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Abstract: The authors study British commodity markets and the extent to which prices in these markets were integrated in the short run and converged in the long run. Their historical data are new. It consists of five price indices for identically described goods—iron products, wood products, processed foods, red wheat, and flour—in Liverpool, the bulk commodity port of mid-19th century Great Britain, and London. Tests for cointegration reveal long-run convergence among all the Liverpool–London price pairs. The authors also report that markets in processed food, red wheat, and flour were integrated in the short-run because they share a serially correlated common feature. This common feature implies that Liverpool and London prices responded to common cyclical shocks at the same moment in time. They find the impact of this shock is short-lived because the trend shock explains more than 80 percent of processed food and red wheat price fluctuations in Liverpool and London and Liverpool flour price movements.

JEL classification: N13, N73, E31

Key words: Liverpool, London, prices, markets, commodities, bulk trade, 19th century, wheat, flour, cointegration, cycles, common features.

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

Economic historians believe that the mid- to late-19th century is an important period in the creation of 'national markets' in Great Britain. In practice, there has been little testing of this view. An exception is the literature on Irish famine period grain prices of the 1840s [O'Rourke (1994)]. However, there is also evidence that suggests many markets within Britain lacked a national character [Latham (1967) and Perren (1990)] during this period.[1] The same claim has also been made of France: that French agricultural markets were fragmented in the 19th century. Ejrnaes and Persson (2000) show this was not the case. By about 1850, nearby French markets adjusted rapidly to common shocks, but more distant markets adjusted slowly. They go onto report that this speed of adjustment began to increase during the third quarter of the 19th century.

This paper seeks to answer the same questions for British markets during the mid-19th century. Although we cannot answer this question in a comprehensive manner, we have sufficient price data to examine the relationship between the two important bulk commodity markets of Liverpool and London. The data we study is new. It consists of Liverpool and London prices indices for iron products, wood products, processed foods, red wheat, and flour that is monthly and runs from 1850 to 1871. The underlying commodities are identically described in the Liverpool and London markets.

Besides offering a new set of British commodity prices that is internally consistent, we contribute to the price history of mid 19th century Britain in two ways. The data gives us the opportunity to examine *(i)* the extent of short-run market integration and *(ii)* long-run price convergence between the two important bulk commodity markets of Liverpool and London. We invoke definitions of short-run market integration and long-run price convergence that allows us to employ standard time series econometrics methods.

We consider London and Liverpool markets to be integrated in the short-run when no relevant information exists that helps to predict price changes in the Liverpool and London markets. If this is not the case, arbitrage opportunities would have been available to market participants. Our definition of short-run market integration is equivalent to the notion of a serially correlated common feature of Engle and Kozicki (1993). Liverpool and London prices share a serially correlated common feature when a linear combination of their rates of change is unpredictable, conditional on the relevant history.

We employ the Bernard and Durlauf (1995, 1996) test of long-run price convergence. They show that convergence exists when long-run forecasts of prices in Liverpool and London move together. This requires Liverpool and London price levels to respond only to common trend

shocks (e.g. shocks to the level of technology and the money stock shock) in the long-run. Thus, long-run price convergence is equivalent to Liverpool and London prices sharing a cointegrating relation. Note that the cointegration null for a Liverpool-London price pair is a test of the long-run 'Law of One Price' hypothesis.

A Liverpool-London price pair that possesses a cointegrating relation *and* a serially correlated common feature is a special case of the Beveridge and Nelson (1981) - Stock and Watson (1988) common trends decomposition, according to Vahid and Engle (1993). The Beveridge, Nelson, Stock, Watson, and Vahid and Engle (BNSW-VE) decomposition only needs the cointegrating and common feature vectors and the levels data to compute the common trend and common cycle of the Liverpool-London price pair. Although all price pairs cointegrate, we find that only processed food, red wheat, and flour price combinations contain a serially correlated common feature.

Engle and Issler (1995) and Issler and Vahid (2001) develop methods to estimate the forecast error variance decomposition (FEVD) of the Liverpool-London price pair, under the BNSW-VE decomposition. The FEVD provides information about the relative contribution of trend and cyclical shocks to movements in the processed food, red wheat, and flour price pairs. Trend shocks account for 80 percent or more of fluctuations in these commodity markets at the 12-month forecast horizon or longer, except for the London flour price. The importance of trend shocks suggests that technological change dominated price fluctuations in mid-19th century commodity prices in Great Britain.

