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Bulk Commodities and the Liverpool and London Markets of the Mid-19th Century

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Abstract: We study British prices and the degree of commodity market integration between Liverpool, the bulk commodity port of mid-19th century, and London. A new wholesale commodity price index is presented for Liverpool and this is compared with the Klovland-Sauerbeck index. Next, we examine the relationship between Liverpool and London markets in specific bulk commodities. Our data consist of price indices for identically described goods in both Liverpool and London: three commodity groups (metal products, wood products, and processed foods), and the specific commodities of wheat and flour. Tests for cointegration reveal convergence among the six price pairs. We also find that the markets were highly integrated in the short-run because three of the commodity group pairs (processed foods, wheat, and flour) shared common features or cycles. A common cycle implies that transitory price shocks in Liverpool had the same impact on prices in London and *vice versa*. The importance of the London and Liverpool common cycle to a shock is brief. Its shock explains less than 20 percent of the variation in the relevant price levels after twelve months, on average.

JEL classification: N13, N73, E31

Key words: Liverpool, London, price indexes, markets, commodities, bulk trade, 19th century, wheat, flour, cointegration, cycles, co-features

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Bulk Commodities and the Liverpool and London Markets in the Mid–19th Century

The importance of the port of Liverpool was its growth to dominance in the overseas bulk trades in the first half of the 19th century. Liverpool prices were particularly important in the North Atlantic trades and invariably the ones reported in the North American press as the key British prices. By transaction volume, the largest Liverpool trades were in raw cotton, timber and grains with the two latter growing rapidly at mid-century. By 1859 the wheat and flour trade rivalled that of timber [Williams (1989), 8 – 25]. Liverpool was also the key export port of mid-century. According to Francis Hyde (1971), the port accounted for about 45 per cent of all British exports in 1857 with its nearest rival, London, far behind at 23 per cent. Although the port continued its absolute growth, by the late 1860s, the relative trade volumes, and values, through the Port of Liverpool were in decline both with respect to London and British ports as a whole.[2] Yet at mid-century, and beyond, it was the port whose prices were of key concern in North America. This paper studies wholesale prices in mid-19th century Liverpool and links to London markets.

Market integration and the spatial convergence of prices are now familiar themes in the history of the late 19th century Atlantic economy [Harley (1996), O'Rourke and Williamson (1999) and Taylor (1999) for example]. Particular attention has been paid to the similar variation of long-run trends using annual prices and to declining transport costs between specific markets over time. While related, market integration and price convergence are nonetheless different economic phenomena. Market integration is said to exist when prices in one market are not independent of prices in another market. In the presence of relatively high transport costs, there can still be a relative high degree of integration brought about by this interdependence. A decline in transport costs may increase market integration by reducing commodity arbitrage risk especially if the cost decline is accompanied by the speedier and safer shipment of commodities. By pushing out the extensive margin of cultivation or production, a decline in transport costs will also extend the economic area under the influence of the wider or world market [Harley (1980)].[4]

Most recent histories of international price convergence are drawn from the years after 1870 and are based on the annual prices, which although useful, mask the short-run dynamics of price adjustments - the key evidence of market integration. In addition the literature tends to concentrate on a few specific

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[2] Liverpool, in 1857, accounted for approximately 45% of all the British exports trade (London, Hull and Glasgow for 23%, 13% and 4% respectively) and one-third of the British import trade by value [Hyde (1971) p. 97].

[4] Even in the 20th century the differential between the Liverpool and Manitoba price of wheat varied on a seasonal basis [Snodgrass (1926), 177 – 202].

commodities, principally wheat and flour. Depending on how the annual price is calculated we also lose historical richness about market adjustment by generalising over two harvest seasons or by use of weighting schemes that ignore the quantity flows. In the context of markets within Britain, the bulk import trades were all ones in commodities with seasonal patterns. This imposed the usual harvest time price adjustments. At one extreme was the timber trade. Because of the cessation of shipments for part of the year from the major supply regions commodity arbitrage within Britain could only be conducted from existing stocks. Trade between Britain and the Baltic region or the Great Lakes - St. Lawrence River region in North America was effectively stopped by the icing up of ports.[5]

In the first section of this study we construct a price index for the port of Liverpool - the bulk trades port of mid-19th century Britain. Next we document the components of the index in order to describe the short-run price instability of the period. Third, this new price evidence is used to examine the sensitivity of the price adjustments between the Liverpool and London markets for several of the key trades. For this task new, London prices are also presented.

Although the mid to late-19th century is thought to be an important period in the creation of 'national markets' in Britain there has been little historical evaluation of the claim. The exception is the literature on grain prices during the Irish famine period of the 1840s [O'Rourke (1994)]. There is also evidence that implies markets within Britain were highly regional in nature [Latham (1967) and Perren (1990)].[6] The same claim has also been made of France: that French agricultural markets were fragmented in the 19th century. Ejrnaes and Persson (2000), recently showed that this was not the case. By about 1850 nearby French markets adjusted rapidly to shocks in the other and while more distant markets adjusted more slowly they did so with increasing speed through the third quarter of the 19th century.

The mid-19th century in Britain and elsewhere in the North Atlantic economies is a key period in the history of commodity arbitrage for two reasons. First, in Britain the decade of the1850s was the first in which the new technologies of the electric telegraph and the railways linked all the main regional centres. In the absence of speedy communications and transport the parties to trade act somewhat in ignorance of the eventual prices to be realised. The near instant communication of prices by telegraph reduced, but did not eliminate, this uncertainty by shortening the time lags. There was still a risk that the price would change between the contract price (or price at time of shipment) and the prevailing price upon arrivals of the goods in the other market and this risk was borne by at least one of the parties to the exchange. Similarly, changes in transport at mid-century provided an alternative to the coastal and canal trades for many bulk commodities and reduced the risks in commodity arbitrage. Second, the mid-19th century is of

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[5] The first shipments of Baltic and North American timber typically arrived at British ports in late May and June. The last shipments usually arrived in mid to late November. Certain BNA Atlantic colonies, such as Nova Scotia, did have ice-free ports but they were not timber shipping ports.

[6] Latham (1967) claims that Liverpool timber and lumber were seldom shipped more than 100 mile and Perren (1990), 420 – 437 makes the same argument about the short distances of domestic flour shipments (25 miles).

interest because of the major fluctuations in world prices associated with the great Victorian boom of the mid-1850s and the US Civil War of the1860s.

Our understanding of the general British price level at mid-19th century stems from three basic sources. The Gayer-Schwartz-Rostow price index ends in 1850 and because of its coverage sheds only limited light on the mid-19th century price behaviour [Gayer et.al. (1953)]. The Sauerbeck index extends from 1846 onward and the Rousseaux price index covers the period 1840 – 1896 [Mitchell (1962)]. The first of these is weighted but the latter two are not. All are annual indices. A major addition to the price history of the period has been made recently by Klovland. He returned to the original sources and recalculated the Sauerbeck index to provide monthly observations [Klovland (1993)]. It is primarily a London-based wholesale price index. Apart from its use for the analysis of many microeconomic issues of the period the monthly index is superior to the annual ones for insight into mid 19th century macroeconomic fluctuations.

Some of the price shocks of this period were of internal origin while others have external sources [Calomiris and Schweikart (1991)]. For the open economies with which Britain traded, these shocks, wherever their source lay, were transmitted from British markets, either directly or through linked markets, by movements in the prices of traded goods – the terms of trade. Liverpool was the port of price reference.

The Price Data

The price index for Liverpool covers the years 1850 to 1871 and is based on the prices of goods that entered into the North Atlantic trade in a major way. In all 36 commodities are included although not all commodities originated in the North Atlantic economies. Items such as tea and spices, for example, were important commodities in the Liverpool trade from a re-export point-of-view. British exports and imports are represented in the index and their appearance in the bundle of goods treated here is justified by the traffic between Liverpool and the combined St. Lawrence River ports of Quebec City and Montreal. Our interest in Liverpool prices builds on an earlier study that proposes a new wholesale price index for Canada of this period [Paterson and Shearer (2003)]. Montreal was the principal port of entry of goods into Canada and Quebec City was the major North American timber port. Shipping and British customs records do not always permit a clear distinction between the various British North American colonies however.[7] In 1853/5 British North American imports represented 16 to 17 % of Liverpool trade by volume. The Liverpool – St Lawrence River trade is likely representative of all trade between Britain and North America in terms of the variety of goods but not necessarily the volume of transactions. Naturally there was no trade in raw cotton with the St. Lawrence River economy but there was a substantial export of cotton cloth to Canada and the other British North American colonies. Liverpool raw cotton prices are thus

[7] Canada here refers to the Province of Canada as it existed between 1841 and 1867. It does not include the separate British North American colonies of New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland. The first two of these joined with the Province of Canada in 1867 to become the Dominion of Canada.

added to the overall price index. While this reflects Liverpool imports of raw cotton it will tend to overstate the price of the shipment of textiles from the port. Textile prices tended to vary less than the basic raw cotton prices although consistent evidence of this is hard to substantiate at high frequency levels.[8] British North America was also important to Liverpool. For instance, of the timber flowing into Liverpool, the largest volume came from British North America. In 1850, this amounted to 81.6% of the total while Baltic shipments accounted for only 6.0% [Williams (1989), 11-13].

The frequency of the price index is monthly and the prices are the low quotations for the third Thursday in each month. In the absence of a Thursday price quotation, the nearest dated price is taken. Where the price was listed as 'nominal' or when no trade took place, the last prevailing price is used – a procedure of modern price index building and which is only infrequently necessary here. The prices are wholesale ones mainly from the 'Wholesale Prices Current', see Table 1 for the list of commodities and the sources of information. All prices are in index form with the average of 1860 prices equal to 100.0. Both an overall price index and sub-indices are presented. Although biased toward towards goods that entered into international trade, many of the sub-indices are also representative of sectoral prices in Britain. For instance, the metals price index covers seven commodities of British manufacture. Timber and lumber prices are also highly representative of domestic prices because of the overall importance of imported wood in domestic consumption (although later we shall draw attention to some important distinctions between the Liverpool and London markets in this commodity).

The overall price index and all sub-indices are geometric means of all the commodities in the group. Since some commodities or their close substitutes appear in the index more than once, such as three types of raw cotton or three types of wheat and flour, this is a weighted index only in the limited sense that there are implicit weights although they are somewhat arbitrary. The weights are given in Table 2. Later in this study comparison is made with London prices. The London prices used here are based on a similar dating and quotation basis as those for Liverpool. They differ from Klovland's collection of London prices although in some cases they share the same sources.[9]

Duties. Newspapers and brokers' circulars of the period normally quoted both Liverpool and London prices exclusive of duty paid where the commodities were held in bonded warehouses or in special holding areas. All the duties of the period that are relevant were specific duties. Here, the main price indices are presented inclusive of duty as is done with most modern indexes. The duty is added to individual pre-duty prices to give market prices. As is well known, the tariff structure of Britain changed radically at mid century with important tariff reductions in the 1840s and the early 1850s. There was, however, one important exception for the 1850s. This was the remnants of the Baltic Timber duties which in various forms existed from 1804 and were designed to confer a competitive advantage to forest products from British North America by discriminating against shipments from Baltic Europe [Lower

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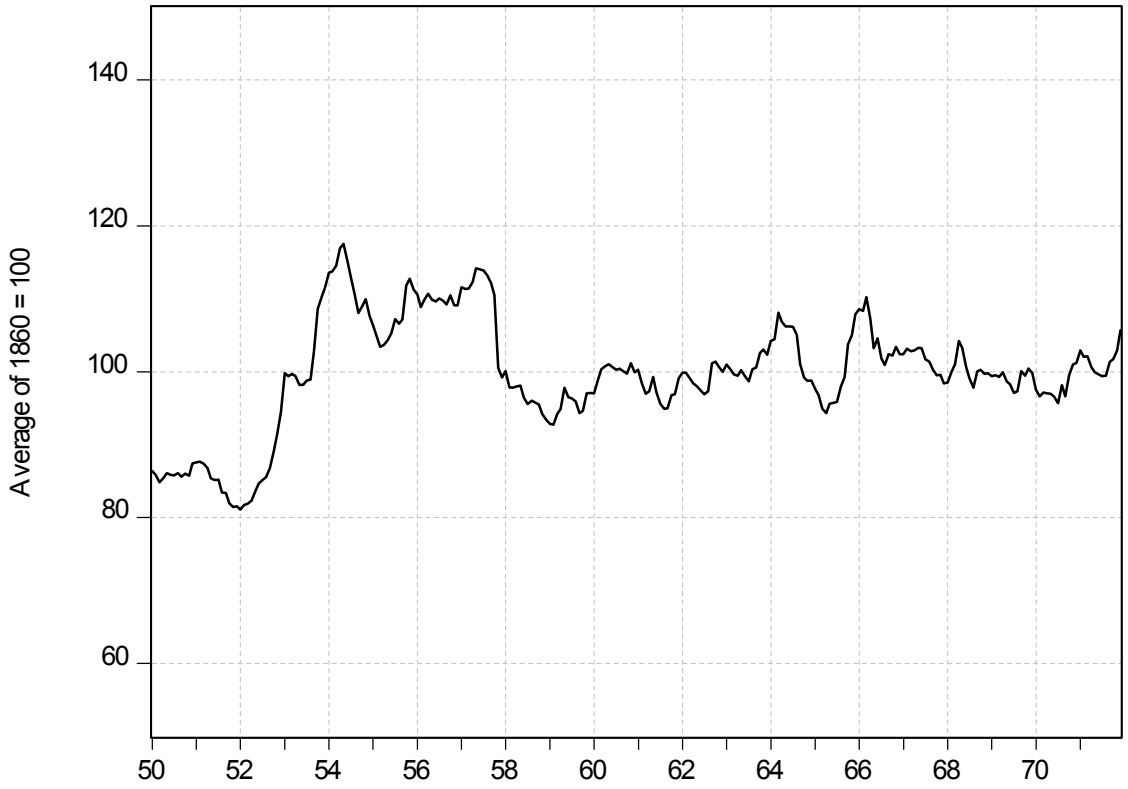
[8] Consistently defined textile prices were only irregularly reported. Our evidence is found in the ***Liverpool Mercantile Gazette*** of the late 1840s.

