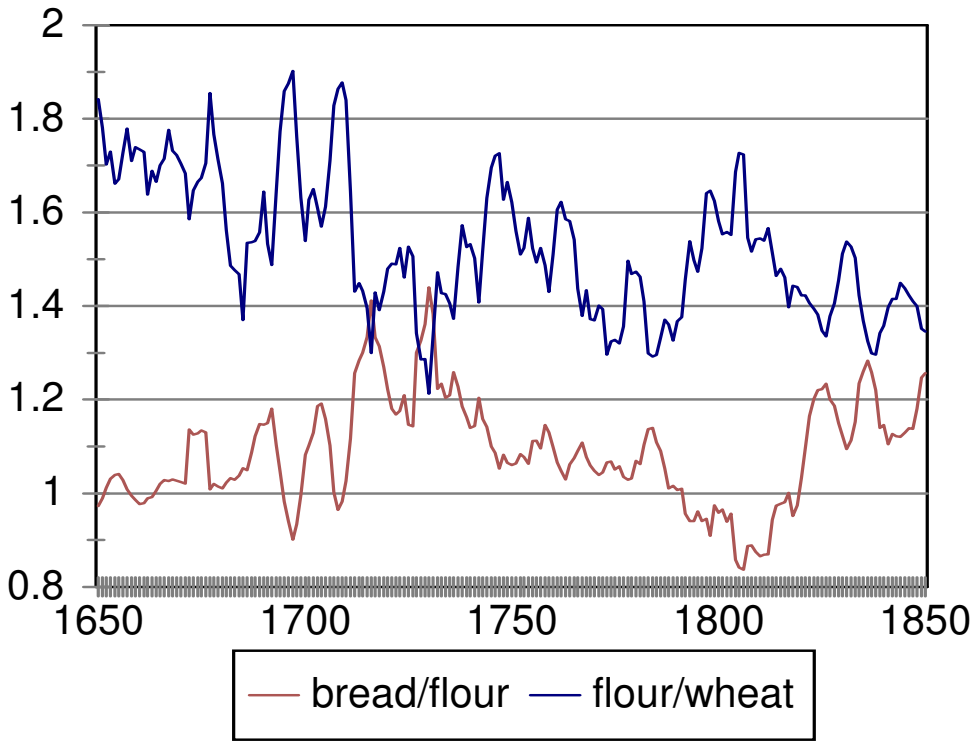


Figure 17

The Real Annual Income of a Baker

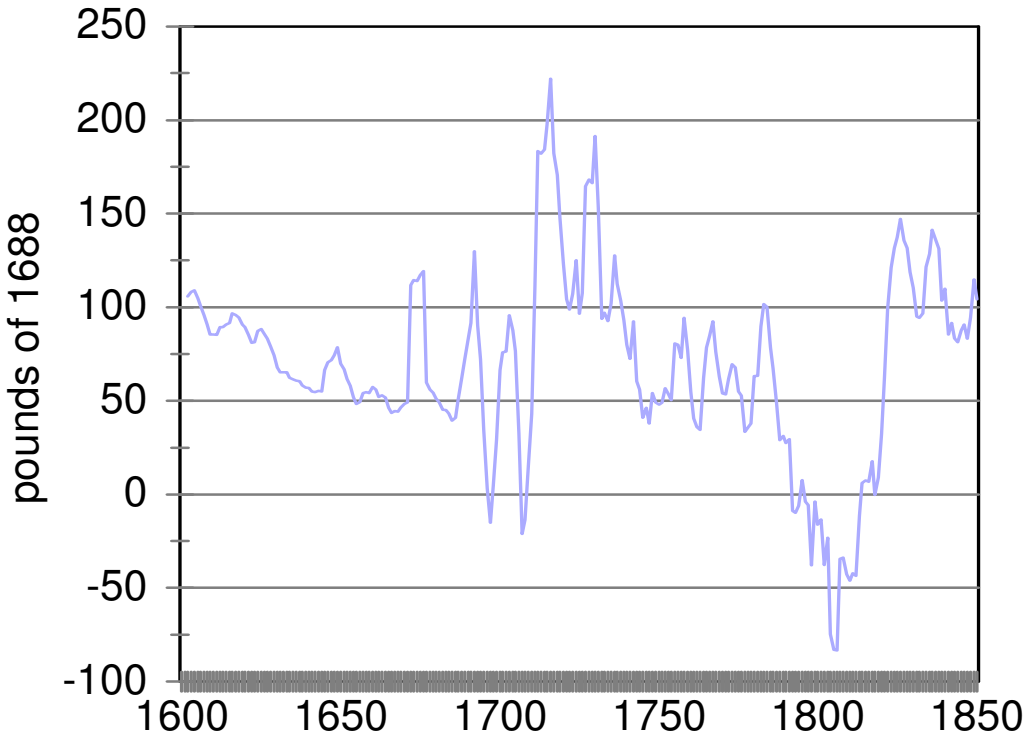


Figure 18

Alternative Consumer Price Indices
(1860-69 = 100)