Liverpool and London Markets

The mid-19th century is a key period in the history of inter-market commodity arbitrage. In the absence of rapid communications and transport the parties to trade act in ignorance of the actual prices other markets at that time and of the eventual prices to be realised as the markets adjust to each other. The 1850s was the first decade when the electric telegraph and the railways linked most of the main regional markets in Britain. The near instant communication of prices by telegraph eliminated uncertainty about existing prices and the improvement of the railway network sharply reduced, but did not eliminate, the risks inherent in interregional transactions.[2] By late 1866, Liverpool and London were also linked to the new trans-Atlantic telegraph cable.

Another striking feature of prices during the mid-19th century is their volatility. Price volatility began with the great Victorian boom of the early to mid-1850s, the subsequent depression in the latter part of the decade and the disruption of trade brought about by the US

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

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

Civil War of the1860s. Volatility is also reflected in the trade volumes. Variation along this margin appears in the recently compiled rates of change of tonnage handled by the port of Liverpool and the port revenue from fees and rates [Milne, pp.55 – 85].

The port of Liverpool dominated British overseas bulk trades in the first half of the 19th century. Liverpool prices were particularly important for the North Atlantic trade and generally were the ones most regularly reported in the North American press as the key British prices although London prices were often reported as well. According to Francis Hyde (1971), the port accounted for about 45 per cent of all British exports, by value, in 1857 with its nearest rival, London, far behind at 23 per cent. By value of transactions, the largest Liverpool import trades were in raw cotton, timber and grains with the two latter growing rapidly at mid-century. 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 relative to London and British ports as a whole.[3] Yet Liverpool remained the port whose prices were key for North American markets.[4]

The international spatial convergence of prices and market integration has become familiar themes in the history of the late 19th century Atlantic economy [for example, see Harley (1996), O'Rourke and Williamson (1999), and Taylor (1999)]. This literature has paid particular attention to declining transport and associated transaction costs.[5] Along with Persson (2002), we argue that technological innovation is a neglected factor to help explain price convergence and market integration of 19th century international trade. We study a new set of British commodity prices to develop evidence in support of our argument.

The Price Data

In order to examine the extent of the market integration between Liverpool and London, the monthly prices of the same commodity are selected in the two markets for the years 1850 to 1871. (A detailed presentation of the data is in Appendix A). Fifteen commodities prices from Liverpool contemporary sources satisfy the condition of having an *apparent* exact London counterpart price. We also consider a sixteenth pair of a Liverpool wheat price and a London flour price. The Liverpool and London commodity pairs are given in Table 1. Wheat and flour prices (as indexes) are considered separately and the other commodities are bundled and represented by geometric indexes. The average of the 1860 observations equals 100. The bundling is justified on the grounds that: a) the commodities have similar attributes, b) they were the likely minimum scope of the traders, and c) that the indexes remove idiosyncratic price reporting (movements).

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[3] 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] See for example the *New York (Daily) Times*.

[5] The unpublished paper by Persson (2002) uses high frequency data and emphasizes the non-transport transactions costs.

Table 1. Liverpool - London Commodity Pairs.

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 Products

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.

Wheat and Flour

1. Liverpool: best "English red" and London: Norfolk (Lincolnshire, Yorkshire) red wheat in shillings per bushel
2. Liverpool: flour (imported Superfine # 2) and London: "best miller's flour" All relevant prices are adjusted for duty.

Sources: *Mark Lane Express and Agricultural Journal* (1850 –71), London,
Myer's Mercantile Advertiser (1852 – 1871), Liverpool,
The Economist (1850 – 1871), London.
The Liverpool Journal of Commerce (various years), Liverpool,
The Liverpool Mercantile Gazette (1850 – 1871), Liverpool,
The Times (1850 – 1871), London, and
Willmer and Smith's,*European Times* (1850 –1868), Liverpool.

There are several issues of concern when comparing prices in Liverpool and London. First, in agricultural goods there are fewer items with a *close* London equivalent (often because of grade distinctions). An example of the incompatibility is salted beef and pork that is quoted in both Liverpool and London but which varied substantially in price and 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 [*Willmer and Smith's European News*]. However, among the Liverpool agricultural commodities that do have a London reasonable counterpart are wheat and flour.[6] Second, 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

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[6] For discussions of the working of the markets see *Yearly Journal of Trade* for London (from 1840) and Milne (2000) for Liverpool.

that may have given rise to 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 practice that often made purchasers cautious in their quality evaluations [Latham (1967), 9 – 12]. This was subsequently reflected in the reported prices. Last, the same commodity was occasionally reported sold in different units (and the underlying prices have to be adjusted appropriately).[7]

As seen in Figures 1, 2, and 3 the pair-wise Liverpool and London price indexes tended to move together. However, there were important differences. One is due to timing of price quotations and stems from institutional differences of how markets in Liverpool and London were organized. 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 each fortnight during the season of May to November. Out-of-season meetings were usually less frequent [Passingham (n.d), 252-261]. While there are a few divergent price movements, 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.