[9] Klovland's prices are the month-end average (between high and low quotations) prices. Klovland (1993), 195 - 228.

(1973), 87 – 126]. Although the highest level of discrimination had been reduced by 1850, in that year the duties still stood at 20/- per load (50 cubic feet) when timber was imported from the Baltic but only 2/- when imported from British North America.[10] The degree of discrimination was reduced several times and finally done away with in May 1866. For the later years of the period to 1871, the duties on most commodities were either abolished or negligible and applied only to a narrow range of commodities. The latter included 'tropical products' such as tea, sugar, spices and spirits.

Figure 1. Liverpool (Trade-Based) Wholesale Price Index, Monthly, 1850 - 1871.



[10] The equivalent Baltic and BNA duties on lumber (sawn timber) were 15/- and 1/- per load respectively. A history of the reductions

Liverpool and the Price Index

The Liverpool price index is presented in Figure 1. It indicates that Liverpool trade goods prices were about 15 to 20 per cent higher in 1871 than they were in 1850. As noted earlier, this particular price index is not a weighted general Liverpool trade index. Nonetheless, it captures some of the key price movements of the period particularly the high short-run price instability relative to later 19th century comparisons. The main price shocks of the period were those of:

- the mid-1850s boom associated with railway building and the price rise often associated with the Crimean War;
- the depression of 1857 and its halting recovery;
- the spill-over effects of the US Civil War (May, 1861 to May, 1865) and the cotton famine; and
- the period of stable or slightly declining prices in the late 1860s.

The price behaviour of the Liverpool index in the early 1850s is of particular significance as it shows a rapid rise in prices beginning in January 1852, long before the Crimean War or its anticipation brought pressure to bear on the markets. Only the later part of the great surge in prices is due to the *anticipated* disruption of markets as pre-war posturing inhibited the flow of the south Russian grain harvest to market in the autumn 1853.

> *Great excitement prevailed at Mark Lane this morning, caused partly by the warlike aspect of affairs in the East and partly by the very unfavourable report from almost all quarters of the kingdom in regard to the acreage yield.*
> *26th September 1853,* ***Mark Lane Express and Agricultural Journal.***

By the actual declaration of war in April 1854 the market prices of wheat and flour had in fact reached their highest level along with those of almost all other commodities. This is evident in the commodity group sub-index for agricultural goods – see Figure 3. It is also apparent that during the early stages of the 1850s boom the rise in construction materials prices contributed to aggregate inflation. Metal prices increased followed by a rise in timber/lumber prices. There then followed a three-peaked price pattern of the mid-1850s expansion – a characteristic also evident in North American monthly prices although not obviously in the annual price indices usually employed [Paterson and Shearer (2003); Warren and Pearson (1933)]. The depression of the late 1850s began in September of 1857. Starting originally as a financial crisis in the US grain market, and then rapidly transmitted to Britain, it developed into a widespread depression that affected most commodity markets [Calomiris and Schweikart (1991); Paterson and Shearer (1993)]. As the economic crisis developed many commodity prices tumbled particularly those of timber and lumber. The trough in Liverpool trade prices occurred in late 1858.

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is found in the ***Annual Abstract of Statistics for the United Kingdom***.

[13] See ***Willmer and Smith's European News***.

TABLE 1. LIVERPOOL PRICE INDEX, MONTHLY, 1850 = 100.

Agricultural Commodities

1. Canadian and US salted beef in barrels of 304 lbs.(tierce) in shillings
2. Canadian and US salted pork in barrels of 200 lbs. in shillings
3. Argentinean leather -salted ox hide- in pence per lb
4. Maryland leaf imported US tobacco in pence per lb.
5. domestic English wheat new, red - in shillings per 70 lbs
6. domestic English barley in shillings per 60 lbs
7. domestic English and Scotch oats in shillings per 45 lbs
8. Canadian wheat described as mixed and red - in shillings per 100 lbs
9. Canadian flour described as Canadian sweet - in shillings per barrel of 196 lbs.

Processed Foodstuffs and Oil

1. Havana No. 8 or 10 brown sugar (in bond) in shilling per cwt.
2. molasses (foreign clayed) shillings per cwt.
3. Jamaica strong rum (in bond) in shillings per gallon
4. Rio coffee, low to good ordinary (in bond) in shillings per cwt.
5. black Malabar pepper (in bond) in pence per lb.
6. Souchong tea (in bond) in pence per lb.
7. salt (rough common) in shillings of per ton
8. linseed oil in pounds per cwt

Lumber and Timber and Naval Stores

1. potash (Montreal first pots) in shillings per cwt.
2. yellow pine timber (Quebec) in shillings per cu. ft
3. oak timber (Canadian) in shillings per cu. ft.
4. yellow pine deals (Quebec) in £s per standard hundred,
5. spruce deals (Quebec) in £s per standard hundred,
6. first quality standard staves (Canadian) in £s per load
7. fir timber (Baltic- Riga) in shillings per cubic foot
8. crown pipe staves (Baltic-Dantzic and Memel) in £s per 1200 pieces
9. Manilla hemp in £s per ton

Iron and Other Metals

1. bar iron (Welsh), in £s per ton of 2240 lbs.
2. nail rods, £s per ton of 2240 lbs.
3. hoop iron, £s per ton of 2240 lbs.
4. iron sheets, £s per ton of 2240 lbs.
5. sheet lead, £s per ton of 2240 lbs.
6. tin (English block), £s per ton of 2240 lbs.
7. charcoal tin plate (IC), in shillings in boxes of 225 sheets

Raw Cotton

1. US raw cotton (Uplands – “fair” quality) in pence per 100lbs.
2. US raw cotton (New Orleans – “fair” quality) in pence per 100lbs.
3. Egyptian raw cotton (“fair” quality) in pence per 100lbs.

Sources: (I) **The Liverpool Mercantile Gazette***; (ii)* **Willmer and Smith’s European Times** *whose last date of publication was August 1868; (iii)* **The Liverpool Journal of Commerce***; (iii)* **The Liverpool Mercantile Gazette** *and* **Myer’s Mercantile Advertiser** *especially for the years 1852, 1857 and 1867, and Sept. 1868 to Dec. 1871. These prices represent the market wholesale prices on large quantities (or the lowest traded price) of the goods on the third Friday of each month - or the nearest reporting date. The cotton prices from 1868 are from* **the Economist**.

TABLE 2. IMPLICIT WEIGHTS OF THE LIVERPOOL PRICE INDEX.

Agricultural Commodities		25.0
Cereals	13.9	
Wheat and Flour	8.3	
Processed Foodstuffs and Oil		22.2
Lumber and Timber		25.0
Deals	5.6	
Timber	8.3	
Iron and Other Metals		19.4
Raw Cotton		8.3

Comparison with the Klovland-Sauerbeck Weights

		Nason-Paterson-Shearer Liverpool Trade Based		Klovland-Sauerbeck London General Wholesale
Vegetable Foodstuffs		13.9		17.8
Animal Foodstuffs		5.6		15.5
Tropical Products		16.7		8.9
Metals		19.4		15.6
Textiles		8.3		17.8
Other Raw Materials	Wood Products	22.3	36.1	24.4
	Salt	5.6		
	Other*	8.3		

*Includes leather, rope and linseed oil.

At the end of the 1850s the slow upward movement of the Liverpool price index was initially led by the rising price of breadstuffs, itself a product of the smaller than normal British grain harvests for three years [Lawes and Gilbert (1893), 77 – 135]. A substantial arbitrage opportunity drew in record imports of grain particularly from North America - see later. Wheat and flour prices started falling only in February 1862. By then, with the opening of the US Civil War in the spring of 1861 the well-documented rise of cotton prices began that contributed to the overall rise in the Liverpool index in the years from 1862 for the rest of the war period. By 1863 metal prices also contributed to the overall rise but only briefly. The years 1864 and 1865 witnessed the greatest reversal of Liverpool prices for the entire period. The sharp saw-toothed movement of prices was led by the price of cotton that declined sharply to December 1864 but then rebounded as the war in the US dragged on into the spring of the next year.[13]

Figure 2. Liverpool Commodity-Group Wholesale Price Index, Raw Cotton, Monthly, 1850 - 1871.

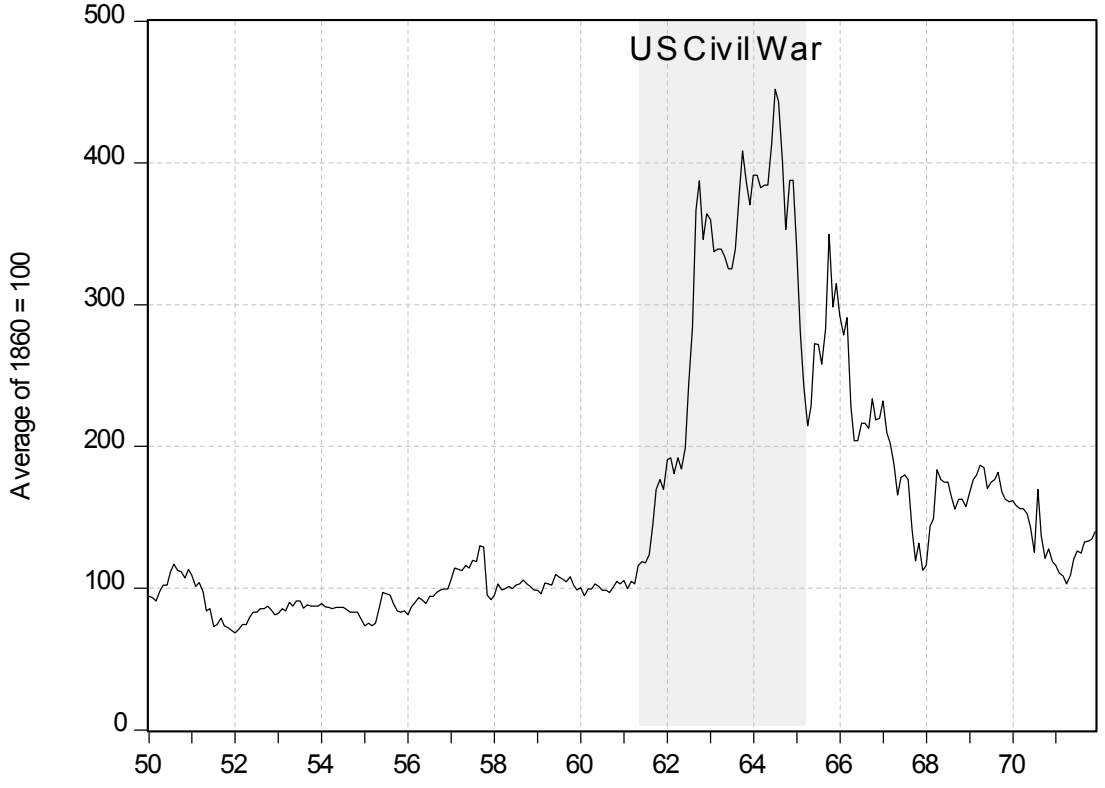


Figure 3. Liverpool Commodity-Group Wholesale Price Indexes, Agricultural Commodities and Processed Foods, Monthly, 1850 - 1871.