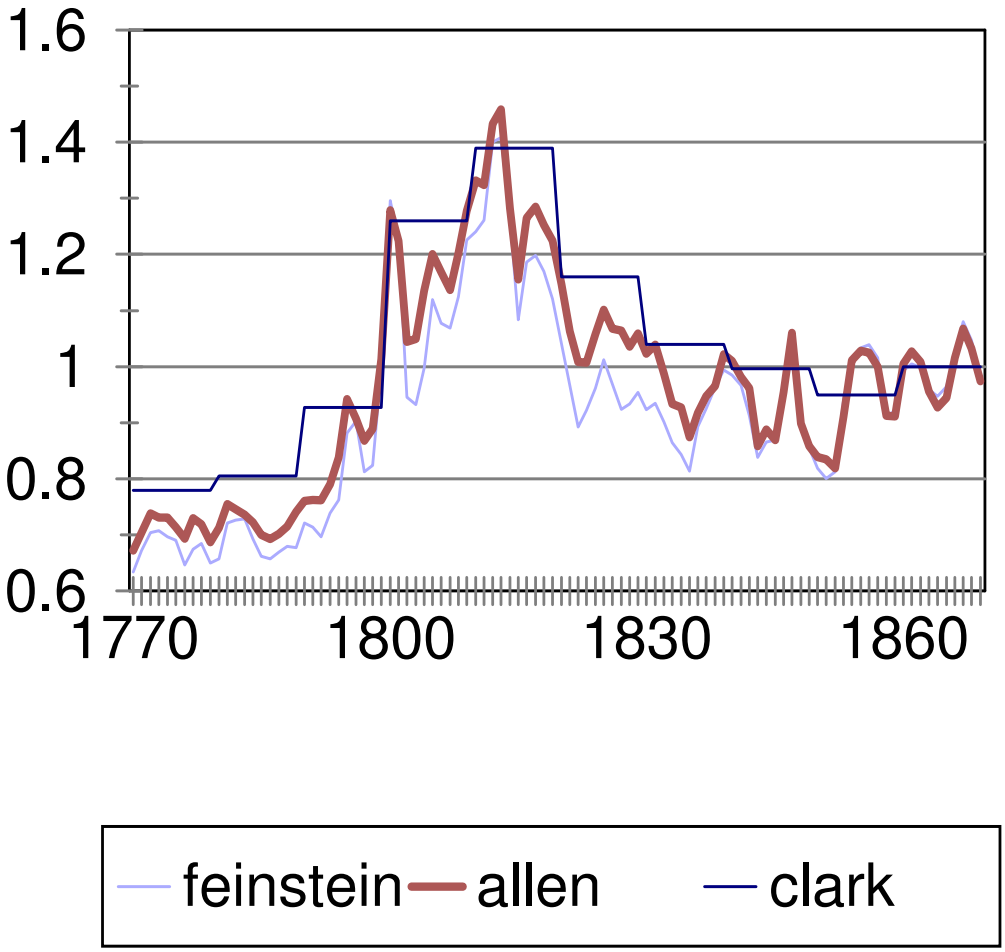
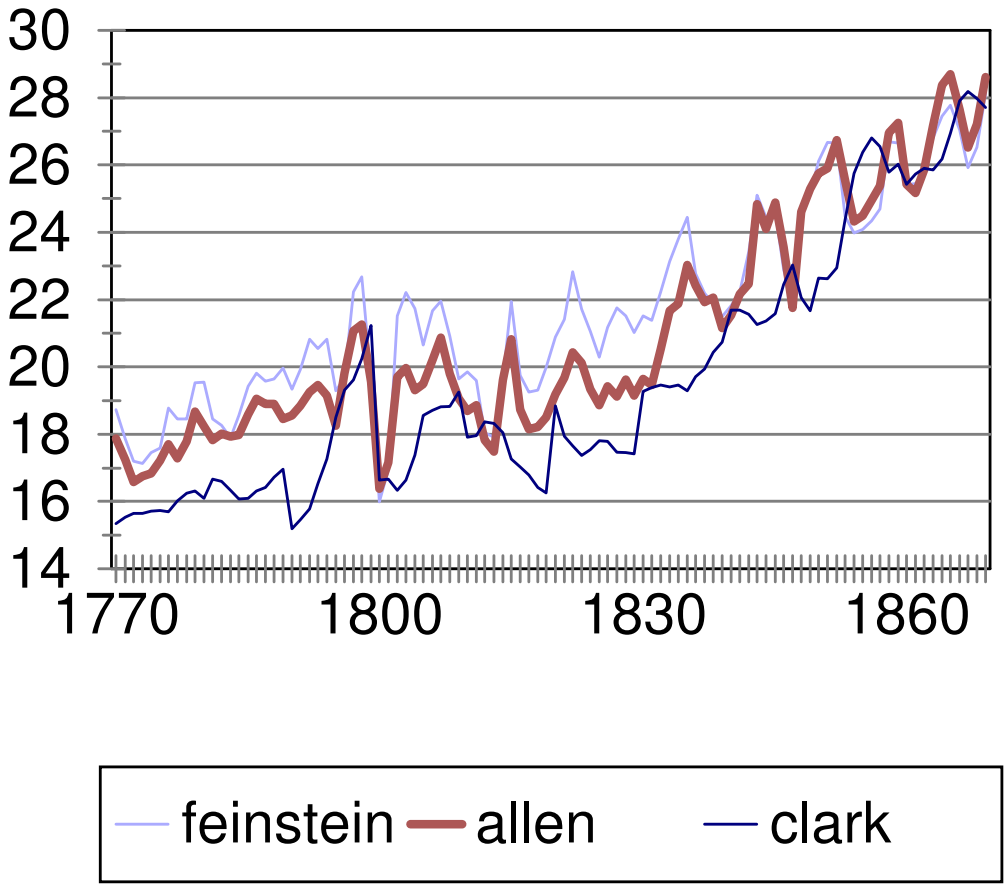