Second, there is no assurance that the overseas goods prices noted 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, in the context of markets within Great Britain, the commodities involved in the bulk import trades all had strong seasonal arrival patterns and associated seasonal price patterns.

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[7] 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. See Lower (1973).

Figure 1. Liverpool and London Price Indexes, Processed Food and Oil, Monthly, 1850 - 1871.

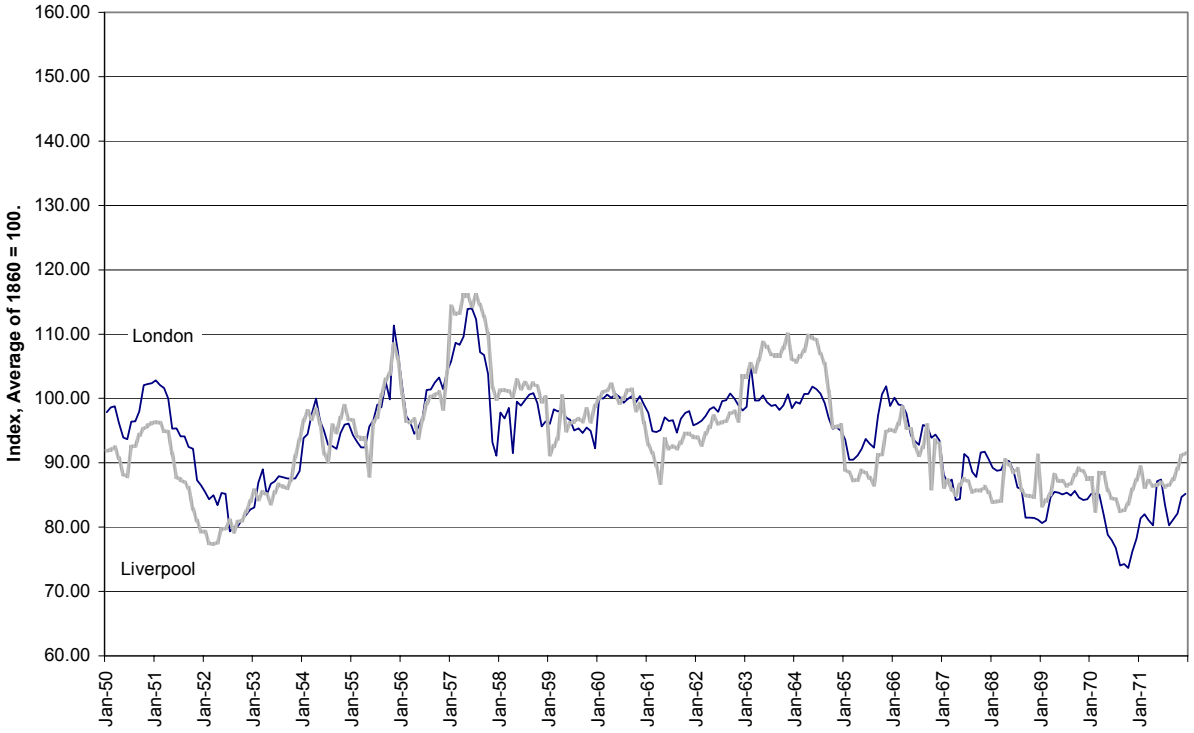


Figure 2. Liverpool and London Price Indexes, Timber and Lumber, Monthly, 1850 - 1871.