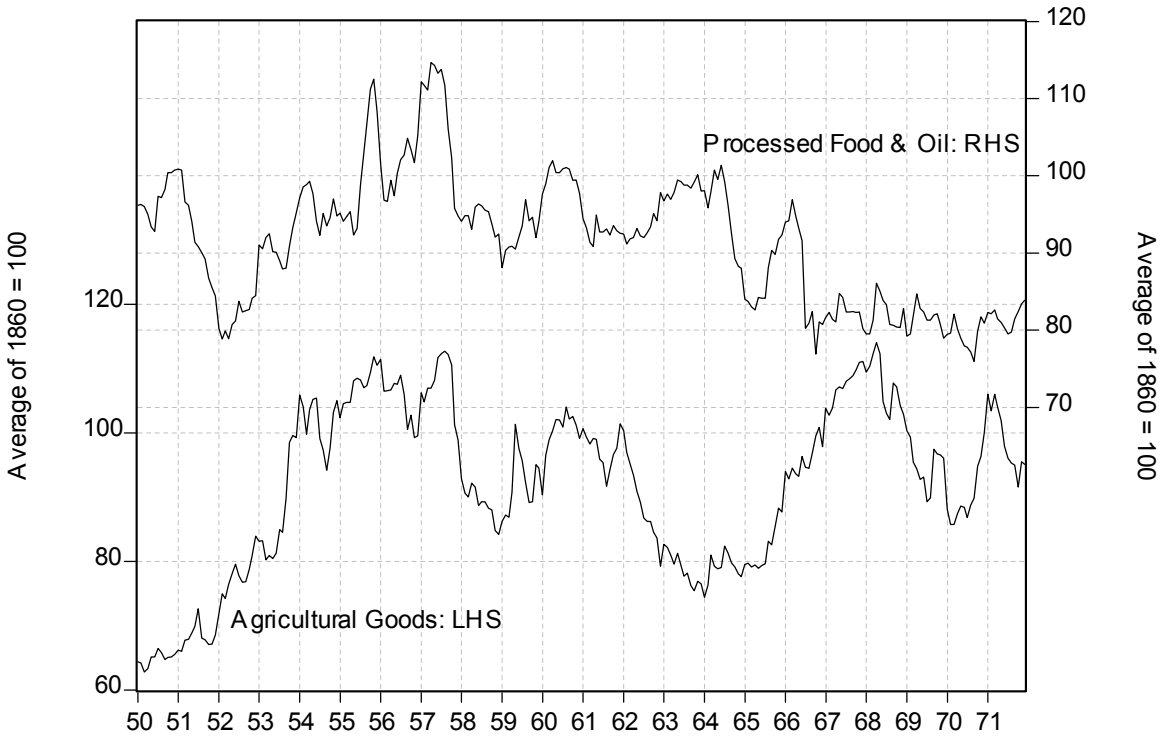
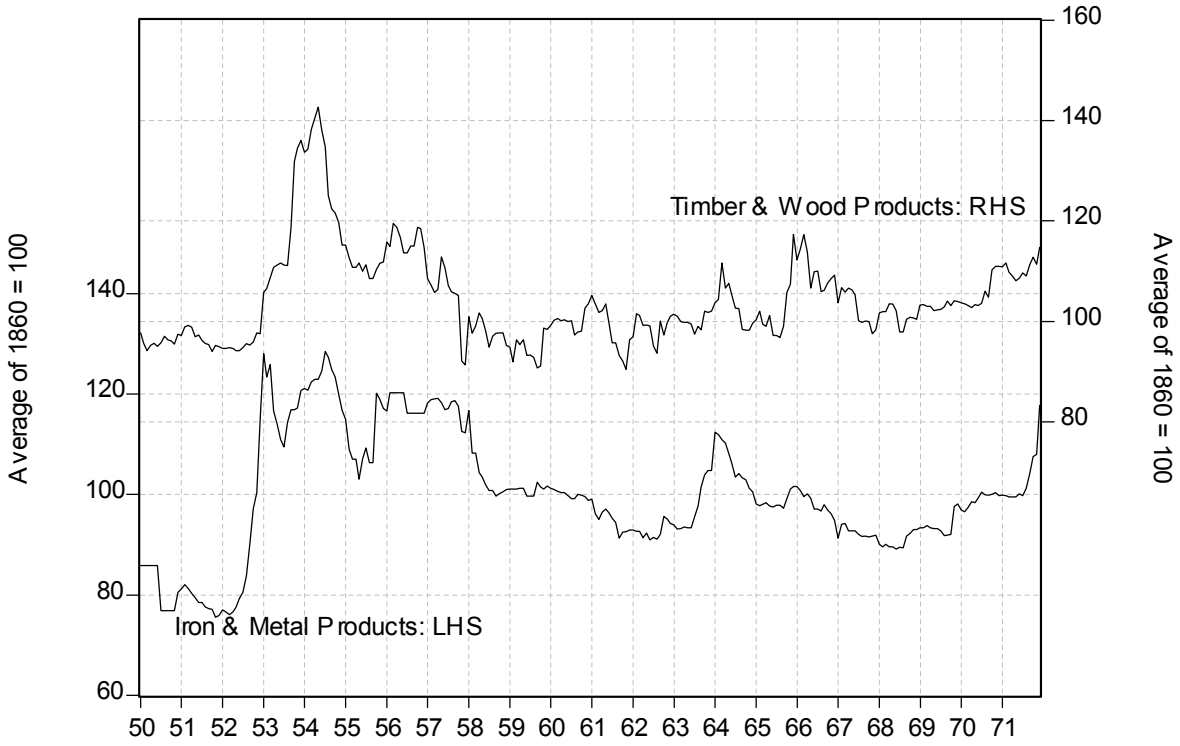


Figure 4. Liverpool Commodity-Group Wholesale Price Indexes, Wood and Iron Products, Monthly, 1850 - 1871.

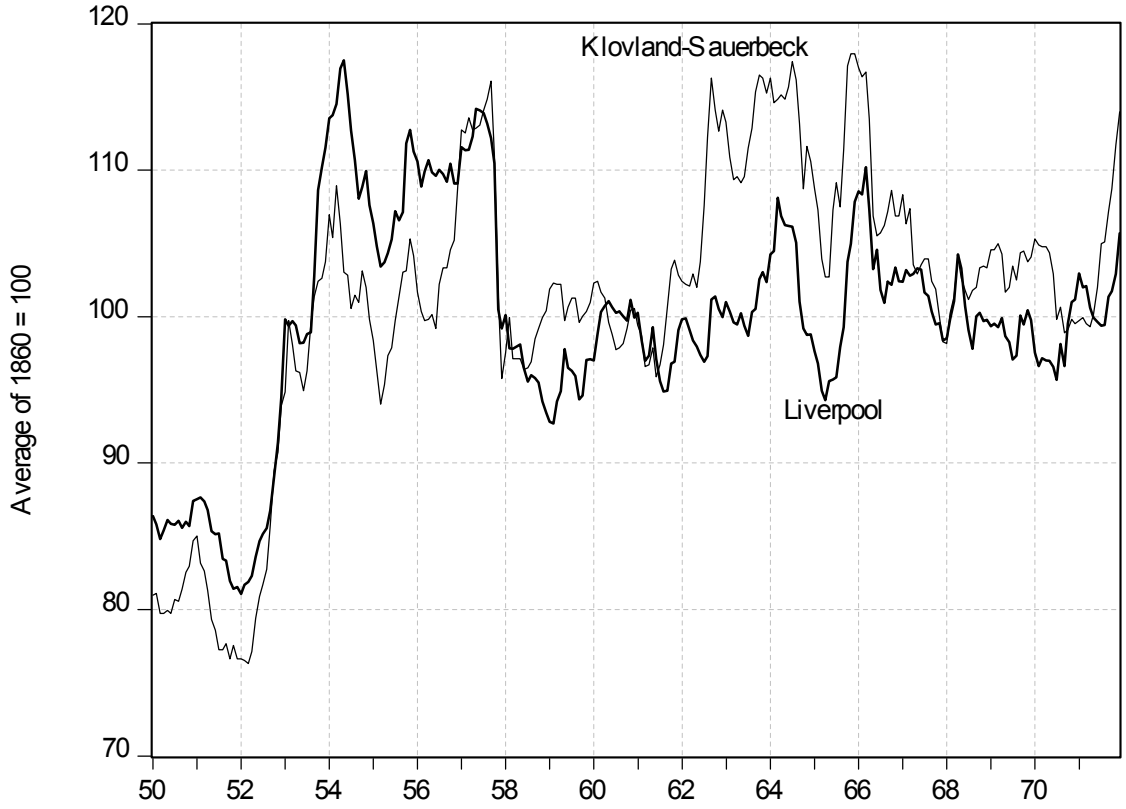


From 1866 to 1870 the Liverpool price index shows a secular decline. There was a weakening of processed food (provisions) prices in these years and although agricultural commodity prices increased to about mid-1868 they declined thereafter. Most other prices remained relatively steady. By far the greatest contributor to the secular decline of the price index in the late 1860s was the very sharp decline in the price of raw cotton - despite its relatively small weight in the overall index it drags the index down by about four to five percentage points. By December 1868, the raw cotton price index almost reached its pre-war level as evident in Figure 2.

With the overall Liverpool index, the first and obvious comparison to be made is with Klovland's recently recalculated Sauerbeck wholesale price index – see Figure 5 [Klovland (1993)]. The two indices show a surprising degree of agreement given the different basis of data collection, commodities represented in the two indices, and weights. The greatest divergence of the two series is in the nature of a shift downward in the Liverpool price index associated with the 1858 depression. The commodity groups of timber and wood products and iron and metal products experience a sharp downward price movement and their prices remain low or continue to decline through the early 1860s. Since much greater weight is given to these two groups of products in the Liverpool price index, the price movements appear

to be a means shift. If adjusted for this shift, the Liverpool and Kovland-Sauerbeck price indices show the same pattern of variation, with minor exceptions, to 1871. The Klovland-Sauerbeck data sources mainly capture price behaviour in the London market. Given the similarity of the two indices and their different geographical origin the pertinent question is: were Liverpool and London prices sufficiently similar in their patterns of variation that they constituted an integrated market at mid-century?

Figure 5. Liverpool Wholesale Price Index and the Klovland-Sauerbeck Price Index, Monthly, 1850 - 1871.



Liverpool and London Market Adjustments

What was the degree of market integration within Britain as a whole at the mid-19th century? Although we cannot answer this question directly from the new price indices, there is enough evidence to examine the relationship between the two important markets of Liverpool and London. As noted, the new technology meant that information about prices was communicated cheaply, rapidly and frequently between Liverpool and London and, in addition, was widely distributed. The growing railway network ensured the efficient movement of goods. For instance, the spoilage of perishable commodities had been

a problem for the long distance shipment of flour by canal and may have been a cost barrier to the creation of a national market in this commodity. Speedier and safer commodity movements, as noted earlier, tend to reduce risk.[14]

In order to examine the extent of the market integration between Liverpool and London the prices of the same commodity are selected in the two markets. Fourteen commodities from the Liverpool price index satisfy the condition of having an *apparent* exact London counterpart price and with these three price indices are constructed for each of the London and Liverpool commodity markets:

- processed foods and oil (provisions),
- timber and lumber, iron and
- metal products.

The commodities are given in Table 3. The indices are geometric means.

TABLE 3. LONDON COMMODITY COMPARISONS.

Processed Foods and Oil

1. Havana No. 8 or 10 brown sugar (in bond) in shilling per cwt.
2. Jamaica rum strong (in bond) in shillings per gallon
3. Rio coffee, low to good ordinary (in bond) in shillings per cwt.
4. Souchong tea (in bond) in pence per lb.
5. linseed oil in £s per cwt

Timber and Lumber

1. yellow pine timber (Quebec) in shillings per cu. ft.
2. oak timber (Canadian) in shillings per cu. ft.
3. yellow pine deals (Quebec) in £s per standard hundred,
4. spruce deals (Quebec) in £s per standard hundred,
5. first quality standard staves (Canadian) in £s per load

Iron and Other Metals

1. Bar iron (Welsh), in £s per ton of 2240 lbs.
2. nail rods, in £s per ton of 2240 lbs.
3. hoop iron, in £s per ton of 2240 lbs.
4. iron sheets, in £s per ton of 2240 lbs.

Sources: ***Mark Lane Express and Agricultural Journal*** (1850 –71), London, ***The Economist*** (1850 – 1871), London, ***The Times*** (1850 – 1871), London.

There are several issues of concern when comparing prices in Liverpool and London. First, the agricultural component of the Liverpool index has few commodities that have a *close* London equivalent (often because of grade distinctions). A comparative index for London cannot be constructed. However, among the Liverpool agricultural commodities that do have a London counterpart are wheat and flour and

[14] Futures markets in certain commodities may have existed although the evidence for them in the commercial press is sparse.

they are considered separately in a later section of this study.[15] Second, there is no assurance that the overseas goods prices cited in the Liverpool and London markets were actually those of goods imported at their own ports. Indeed, if commodity arbitrage was working well, we should expect shipments from one market to the other and perhaps even the cross-shipment of goods. Third, simply because items were described in identical terms is no guarantee that the quality of the goods was the same from the perspective of the purchaser. In the overseas trade, each port had developed different capabilities and methods of handling bulk commodities that may have given rise to otherwise unexplained price differences. In timber and lumber, for instance, the method of selling lumber was very different in the two ports. Liverpool handled a greater volume of timber and lumber than the port of London and specialised in the North Atlantic timber trade. Most Baltic wood products, however, entered Britain through London. Lumber at Liverpool had to be cleared from the docks typically within forty-eight hours by the importing agent whereas in London it was actually stored on the (Surrey) docks. Square timber at Liverpool was often floated into the 'pool', a practise that often made purchasers cautious in their quality evaluations [Latham (1967), 9 – 12]. This was subsequently reflected in the reported prices. Fourth, raw cotton invariably was shipped to Liverpool and the standard London reporting was of the Liverpool price of this commodity. No separate London market in cotton existed. Fifth, in several instances, in the timber and lumber markets, the same commodity was reported sold in different units (and the underlying prices have to be adjusted appropriately).[16]

As seen in Figures 6, 7, and 8 the pair-wise comparison of the Liverpool – London prices tend to move together. However, there are important differences. One is due to timing of price quotations and stems from institutional differences of how markets in Liverpool and London were organised. For instance, the Liverpool Timber Exchange typically traded once each week at a meeting of the wholesale buyers and the importing agents – in the Great Eastern Hotel. The London market meetings were less frequent, sometimes only once fortnight during the season of May to November. Out-of-season meetings were usually less frequent yet [Passingham (n.d), 252-261]. There are a few divergent price movements but they are rare. London timber and lumber prices do not seem to respond to the increase registered at Liverpool for the months in late 1861 and early 1862. The same is the case in 1866. This is most likely a result of the fact that the index only records the prices of British North American wood. The close substitutes of Baltic wood were less frequently found in the Liverpool market. There is a slight mean drift in the last years in a few of the pairs but this largely disappears by the terminal date of 1871.

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[15] An example of the incompatibility is salted beef and pork that is quoted in both Liverpool and London but which varied in quality with the age of the commodity and we cannot be sure of the vintage of sales. Substantial amounts of salted beef and pork were imported from North America. See ***Willmer and Smith's European News.***

[16] Timber and lumber in the London market generally conformed to Baltic shipping measures whereas that in the Liverpool market was generally in North American shipping dimensions.

Figure 6. Liverpool and London Prices of Selected Metals, Monthly, 1850 - 1871.