Figure 19

Alternative Real Wage Indices
(Average annual earnings in pounds of the 1860s)



Appendix I: The New Consumer Price Index

1770	67.7	1821	107.2
1771	70.9	1822	101.6
1772	74.4	1823	101.5
1773	73.7	1824	106.6
1774	73.6	1825	111.0
1775	71.9	1826	107.6
1776	69.9	1827	107.3
1777	73.5	1828	104.3
1778	72.4	1829	106.7
1779	69.3	1830	103.1
1780	71.8	1831	104.7
1781	76.1	1832	99.5
1782	75.1	1833	94.1
1783	74.1	1834	93.4
1784	72.8	1835	88.0
1785	70.5	1836	92.4
1786	69.7	1837	95.5
1787	70.7	1838	97.3
1788	72.0	1839	103.0
1789	74.7	1840	101.8
1790	76.7	1841	98.9
1791	76.9	1842	96.9
1792	76.8	1843	86.5
1793	79.6	1844	89.5
1794	84.5	1845	87.6
1795	94.9	1846	96.3
1796	91.4	1847	106.9
1797	87.4	1848	90.5
1798	89.6	1849	86.5
1799	102.1	1850	84.6
1800	128.9	1851	84.1
1801	123.3	1852	83.1
1802	105.2	1853	91.7
1803	105.7	1854	102.4
1804	114.5	1855	102.9
1805	120.9	1856	102.4
1806	117.7	1857	98.7
1807	114.6	1858	90.4
1808	121.2	1859	90.2
1809	128.8	1860	99.1
1810	134.3	1861	101.8
1811	133.4	1862	99.6
1812	144.4	1863	96.4
1813	147.0	1864	93.2
1814	129.2	1865	95.2
1815	116.4	1866	102.3
1816	127.5	1867	107.7
1817	129.6	1868	103.9
1818	126.3	1869	97.5
1819	123.4		
1820	115.6		

Appendix II: The New Real Wage Index

(Feinstein's nominal wage series divided by new cpi)

Pounds per year in prices of the 1860s

1770	17.50	1821	19.26
1771	16.88	1822	20.00
1772	16.23	1823	19.69
1773	16.40	1824	18.94
1774	16.48	1825	18.46
1775	16.85	1826	19.02
1776	17.33	1827	18.70
1777	16.91	1828	19.21
1778	17.41	1829	18.74
1779	18.27	1830	19.23
1780	17.84	1831	19.05
1781	17.45	1832	20.10
1782	17.62	1833	21.21
1783	17.55	1834	21.42
1784	17.60	1835	22.54
1785	18.20	1836	21.94
1786	18.64	1837	21.47
1787	18.49	1838	21.59
1788	18.49	1839	20.71
1789	18.07	1840	21.07
1790	18.16	1841	21.69
1791	18.44	1842	21.99
1792	18.85	1843	24.30
1793	19.04	1844	23.59
1794	18.74	1845	24.35
1795	17.87	1846	23.06
1796	19.40	1847	21.30
1797	20.63	1848	24.10
1798	20.80	1849	24.75
1799	19.15	1850	25.20
1800	16.04	1851	25.35
1801	16.80	1852	26.00
1802	19.28	1853	25.03
1803	19.55	1854	23.67
1804	18.90	1855	24.14
1805	19.08	1856	24.64
1806	19.79	1857	25.34
1807	20.43	1858	26.85
1808	19.38	1859	27.17
1809	18.66	1860	25.42
1810	18.30	1861	25.06
1811	18.47	1862	25.80
1812	17.45	1863	26.61
1813	17.12	1864	27.86
1814	19.19	1865	28.07
1815	20.37	1866	27.04
1816	18.33	1867	25.94
1817	17.77	1868	26.68
1818	17.84	1869	28.18
1819	18.11		
1820	18.78		

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