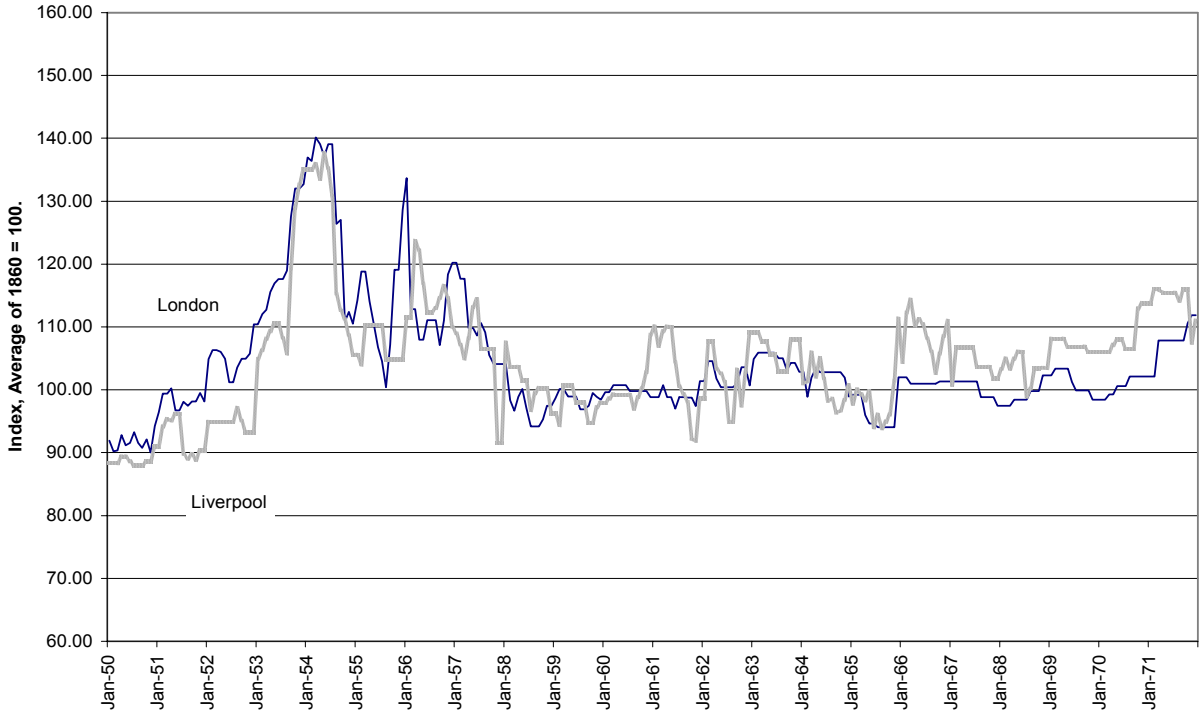
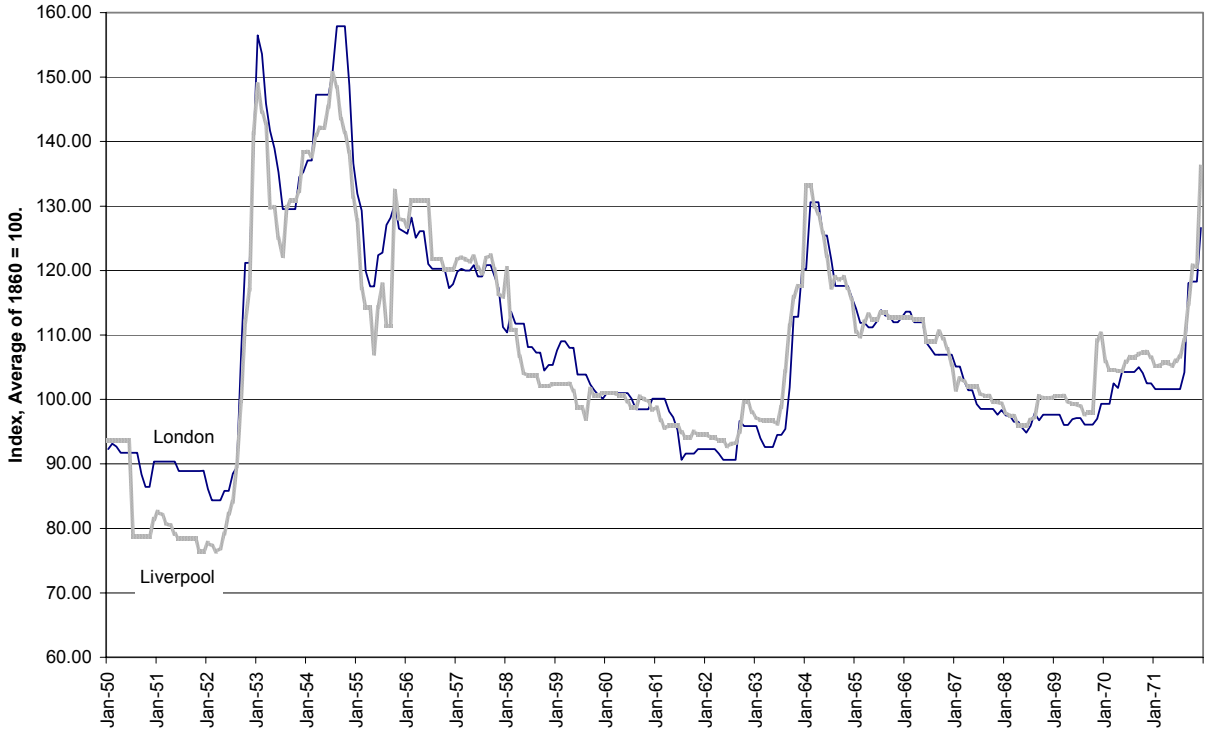