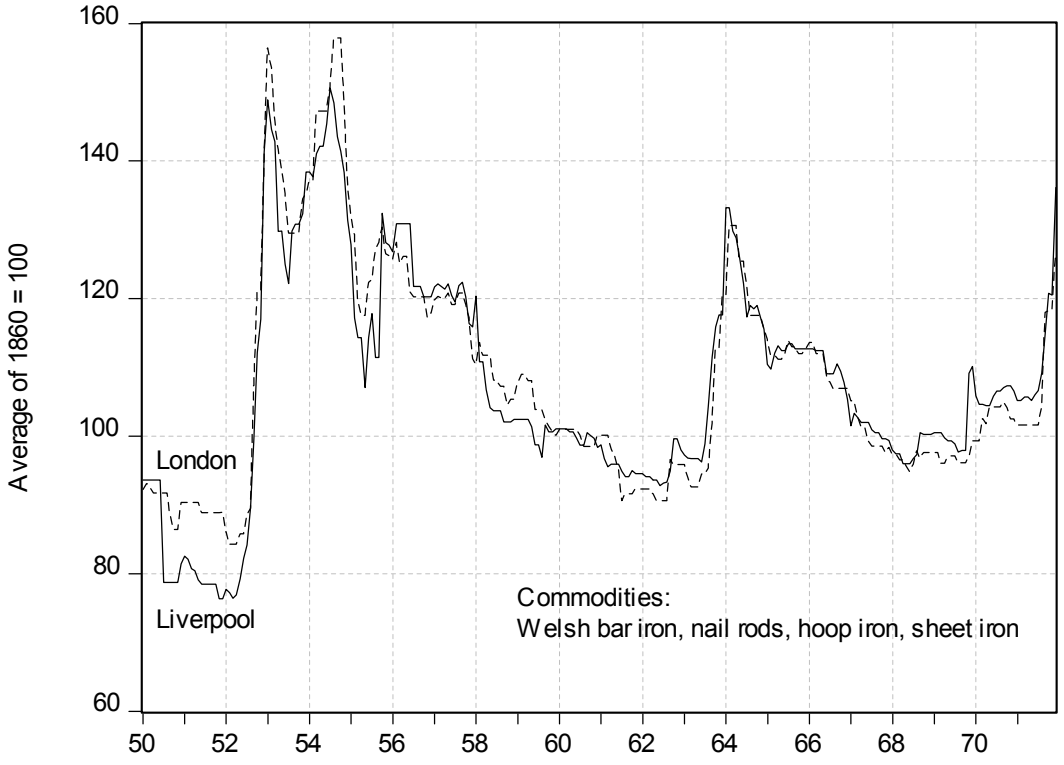


Figure 7. Liverpool and London Prices of Selected Timber and Wood Products, Monthly, 1850 - 1871.

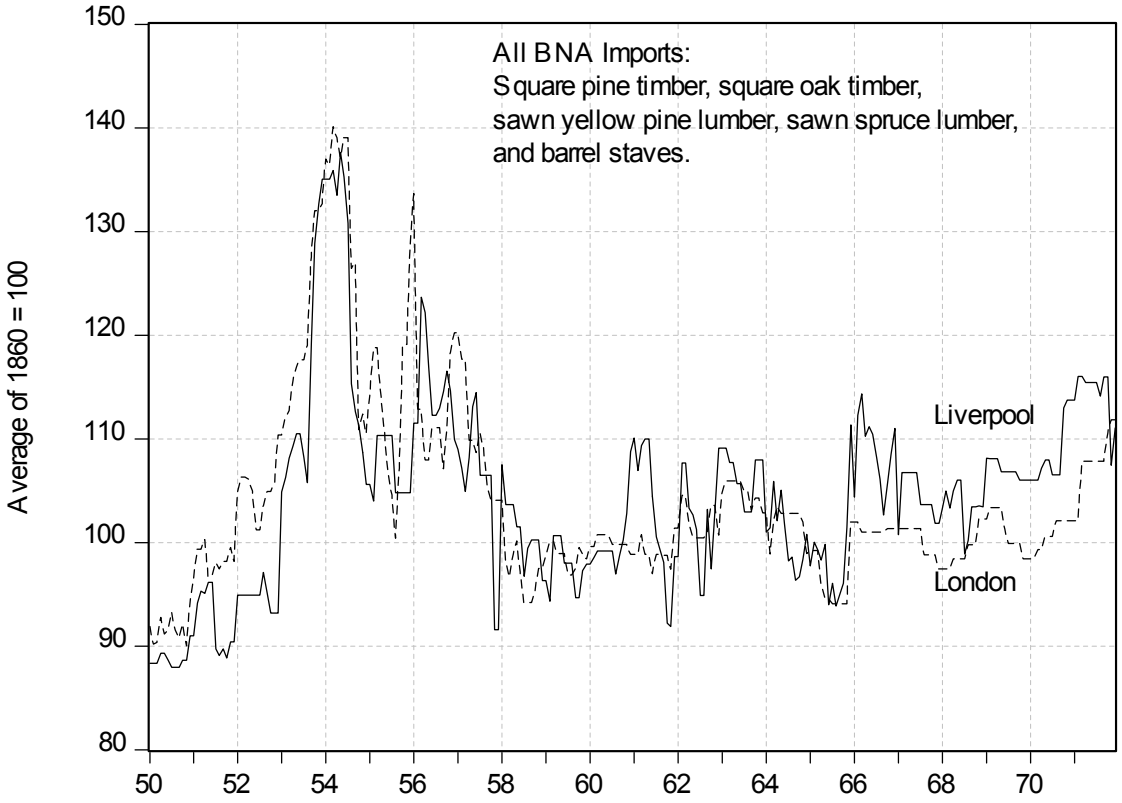
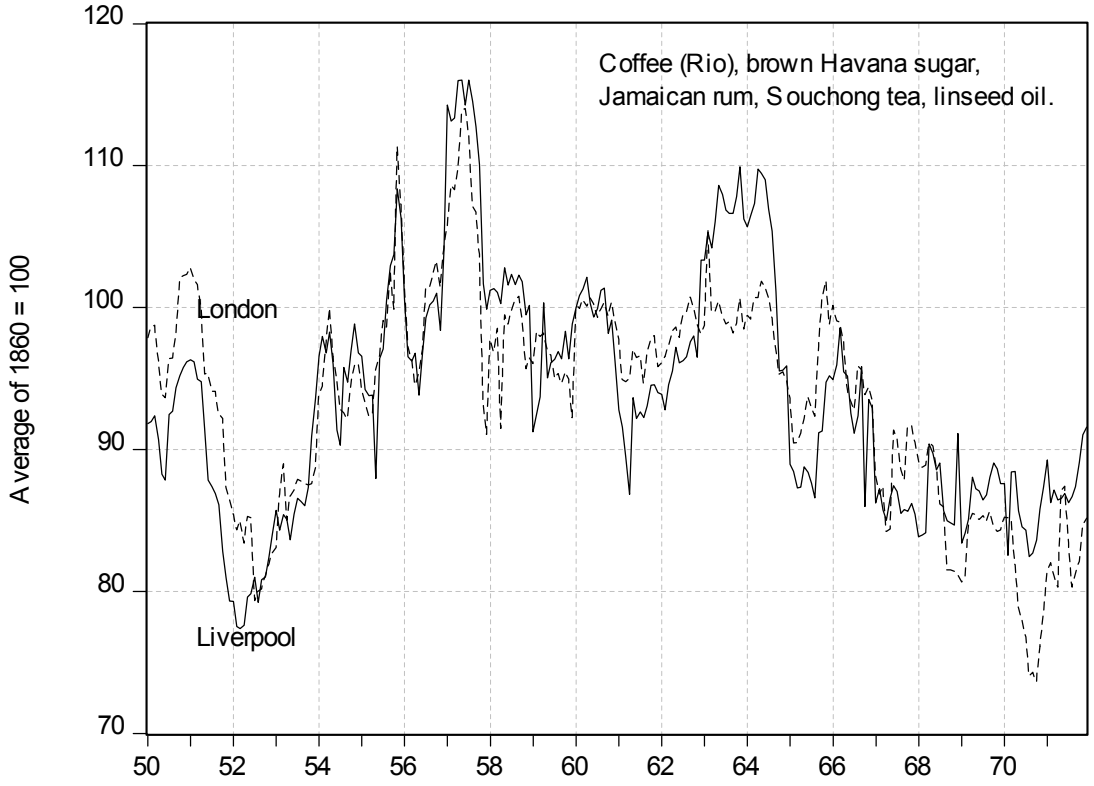


Figure 8. Liverpool and London Prices of Selected Pocessed Foods and Oil, Monthly, 1850 - 1871.

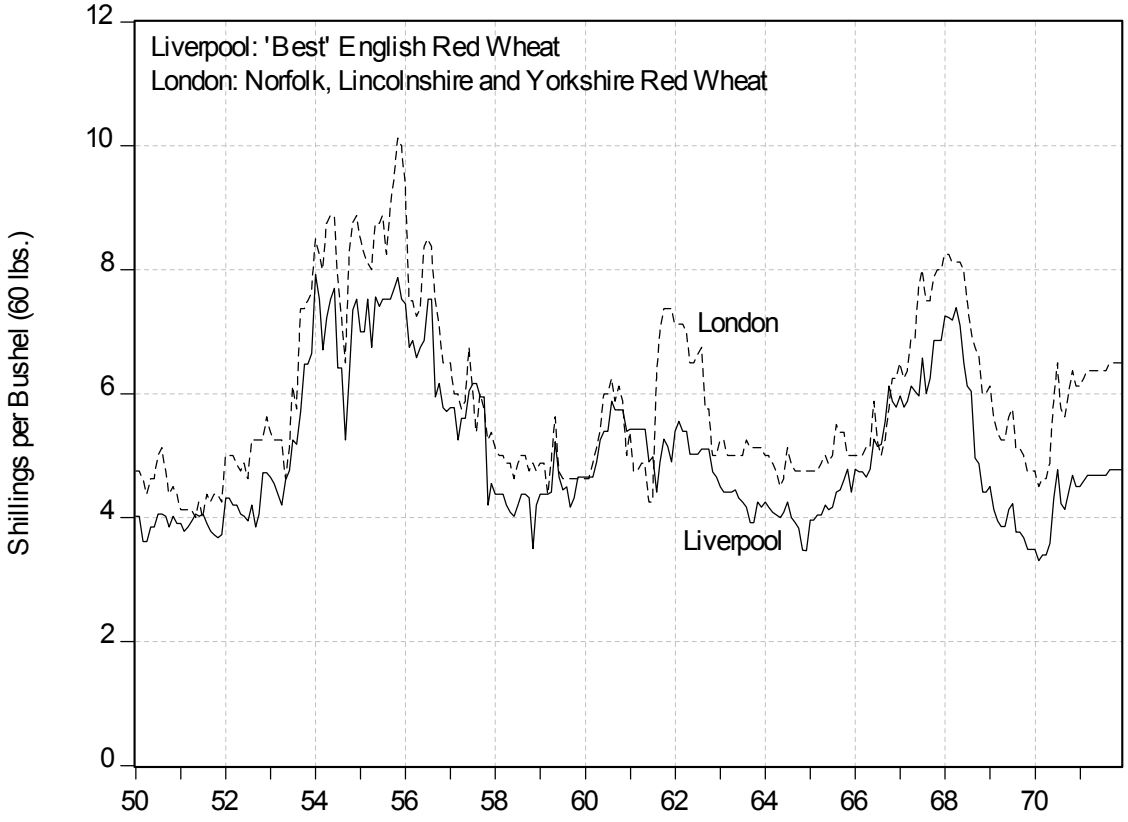


The Liverpool and London Markets in Wheat and Flour. The most frequently cited price of British wheat for study of 19th century international markets is the Gazette price of wheat. This is an unweighted weekly average of unspecified grades of wheat in a variety different markets throughout Britain. The number of underlying observations that make up any particular Gazette price varied week to week as all markets did not necessarily report or record transactions every period.[17] Therefore, while the Gazette price of wheat gives a general impression of the movement of the prices of wheat in Britain its usefulness for studying the integration of markets is strictly limited: it is not a market price. For instance, the main wheat varieties traded on London's Corn Exchange in Mark Lane normally traded well below the Gazette price. The two main locations from which London drew domestic supplies of wheat were Essex-Kent (described as 'white') and Norfolk (described as 'red'). The latter often also included shipments from Lincolnshire and Yorkshire. The average overstatement of the Gazette price in this period with respect to

[17] The Gazette prices of grains were reported at the end of the week and were a regular feature of the trade paper that served the London Corn Exchange. Later corrections were made from time to time as markets which did not report on time were added. See the ***Mark Lane Express and Agricultural Journal.***

the Essex-Kent one is 4 ½ d. per bushel of 60 lbs. or about 6.25 per cent.[18] The unconditional standard deviation of the growth rate of the Gazette price is greater than that of the specific London market prices.[19]

Figure 9. Liverpool and London Prices of 'Red' Wheat, Per Bushel (60 lbs.), Monthly, 1850 - 1871.



For the purposes of comparing the Liverpool and London markets we use several wheat and flour prices. Figure 9 shows the actual prices of 'red' wheat in Liverpool and London for the mid-century period. The grades are noted as 'English red' and 'Norfolk (Lincolnshire, Yorkshire) red' in Liverpool and London respectively. Both prices are in shillings per bushel (60lbs.).[20] There was a very close correspondence

[18] There are two interesting anomalies. During the height of the 1850s boom the Gazette price substantially underestimates the London price of Essex-Kent wheat whereas during the sharp rise in grain prices in 1861 – 2 it overstates the price.

[19] The standard deviations of log (P) are, where the Ps are the Gazette price, the Essex white price, and the Norfolk red price: 1.52; 1.45 and 1.39.

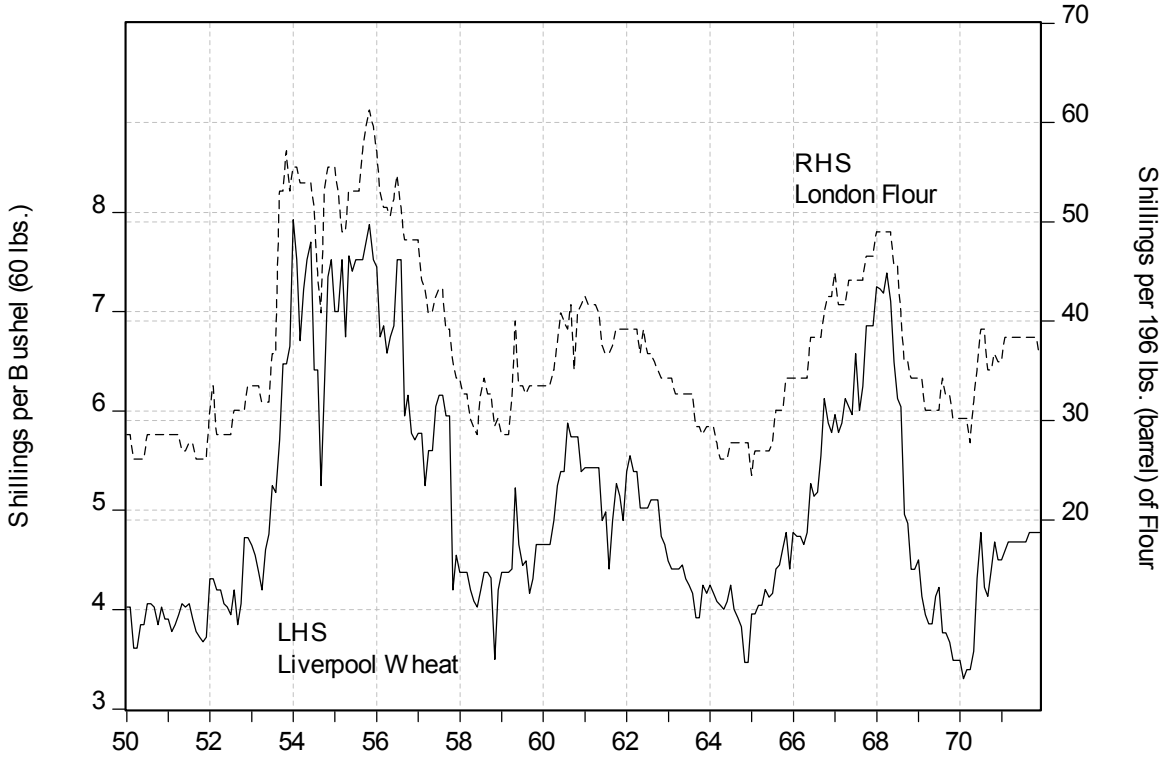
[20] Grain in the London market was reported in imperial quarters of 480 lbs. (8 bushels) whereas Liverpool sales were usually reported per sack of 70 lbs. or occasionally per sack of 100lbs. Flour was most frequently quoted in sacks (240 lbs.) and imported North American flour was reported in barrels of 196 lbs.

between Liverpool and London prices and the latter were always greater. This may reflect a quality difference in the grains in the two markets. Or, it may reflect the spatial hierarchy of prices.

There are two episodes when these prices appear to move independently of one another. The first is at the height of the 1850s boom and the other at the height of the wheat price rise in the autumn of 1861. There is no obvious explanation for these anomalies, but they may be related to increased (and justified) uncertainty when market prices increase rapidly. They may also be associated with differences in the quality of regional harvests. In his study of British flour milling, Perren argues that at mid-century most flour was consumed within a short distance of the mills where it was produced. The milling industry was atomistic and twenty-five miles was usually the limit of flour shipments [Perren (1990), 422 – 423]. Yet, shipments of flour did travel great distances and reached both Liverpool and London from North America. However, the amounts were relatively small. The price of US flour was regularly quoted in London and that of Canadian flour in Liverpool. US 'sweet' flour in barrels of 196 lbs. was discounted about 24.5 per cent on average over the best London-milled flour throughout the period and less on standard flour varieties. (The mean price of the London flour was 37s. 4d. for an equivalent amount). Perren's observation requires that the main commodity arbitrage in breadstuffs was by the shipment of wheat not flour and that shipments of flour constituted small marginal adjustments.

To review, the London-Liverpool prices pairs in all commodities we report on appear to move closely together throughout the January 1850 to December 1871 sample. Nonetheless, several of the price pairs exhibit periods during which the co-movement appears to change. This raises questions about the joint dynamics of prices across the London and Liverpool markets. The next section outlines a way to measure this aspect of London and Liverpool prices and reports results.

Figure 10. The Prices of London-Milled Flour and Liverpool 'Red' Wheat, Monthly, 1850 - 1871.



Statistical Tests

Tests for market integration are conducted for the Liverpool and London markets in this section. These relationships, as indicated earlier, are:

- London processed foods and Liverpool processed foods (category indices);
- London wood products and Liverpool wood products (category indices);
- London metals and Liverpool metals (category indices);
- London (Norfolk) red wheat and Liverpool (undesignated) red wheat (prices in index form);
- London best millers flour and Liverpool (undesignated) flour (prices in index form); and
- London best millers flour and Liverpool (undesignated) red wheat (prices in index form).

It is important to note that these prices are sampled one day of the month (the third Thursday or nearest date) and are not monthly averages. Since our concern is price dynamics, these data allows us to judge the extent of the response of a price to a given shock. The long-run response provides evidence about

the existence of a long-run equilibrium, which is driven by a common trend. This equilibrium supports price convergence, that is the Law of One Price hypothesis. Information about the length short-run price dynamics yields evidence about the nature of the integration across London and Liverpool markets.

A London and Liverpool price pair is described by a p[th]-order vector autoregression, VAR(p):

$$Y_t = \alpha + \sum_{j=1}^{p} \varphi_j Y_{t-j} + \varepsilon_t ,$$

where Y_t is a vector of the London and Liverpool prices in logs and ε_t is vector of forecast innovations. When Y_t is a multivariate unit root process, which arise when (at least one of) the roots of the φ_j are on (or inside) the unit circle, the price level (in logs) cannot exhibit mean reversion. There is evidence the 12 prices series contain stochastic trends. Thus, maintaining the unit root hypothesis appears reasonable.[22]

Unit roots in a price pair yield regressions which have non-standard interpretations. Given the data has multivariate unit roots, the distributions of the regression slope coefficients are non-standard, which suggests hypotheses tests can be misleading as well. Hence, a test of the Law of One Price relies on the long-run behaviour of the data.

Another implication is that a linear combination of Y_t can be stationary given it has unit roots. According to Granger and Engle (1987), this situation arises here when London and Liverpool prices share a common trend, or are cointegrated. A cointegrating relation reflects the long-run equilibrium of the price system. Call β' the cointegrating vector(s), so that $Z_t = \beta' Y_t$ represents the cointegrating relation. Cointegrating relations also capture the mechanism that pushes or corrects the price system toward its long-run equilibrium path given a shock. This motivates Engle and Issler (1995) to refer to the cointegrating relation Z_t as a cycle generator because a multivariate unit root process, Y_t, is transformed into a stationary time series by β'.

The vector error correction model (VECM) representation of the levels VAR(p) is commonly employed to test for cointegration and estimate cointegrating vectors as in Johansen (1988, 1991). The VECM of the VAR(p) of Y_t is

$$\Delta Y_t = \alpha + \delta Z_{t-1} + \sum_{i=1}^{p-1} \gamma_j \Delta Y_{t-1} + \varepsilon_t$$

where $\gamma_i = -\sum_{i=j+1}^{p} \varphi_j$, δZ_{t-1} is the ECM, and δ ($= -\sum_{j=1}^{p} \varphi_j$ where j = 1, …, p-1) is the

coefficient vector or factor loadings of the cointegrating relation. These factors measure the price response to shocks that force the system towards its long-run equilibrium path. The ECM pushes the

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[22] Augmented Dickey-Fuller test of the 12 prices series are available from the authors upon request.

bivariate price system back to its long-run path given a transitory shock. Thus, the VECM imposes the common trends restrictions of the long-run equilibrium on the data.

We conduct Johansen (1988, 1991) tests for common trends tests with the pair-wise price relationships. This is a maximum likelihood testing approach to cointegration. Likelihood ratio (LR) tests of restrictions on the deterministic trends of the bivariate price systems selected either Osterwald-Lenum Case 1*, Case 1, or Case 2 VECMs [see Osterwald-Lenum (1992)].[23] Case 1* of Osterwald-Lenum places an unrestricted intercept in the cointegrating relation, $Z_{1^*,t} = (\beta' \ \mu')[Y_t \ \ 1]$, because there is only a restricted intercept in the levels bivariate AR(p). The Case 1 and Case 2 models restricts the deterministic trends, in which case the cointegrating relation is Z_t. The former model leaves the intercept of the VECM unrestricted, while the latter model adds an unrestricted linear trend.[24]

Table 4. Cointegrations Tests for London-Liverpool Pair-wise Price Indices.

Number of Observations = 224

Commodity Groups	**Processed Food**	**Wood Products**	**Iron & Metals**	**Wheat-Lon. Wheat-Liv.**	**Flour-Lon. Flour-Liv.**	**Flour-Lon. Wheat-Liv.**
Lags	13	14	18	18	14	19
Models: Osterwald-Lenum (1992)	1*	1*	1*	2	1	1*
MacKinnon, et al (1998)	II	II	II	N.A	N.A.	II
Johannsen Cointegration Tests						
Maximum Likelihood Test						
One Cointegration Equation	17.82 #	29.9 #	27.52 #	14.61	18.23 #	19.86 #
Two Cointegration Equations	2.62	3.82	7.73	3.50	2.09	3.35
Trace Tests						
One Cointegration Equation	20.44 #	28.80 #	35.24 #	18.17 #	20.31 #	23.21 #
Two Cointegration Equations	2.62	3.82	7.73	3.56	2.09	3.35

MacKinnon (1998) critical values for case 1* model.
Osterwald-Lenum (1992) critical values for models 1 and 2.
N.A. indicates no corresponding equivalent model.
# indicates significance at the 5% level of confidence
indicates significance at the 10% level of confidence

[23] These correspond to MacKinnon, Huag and Michelis (1998) type II and type IV models.

[24] We compute tests of the Osterwald-Lenum (1992) restricted quadratic trends Case 2 model against the Case 2* model for all six combinations. The London-Liverpool wheat combination fails to reject the null of Case 2 in favour of the alternative. The remaining five pairs reject the quadratic trends specifications. Tests of the restricted linear trend Case 1 against Case 1* reject the former, except for the London-Liverpool flour price pair.

Johansen λ–max and trace tests appear in Table 4. The lag lengths of the levels bivariate ARs were selected using likelihood ratio (LR) tests with Sims (1980) degrees-of-freedom modification.[25] These tests allow us to conclude there is evidence to support a common trend in each of the London – Liverpool price relationships. We cannot reject the presence of one cointegration equation at the five percent level of significance in any price combination. There is one caveat because the λ–max test yields no evidence for cointegration in the wheat price pair, but the trace test does. Thus, we have evidence the London and Liverpool markets share a long-run equilibrium relation because price (forecasts) in these two markets were not independent. This favours long-run convergence in the six price pairs we study, which represents compelling historical evidence of highly integrated markets in our 1850 – 1871 sample.

Evidence of long-run price convergence cannot speak to the question of the short-run behaviour of these markets. Vahid and Engle (1993) develop methods to uncover these short-run dynamics. These methods begin with tests that a linear combination of the growth rates of London and Liverpool prices is unpredictable, conditional on the regressors of the VECM (p-1). The idea is that an unobserved feature common to prices in London and Liverpool is the only source of fluctuations in their growth rates (e.g., inflation rates). Hence, the transitory or cyclical movements in London and Liverpool prices are driven by shocks to the common feature.[26]

Vahid and Engle show that an important special case arises when the number of cointegrating relations and common feature relations equals the dimension of Y_t. This case provides a simple way to decompose Y_t into its Beveridge and Nelson (1981) and Stock and Watson (1988) trend and cycle components.

Table 5 reports on tests for a common feature in the price pairs. The tests for common features draws on Vahid and Engle (1993) and Engle and Issler (1995). They suggest testing for common features using canonical correlations of the growth rates of the price pairs. Vahid and Engle develop a χ^2 test, while Engle and Issler (1995) use a *F*-test due to Rao (1973). Engle and Issler report Rao's test has better small sample properties.

The null hypothesis is that the smallest canonical correlation equals zero. This implies a linear combination of the growth rates of prices is white noise, $\xi' \Delta Y_t = \varepsilon_t$, where ξ' is the common feature vector. Hence, the common feature annihilates serial correlation in price growth. Another implication of common feature vector is $\xi' Y_t$ wipes out the cycles in price levels, Y_t, which leaves only its trend. This explains Engle and Issler (1995) referring to ξ' as a "trend generator".

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[25] The estimated VECMs include monthly dummy variables to account for the seasonal factors. We could not find evidence of there being seasonal variation at the growth frequencies in the bivariate price series.

[26] Common features tests are used by Engle and Issler (1995), Issler and Vahid (2001), and Wakerly, Scott, and Nason (2003) in a variety of models.

The common features tests yield three common feature relations in the six London – Liverpool price pairs. The wood products, iron and metals, and London flour – Liverpool wheat price pairs reject a common feature. These price pairs do not possess a common feature because these bivariate series generate two non-zero canonical correlations. In these price combinations, idiosyncratic market factors dominate short-run movements in an economically significant way even though these prices exhibit long-run convergence. The likely sources are that at least two of these commodities were non-perishable products capable of being stored for long periods without degradation, which may also apply to flour in barrels, and perhaps one of the two ports was a local price setter.

We fail to reject a common feature in the other price combinations at the five percent level for processed foods and red wheat, and at the ten percent level for the London – Liverpool flour price pair. A London – Liverpool price common feature relation indicates short-run price fluctuations respond almost entirely to the common cycle and little to idiosyncratic shocks.

Table 5. Common Features Tests for London - Liverpool Pair-wise Price Indices.

Number of Observations = 224

Commodity Groups	**Processed Food**	**Wood Products**	**Iron & Metals**	**Wheat-Lon. Wheat-Liv.**	**Flour-Lon. Flour-Liv.**	**Flour-Lon. Wheat-Liv.**
Lags	13	14	18	18	14	19
Conditioning Models						
Osterwald-Lenum (1992)	1*	1*	1*	2	1	1*
MacKinnon, et al (1998)	II	II	II	N.A.	N.A.	II
Squared Canonical Correlations						
	0.08	0.21	0.24	0.19	0.17	0.22
	0.25	0.25	0.43	0.23	0.18	0.32
Chi-square test						
	18.74	53.16 #	57.32 #	46.17	41.58 #	56.07
	87.35 #	117.53 #	185.80 #	102.31 #	86.96 #	141.37 #
Rao's F-test						
	0.70	2.00 #	1.66 #	1.27	1.52 ##	1.53 #
	1.62 #	2.15 #	2.74 #	1.38 #	1.54 #	1.93 #

\# indicates significance at the 5% level of confidence
indicates significance at the 10% level of confidence

Vahid and Engle (1993) show that bivariate time series which possess a common trend and a common cycle have a simple Beveridge-Nelson-Stock-Watson decomposition. This decomposition is a simple linear transformation of the (log) levels of the bivariate time series that employs the cointegrating vector, β', and common feature vector, ξ'.

Plots of the common trend-common cycle decomposition of the processed food, red wheat, and flour price pairs appear in Figures 11, 12 and 13.[27] The upper (lower) window contains the common trend (cycle). These plots reveal that the common trend-common cycle decomposition maps general price behaviour into standard historical views of the period.[28] For example, the decompositions capture the collapse of prices in the financial crisis and subsequent depression of 1857. This shows up as rapid drop in the trend and cyclical components of processed food, red wheat, and flour.[29]

Of particular interest from Figures 11, 12 and 13 are the price disturbances of the early 1860s. As noted earlier in the paper, the North Atlantic wheat markets were disrupted in the years 1860/2 as the shrinking British harvests of the late 1850s, itself a response to earlier falling prices, produced a demand for imports that caused an unprecedented large inflow of North American wheat and flour. Processed food (including linseed oil) were all imported goods which were shipped long distances. The disruption to world shipping associated with the cotton famine, US Civil War, and uneven commodity flows show up as a rise in the cyclical component of these prices, but a decline in the trend component during this period. This is evidence that economically important shocks to the common cycle affected London and Liverpool during this period.

Issler and Engle (1995) and Issler and Vahid (2001) describe a method to generate the forecast error variance decomposition (FEVD) of the common trend-common cycle decomposition. A FEVD shows the percentage of the variation in the level of London and Liverpool prices explained by a given shock. The FEVDs of the processed food, red wheat, and flour price pairs appear in table 6. The processed food FEVD shows that the trend shock dominates price fluctuations in London within a month of the shock. It took longer in Liverpool, where about two-thirds movements in the processed food price is accounted for by the trend shock at a three month forecast horizon. The FEVDs of the two cities are essentially the same only after two years.

The opposite is true for the breadstuffs pairs of red wheat and flour. Movements in the Liverpool red wheat and flour prices depend more on the permanent shock at short forecast horizon than do the London prices. This is especially true for the London flour price because less than 70 percent of its fluctuations are explained by the permanent shock at a three year forecast horizon.

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[27] We cannot dismiss the possibility that the co-features may arise from systematic (but unknown) differences between the commodities that are similarly described but may differ in grade and age.

[28] When the trend and cycle shocks are positively correlated, the trend is less volatile than the actual price level.

[29] Vahid and Engle (1993) show that bivariate time series which possess one common trend and common cycle have a simple Beveridge-Nelson-Stock-Watson decomposition. This decomposition is a simple linear transformation of the (log) levels of the bivariate time series that employs the cointegrating vector, β', and common feature vector, ξ', to produce the common trend and common cycle. Vahid and Engle (1993) and Engle and Issler (1995) discuss the details of this version of the BNSW decomposition.

Table 6. Forecast Error Variance Decomposition of London - Liverpool Commodity Pairs with Common Co-features.

Monthly Forecast Horizon	Processed Food		Wheat (Red)		Flour	
	London	Liverpool	London	Liverpool	London	Liverpool
1	78.15	39.37	45.54	70.68	1.42	71.40
2	88.14	58.53	59.35	77.20	3.60	84.61
3	91.41	68.48	63.95	81.11	6.77	89.05
6	95.13	81.38	72.28	87.94	19.33	93.50
12	96.08	86.66	81.06	93.69	40.78	96.71
18	95.89	87.18	86.32	95.74	56.16	98.09
24	97.03	89.79	90.00	96.58	61.00	98.32
30	97.39	90.45	91.29	97.19	63.51	98.38
36	97.68	90.99	92.60	97.87	68.75	98.41

In summary, the statistical tests support the view that Liverpool and London were essentially different parts of one market in the commodity groups we study. We find solid evidence for the Law of One Price in the long-run. The markets for three of the price pairs were also linked together because they shared a common cycle. In these cases, transitory shocks accounted for less than 20 per cent of the fluctuations in these price levels at a one year forecast horizon, on average. This was rapid even by the standards of present-day highly integrated markets [Mohanty, Meyers and Smith (1999)].

Conclusions

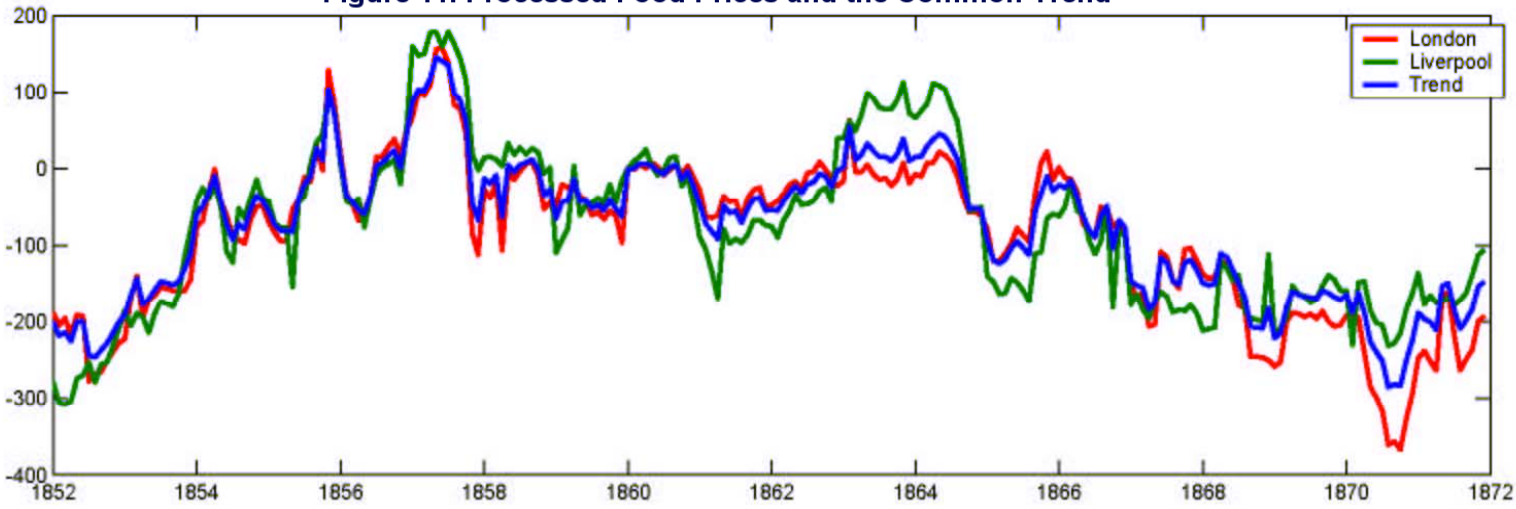
A new price index for Liverpool is presented. Not intended as a general price index, nonetheless, it follows the Klovland – Sauerbeck general wholesale price index very closely – most likely because of the large weights given to agricultural goods. The component sub-indices give more details of the price history and show which of the commodities contributed to the overall price instability. We find support for the Law of One Price in all of the price pairs because the prices share a common trend. This is consistent with the finding of Ejrnaes and Persson (2000) for the market in wheat in France of the mid-19th century. Three of the London – Liverpool commodity groups (wood products, metals and the combination of Liverpool wheat and London flour) were restricted only by their common trends.

Three other markets were also linked by common activity found uniquely in these commodities (processed food and oil, wheat, and flour). Any disturbance in the Liverpool market was common to London, and *vice versa*. This suggests a high degree of integration between the two markets of Liverpool and London in the short-run. We believe this is a new result that is important because of the strategic importance of Liverpool in the North Atlantic trades. It also helps focus the general debate about

integrated markets deeper into the 19th century and argues for an even deeper look still. Our conclusions also point to an agenda for historical research on the dynamics of the Liverpool and London market, on one hand, and, on the other, the key ports of the North Atlantic trade such as Montreal, Quebec, Charleston and New York.[30]

[30] See the unpublished paper: Karl Gunner Persson (2002), "Mind the Gap! Transport Costs and Price Convergence in the 19tth Century Atlantic Economy", University of Copenhagan, Copenhagan.

Figure 11. Processed Food Prices and the Common Trend



Processed Food Price Common Cycle

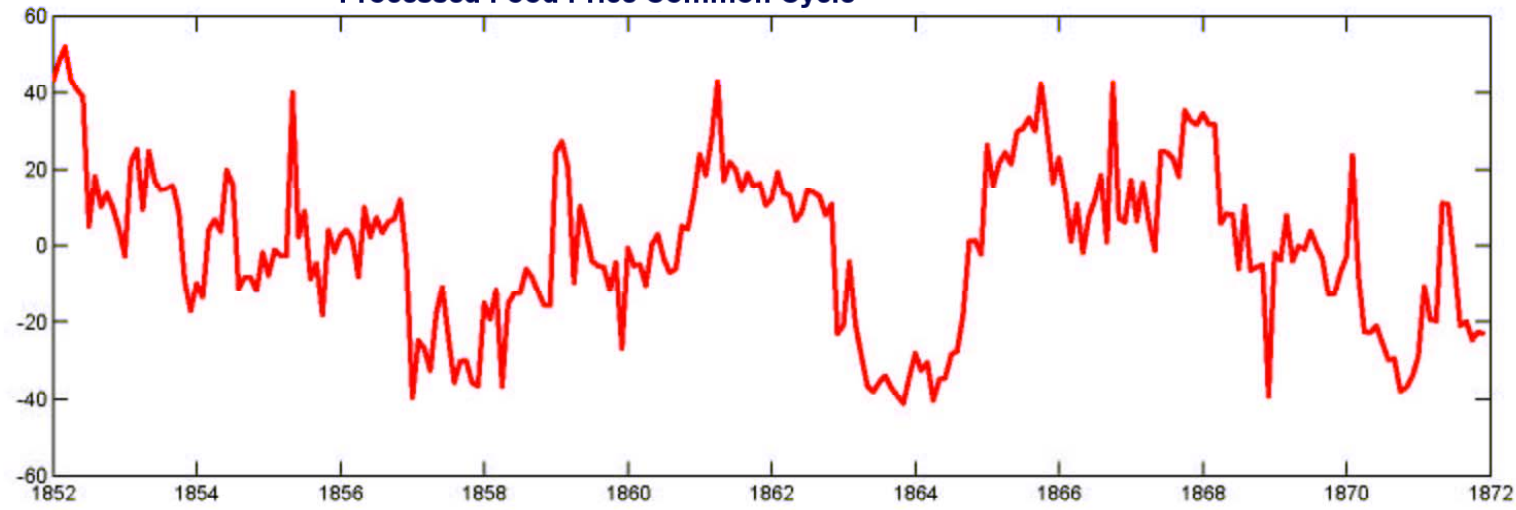
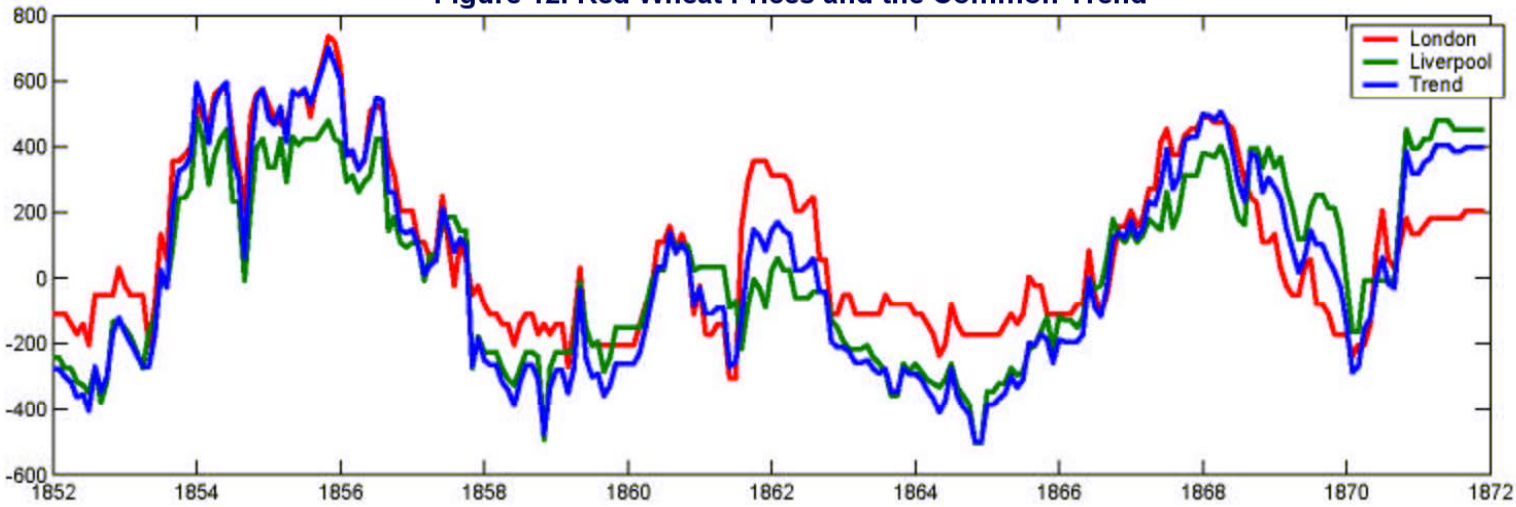


Figure 12. Red Wheat Prices and the Common Trend



Red Wheat Price Common Cycle

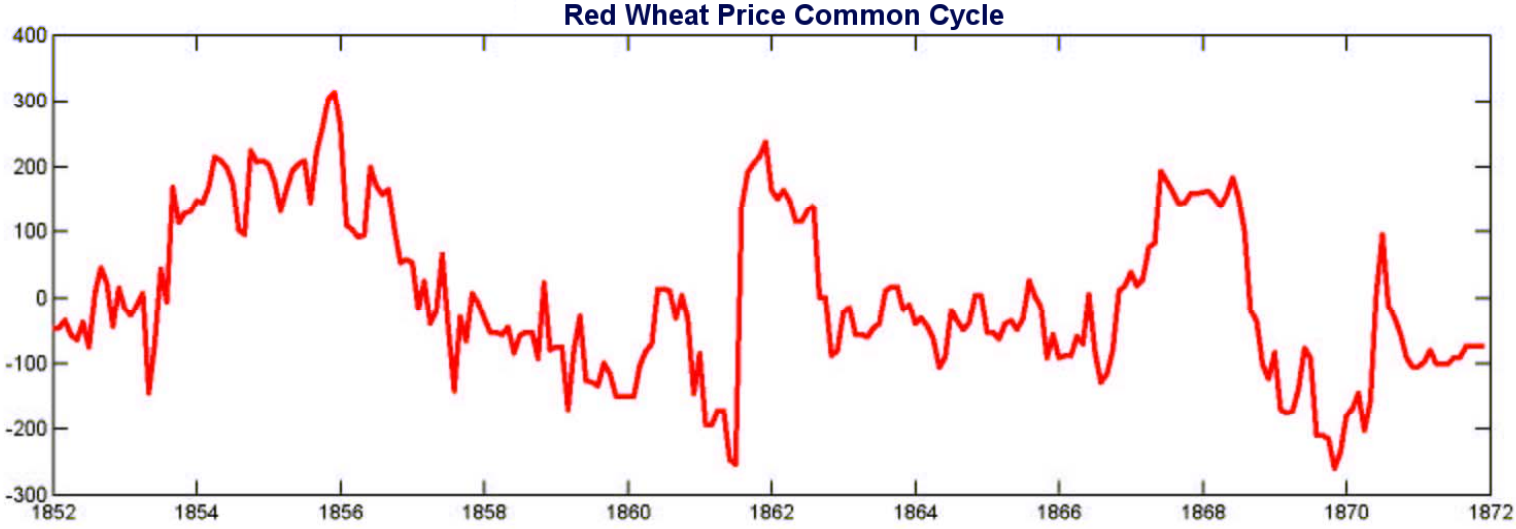
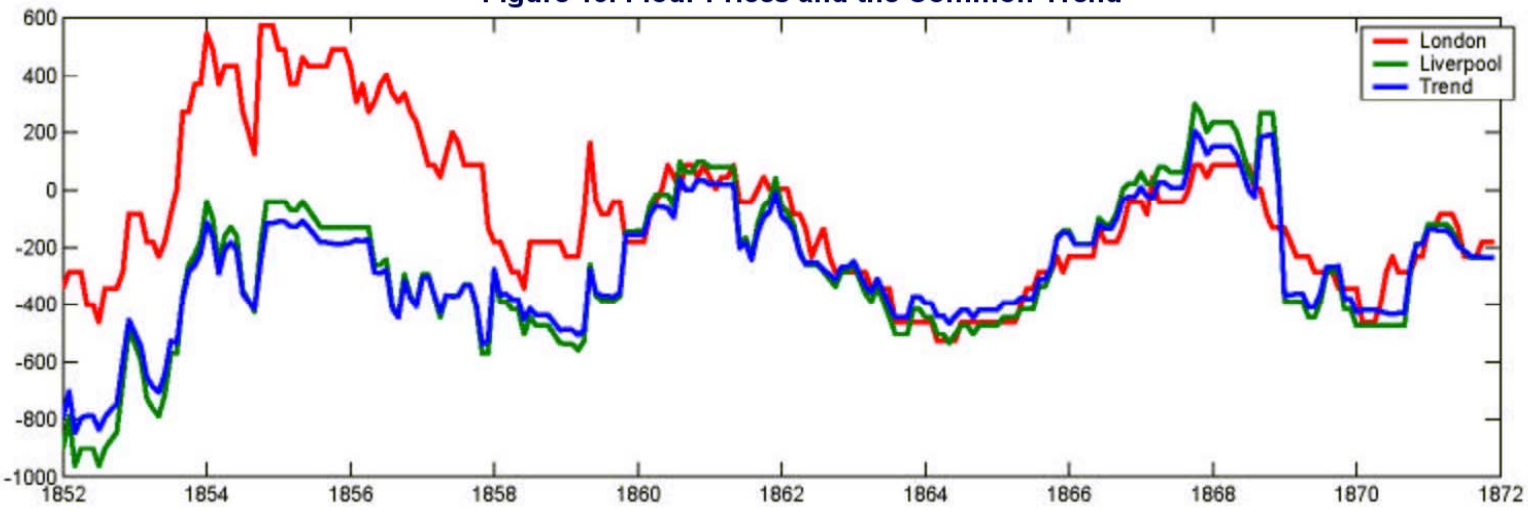
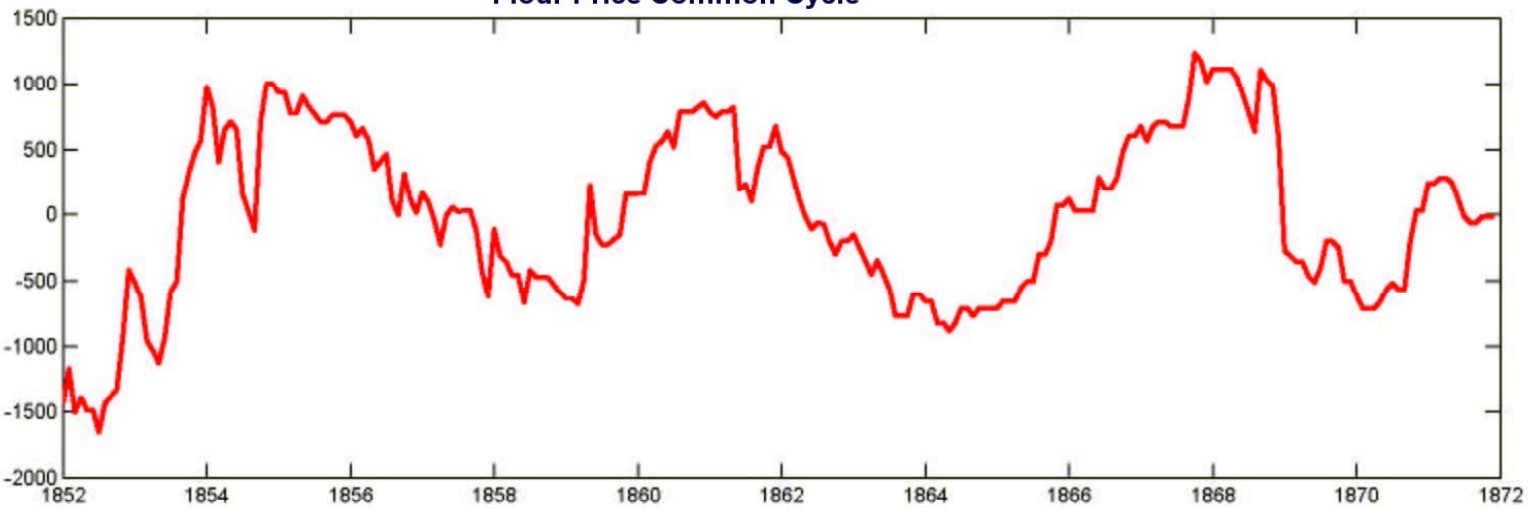


Figure 13. Flour Prices and the Common Trend



Flour Price Common Cycle



Appendix B. The Liverpool Price Index, Monthly, 1850 – 1871.

Average of 1860 =100

[1] All Commodities
[2] Agricultural Commodities
[3] Processed Foodstuffs and Oil
[4] Timber, Lumber & Naval Stores
[5] Metal Products
[6] Raw Cotton

	[1]	[2]	[3]	[4]	[5]	[6]		[1]	[2]	[3]	[4]	[5]	[6]
Jan-50	86.4	64.4	96.2	97.7	85.9	94.3	Sep-54	108.0	94.2	93.5	122.4	124.9	83.1
Feb-50	85.8	64.2	96.3	95.6	85.9	93.4	Oct-54	108.8	97.7	94.6	121.6	123.3	83.1
Mar-50	84.8	62.8	96.0	94.2	85.9	90.8	Nov-54	109.9	103.2	97.0	119.7	119.9	83.1
Apr-50	85.4	63.3	95.0	95.2	85.9	97.8	Dec-54	107.6	105.0	94.8	115.2	116.8	77.9
May-50	86.1	65.1	93.4	95.6	85.9	102.1	Jan-55	106.4	102.3	95.2	115.2	115.0	73.6
Jun-50	85.8	65.2	92.8	95.0	85.9	102.1	Feb-55	104.8	104.5	94.1	112.7	109.0	75.3
Jul-50	85.8	66.5	97.4	95.7	76.8	111.6	Mar-55	103.4	104.7	94.7	110.8	107.0	73.6
Aug-50	86.0	65.8	97.2	97.1	76.8	116.8	Apr-55	103.7	104.7	95.3	110.8	107.0	75.3
Sep-50	85.6	64.8	98.2	96.3	76.8	112.5	May-55	104.3	108.1	92.4	111.6	103.1	86.5
Oct-50	86.0	65.1	100.4	96.1	76.8	111.6	Jun-55	105.3	108.4	93.2	110.0	107.0	96.9
Nov-50	85.7	65.1	100.4	95.5	76.8	107.3	Jul-55	107.2	108.2	98.8	111.3	109.3	96.1
Dec-50	87.4	65.6	100.8	97.5	80.5	113.3	Aug-55	106.6	107.0	103.0	108.5	106.3	95.2
Jan-51	87.5	66.2	100.9	97.2	81.1	109.0	Sep-55	107.1	107.3	106.8	108.5	106.3	89.0
Feb-51	87.6	66.0	100.8	99.0	82.0	101.2	Oct-55	111.8	109.3	111.2	110.3	120.2	83.8
Mar-51	87.4	67.7	96.6	99.1	81.2	103.8	Nov-55	112.8	111.8	112.5	111.5	118.9	83.0
Apr-51	86.8	67.9	96.2	98.8	80.3	97.6	Dec-55	111.3	110.5	108.3	111.8	117.1	83.9
May-51	85.4	68.9	94.1	96.9	79.4	83.8	Jan-56	110.6	111.4	101.5	115.8	116.6	81.3
Jun-51	85.1	69.9	91.4	97.3	78.5	85.6	Feb-56	108.9	106.4	96.9	114.9	120.3	86.6
Jul-51	85.2	72.7	90.8	96.2	78.5	72.7	Mar-56	109.9	106.6	96.7	119.5	120.3	89.9
Aug-51	83.4	68.1	90.0	95.6	77.7	74.4	Apr-56	110.7	106.7	99.4	118.7	120.3	93.5
Sep-51	83.3	67.8	89.2	95.4	77.3	78.7	May-56	109.8	107.6	97.4	116.8	120.3	91.7
Oct-51	81.9	67.1	86.8	94.0	77.1	73.5	Jun-56	109.6	107.5	100.3	113.6	120.3	89.1
Nov-51	81.4	67.2	85.5	95.2	75.6	71.8	Jul-56	110.0	109.0	102.1	113.6	116.2	94.3
Dec-51	81.5	68.6	84.4	95.0	75.9	70.1	Aug-56	109.7	105.9	102.7	115.0	116.2	94.3
Jan-52	81.0	71.8	80.3	94.6	77.0	68.4	Sep-56	109.2	100.5	104.9	115.0	116.2	96.9
Feb-52	81.7	75.0	78.8	94.6	76.6	71.0	Oct-56	110.4	102.7	103.4	118.7	116.2	98.7
Mar-52	81.9	74.3	79.9	94.8	76.1	74.4	Nov-56	109.1	99.2	101.7	118.5	116.2	99.5
Apr-52	82.3	76.4	78.9	94.6	76.6	74.4	Dec-56	109.1	99.5	105.2	114.6	116.2	99.5
May-52	83.6	78.1	80.7	94.2	77.6	79.6	Jan-57	111.6	106.2	112.1	108.5	118.2	106.4
Jun-52	84.7	79.6	81.2	94.2	79.3	83.1	Feb-57	111.4	104.8	111.7	107.3	118.8	114.2
Jul-52	85.2	77.8	83.8	94.8	80.5	83.1	Mar-57	111.4	106.9	111.1	105.8	119.0	113.4
Aug-52	85.5	76.8	82.4	95.6	83.7	85.6	Apr-57	112.3	106.9	114.7	106.4	119.1	112.4
Sep-52	86.8	76.9	82.6	95.3	90.0	85.6	May-57	114.2	108.1	114.3	112.9	118.3	115.9
Oct-52	89.1	78.8	82.7	95.9	97.2	87.4	Jun-57	114.1	111.7	113.3	110.7	116.9	114.2
Nov-52	91.4	80.9	84.1	97.7	100.4	84.8	Jul-57	113.9	112.3	113.8	107.2	117.1	119.4
Dec-52	94.5	83.9	84.5	97.5	114.9	81.3	Aug-57	113.2	112.7	111.7	105.9	118.5	118.5
Jan-53	99.8	83.2	91.0	105.7	128.0	82.2	Sep-57	112.2	112.1	106.1	105.6	118.7	129.8
Feb-53	99.4	83.2	90.5	106.5	123.3	85.6	Oct-57	110.5	110.6	102.3	105.1	117.5	128.9
Mar-53	99.7	80.2	92.0	108.7	125.9	83.9	Nov-57	100.5	101.2	95.8	92.1	112.5	95.2
Apr-53	99.4	80.9	92.5	110.8	116.6	90.0	Dec-57	99.2	98.9	94.8	91.4	112.3	91.7
May-53	98.2	80.4	90.2	111.2	114.0	87.4	Jan-58	100.1	92.9	94.1	101.0	116.7	95.2
Jun-53	98.2	81.3	90.1	111.7	110.9	90.8	Feb-58	97.8	90.6	94.9	97.6	108.2	103.0
Jul-53	98.8	84.9	89.0	111.2	109.5	90.8	Mar-58	97.8	90.0	94.8	99.1	108.2	98.7
Aug-53	98.9	84.5	88.0	111.1	114.3	85.7	Apr-58	97.9	92.2	93.0	101.7	104.3	99.5
Sep-53	102.8	89.8	88.0	118.7	116.9	88.3	May-58	98.1	91.6	96.0	100.5	103.5	101.2
Oct-53	108.6	98.5	90.9	131.8	116.9	87.4	Jun-58	96.5	88.7	96.4	98.1	101.9	99.5
Nov-53	110.2	99.6	93.3	134.5	117.3	87.4	Jul-58	95.5	89.3	96.1	94.9	100.8	102.1
Dec-53	111.5	99.3	95.2	136.0	120.7	87.4	Aug-58	96.0	89.3	95.6	97.0	100.8	102.9
Jan-54	113.6	105.8	97.1	133.7	121.1	89.1	Sep-58	95.8	88.3	95.4	97.6	99.7	105.6
Feb-54	113.8	104.1	98.6	134.3	120.7	86.6	Oct-58	95.5	88.0	93.8	97.7	100.2	102.9
Mar-54	114.5	99.7	98.9	138.2	122.4	86.5	Nov-58	94.2	84.8	92.0	97.7	100.5	101.2
Apr-54	117.0	103.6	99.3	140.5	122.9	85.6	Dec-58	93.4	84.2	92.4	95.2	100.9	98.7
May-54	117.5	105.2	97.7	142.7	122.9	86.5	Jan-59	92.8	86.2	88.1	94.8	101.1	98.5
Jun-54	115.2	105.4	94.1	138.1	124.6	86.5	Feb-59	92.7	87.2	90.3	91.9	101.1	96.0
Jul-54	112.7	99.1	92.3	134.8	128.4	86.5	Mar-59	94.2	86.9	90.8	96.4	101.1	103.6
Aug-54	110.7	97.3	95.1	125.0	127.4	84.8	Apr-59	94.9	90.7	90.9	95.4	101.2	102.9
							May-59	97.8	101.3	90.5	96.4	101.2	102.0

	[1]	[2]	[3]	[4]	[5]	[6]		[1]	[2]	[3]	[4]	[5]	[6]
Jun-59	96.5	97.6	92.0	93.2	99.7	109.6	Mar-65	94.9	79.1	83.0	99.4	98.0	242.3
Jul-59	96.3	95.6	93.5	93.3	99.7	107.8	Apr-65	94.3	79.5	82.6	99.0	98.4	214.5
Aug-59	95.9	92.2	96.9	92.8	99.7	106.2	May-65	95.6	78.9	84.3	101.2	97.7	228.4
Sep-59	94.3	89.2	94.2	90.7	102.4	104.6	Jun-65	95.7	79.4	84.2	97.2	97.5	272.4
Oct-59	94.6	89.3	94.6	91.2	101.5	108.2	Jul-65	95.9	79.6	84.1	97.2	97.8	271.8
Nov-59	97.0	95.0	92.0	98.7	101.1	102.1	Aug-65	97.9	83.1	88.1	96.7	97.8	257.9
Dec-59	97.1	94.5	94.1	98.4	101.6	98.7	Sep-65	99.3	82.6	90.3	99.0	97.3	283.1
Jan-60	97.0	90.4	97.6	99.2	101.2	100.3	Oct-65	103.7	85.5	89.8	105.8	99.1	349.6
Feb-60	98.8	96.5	99.0	100.3	101.0	94.6	Nov-65	105.0	88.3	91.8	107.4	101.0	298.5
Mar-60	100.3	98.9	101.1	100.5	100.7	99.5	Dec-65	107.9	87.7	92.3	117.4	101.6	315.0
Apr-60	100.7	100.3	102.0	100.2	100.4	99.5	Jan-66	108.6	94.0	94.0	112.2	101.6	292.5
May-60	101.0	102.1	100.4	100.3	100.4	102.9	Feb-66	108.3	92.9	94.2	114.4	100.8	278.6
Jun-60	100.6	102.0	100.4	99.9	99.7	101.2	Mar-66	110.2	94.5	96.9	117.3	99.6	290.7
Jul-60	100.3	100.9	100.9	100.1	99.2	98.5	Apr-66	107.3	93.6	94.8	113.8	100.1	228.4
Aug-60	100.4	104.0	101.1	97.3	99.2	98.5	May-66	103.2	93.2	93.2	106.6	99.2	204.0
Sep-60	100.0	102.1	100.9	97.9	100.1	96.9	Jun-66	104.6	96.3	91.6	109.9	97.0	204.0
Oct-60	99.7	102.5	99.4	98.1	99.8	100.4	Jul-66	101.8	94.6	80.2	110.0	97.0	216.3
Nov-60	101.1	101.2	99.4	102.7	99.6	104.7	Aug-66	100.9	94.5	80.9	105.9	96.7	216.3
Dec-60	99.9	99.1	97.8	103.5	98.8	102.9	Sep-66	102.4	96.8	82.4	106.2	97.9	212.9
Jan-61	100.2	100.6	94.5	105.1	99.1	105.5	Oct-66	102.2	99.5	76.9	107.7	96.9	233.6
Feb-61	98.4	99.3	93.3	103.4	96.1	99.5	Nov-66	103.4	100.8	81.1	108.5	96.1	218.8
Mar-61	97.0	98.2	91.4	101.8	95.0	104.7	Dec-66	102.4	97.8	80.7	109.2	94.8	219.8
Apr-61	97.3	99.1	90.8	102.1	96.5	102.9	Jan-67	102.4	103.8	81.6	103.6	91.3	231.9
May-61	99.3	99.0	94.9	103.4	97.1	116.0	Feb-67	103.2	102.7	82.3	106.7	94.1	209.4
Jun-61	97.1	95.9	92.8	99.9	96.3	118.6	Mar-67	102.8	103.9	81.4	105.8	94.2	202.2
Jul-61	95.6	95.4	92.8	95.7	95.3	117.7	Apr-67	102.9	106.7	81.1	106.6	92.8	186.8
Aug-61	94.9	91.7	93.1	95.7	94.4	123.7	May-67	103.3	107.1	84.7	106.3	92.8	165.6
Sep-61	95.0	94.3	92.4	93.2	91.3	144.5	Jun-67	103.2	106.9	84.2	105.3	92.8	178.1
Oct-61	96.8	96.7	93.6	92.1	92.5	169.6	Jul-67	101.7	108.0	82.4	100.2	92.0	179.9
Nov-61	96.9	97.5	92.9	90.4	92.6	176.6	Aug-67	101.4	108.4	82.4	99.8	91.6	176.5
Dec-61	99.1	101.4	92.5	96.3	92.9	169.6	Sep-67	100.3	108.9	82.4	100.1	91.8	141.9
Jan-62	99.8	100.3	92.5	97.0	92.9	190.4	Oct-67	99.5	109.7	82.3	100.0	91.6	119.3
Feb-62	99.9	97.0	91.2	101.6	92.6	192.1	Nov-67	99.5	110.9	82.4	97.6	91.7	131.5
Mar-62	99.1	95.2	91.8	101.2	92.6	180.9	Dec-67	98.4	111.1	80.2	98.4	91.9	112.5
Apr-62	98.4	93.5	92.0	99.1	91.4	192.1	Jan-68	98.5	109.4	79.5	101.7	90.0	116.0
May-62	98.0	90.9	93.2	99.3	92.3	184.3	Feb-68	99.8	110.3	79.5	102.0	89.6	143.7
Jun-62	97.4	89.2	92.2	99.1	90.9	199.0	Mar-68	101.1	112.3	81.3	102.0	90.1	148.8
Jul-62	96.9	86.7	92.0	95.1	91.4	243.3	Apr-68	104.2	114.0	86.1	103.5	89.6	183.5
Aug-62	97.3	86.2	92.6	93.7	91.1	283.8	May-68	103.3	112.3	85.0	103.4	89.6	176.5
Sep-62	101.2	86.2	93.4	100.1	92.1	367.0	Jun-68	100.7	104.9	83.9	102.1	89.2	174.8
Oct-62	101.4	84.5	95.1	97.3	95.6	387.5	Jul-68	99.1	103.0	83.3	97.9	89.5	174.8
Nov-62	100.5	83.7	94.2	99.8	95.1	345.9	Aug-68	97.8	102.0	80.7	97.9	89.4	164.4
Dec-62	100.0	79.2	97.9	101.0	94.2	364.2	Sep-68	100.0	107.7	80.7	100.4	91.7	155.8
Jan-63	101.0	82.7	96.8	101.4	94.0	359.8	Oct-68	100.3	107.2	80.4	100.8	92.3	162.7
Feb-63	100.3	82.2	97.6	101.0	93.1	337.3	Nov-68	99.7	104.3	80.3	100.7	93.1	162.7
Mar-63	99.6	81.0	97.0	99.9	93.2	339.2	Dec-68	99.8	102.9	82.8	100.4	93.0	157.5
Apr-63	99.5	79.6	97.8	99.8	93.5	339.2	Jan-69	99.4	100.3	79.2	103.2	93.3	167.0
May-63	100.2	81.3	99.5	99.8	93.3	334.0	Feb-69	99.5	99.3	79.5	103.3	93.3	176.5
Jun-63	99.4	79.4	99.3	99.5	93.4	325.4	Mar-69	99.3	95.4	81.8	103.0	93.8	180.0
Jul-63	98.7	77.7	98.8	97.5	95.5	325.4	Apr-69	99.9	94.4	84.7	103.0	93.4	186.9
Aug-63	100.3	78.2	98.8	99.0	97.7	339.2	May-69	98.7	92.8	82.8	102.1	93.2	185.1
Sep-63	100.5	76.2	98.4	98.3	101.4	377.3	Jun-69	98.3	93.1	82.4	102.3	93.2	170.3
Oct-63	102.6	75.4	99.2	102.0	103.9	408.5	Jul-69	97.1	89.2	81.3	102.4	92.8	174.8
Nov-63	103.0	76.9	100.1	101.8	104.8	386.0	Aug-69	97.3	89.9	81.3	102.9	91.8	176.5
Dec-63	102.3	76.5	98.0	102.0	104.8	370.4	Sep-69	100.1	97.4	82.0	104.0	91.9	181.7
Jan-64	104.2	74.5	98.1	103.7	112.4	391.2	Oct-69	99.5	96.7	82.2	103.2	92.1	167.9
Feb-64	104.5	76.3	95.9	104.4	112.0	391.2	Nov-69	100.4	96.6	80.7	104.1	97.6	162.7
Mar-64	108.1	81.0	97.9	111.6	110.9	382.5	Dec-69	99.8	96.0	79.0	103.9	98.1	161.0
Apr-64	106.9	79.3	100.7	106.7	110.3	384.3	Jan-70	97.5	88.1	79.5	103.7	96.9	161.8
May-64	106.2	78.9	99.5	107.6	108.1	384.3	Feb-70	96.6	85.7	79.6	103.5	96.5	158.4
Jun-64	106.2	79.0	101.3	105.2	106.1	413.7	Mar-70	97.2	85.7	82.1	103.2	97.4	156.2
Jul-64	106.1	82.4	99.3	102.6	103.5	451.8	Apr-70	97.0	87.4	80.2	102.7	98.6	156.2
Aug-64	105.1	81.3	96.3	102.6	104.1	443.1	May-70	97.0	88.6	78.9	103.3	98.3	152.3
Sep-64	101.0	79.8	92.5	98.4	103.3	401.5	Jun-70	96.6	88.4	78.0	103.2	99.2	142.8
Oct-64	99.2	79.1	89.3	98.2	103.0	353.1	Jul-70	95.7	86.8	77.8	103.6	100.4	125.3
Nov-64	98.7	78.0	88.3	98.2	101.2	387.7	Aug-70	98.1	88.7	77.2	106.0	100.0	169.6
Dec-64	98.8	77.7	88.1	99.6	100.6	387.7	Sep-70	96.6	89.8	76.0	104.8	99.9	136.7
Jan-65	97.6	79.5	84.0	100.3	98.1	342.7	Oct-70	99.5	94.7	79.8	110.2	100.0	121.2
Feb-65	96.8	79.7	83.7	102.0	97.8	280.2	Nov-70	101.0	96.3	81.8	110.9	100.4	127.6

	[1]	[2]	[3]	[4]	[5]	[6]
Dec-70	101.2	100.0	80.9	110.9	99.8	118.6
Jan-71	102.9	106.0	82.3	110.8	99.9	116.0
Feb-71	102.0	103.4	82.2	111.6	99.8	110.7
Mar-71	102.1	106.0	82.7	109.8	99.5	108.5
Apr-71	100.6	104.0	81.5	109.0	99.5	103.0
May-71	99.9	101.9	81.0	108.1	99.5	109.0
Jun-71	99.6	97.9	80.3	108.6	100.1	120.6
Jul-71	99.4	96.0	79.5	109.7	99.7	126.4
Aug-71	99.4	95.3	79.8	109.0	101.2	124.6
Sep-71	101.3	95.0	81.5	111.3	104.1	132.4
Oct-71	101.7	91.6	82.4	112.8	107.6	133.3
Nov-71	102.9	95.5	83.4	111.4	108.0	134.6
Dec-71	105.7	95.1	83.9	114.8	117.7	139.7

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