Figure 3. Liverpool and London Price Indexes, Iron Products, Monthly, 1850 - 1871.



As noted earlier, the different basis of price quotations does not permit a broad comparison of Liverpool and London agricultural goods prices. Here we rely on the price of red wheat and "good quality" flour in both cities to reflect the grain market. The Liverpool 'English or Yorkshire red' wheat was a domestic product (including occasional imports from Ireland). London red wheat usually originated in Norfolk, but it occasionally arrived from Lincolnshire and Yorkshire.[8] There was a very close correspondence between Liverpool and London prices. London prices were nearly always greater than the Liverpool ones. This may reflect a quality difference in the grains in the two markets. Or, it may reflect the spatial hierarchy of prices.

[8] 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.

Figure 4. Liverpool and London Price Indexes, Red Wheat, Monthly, 1850 - 1871.

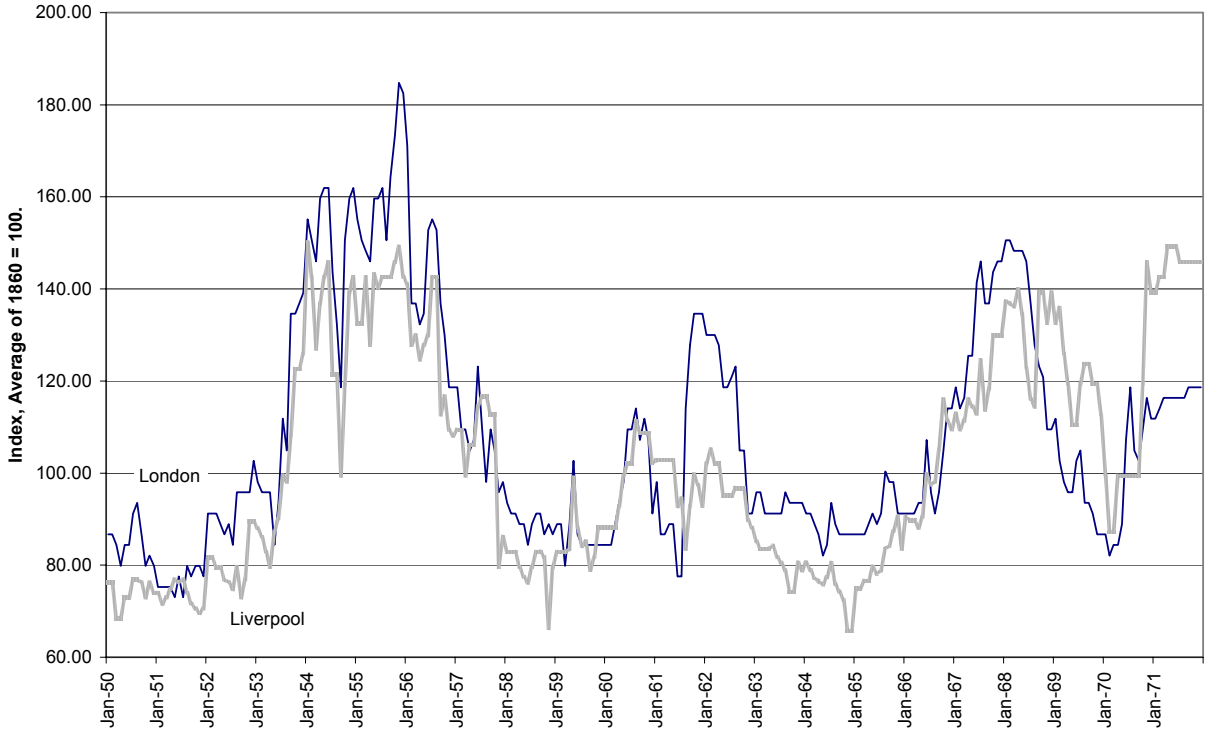
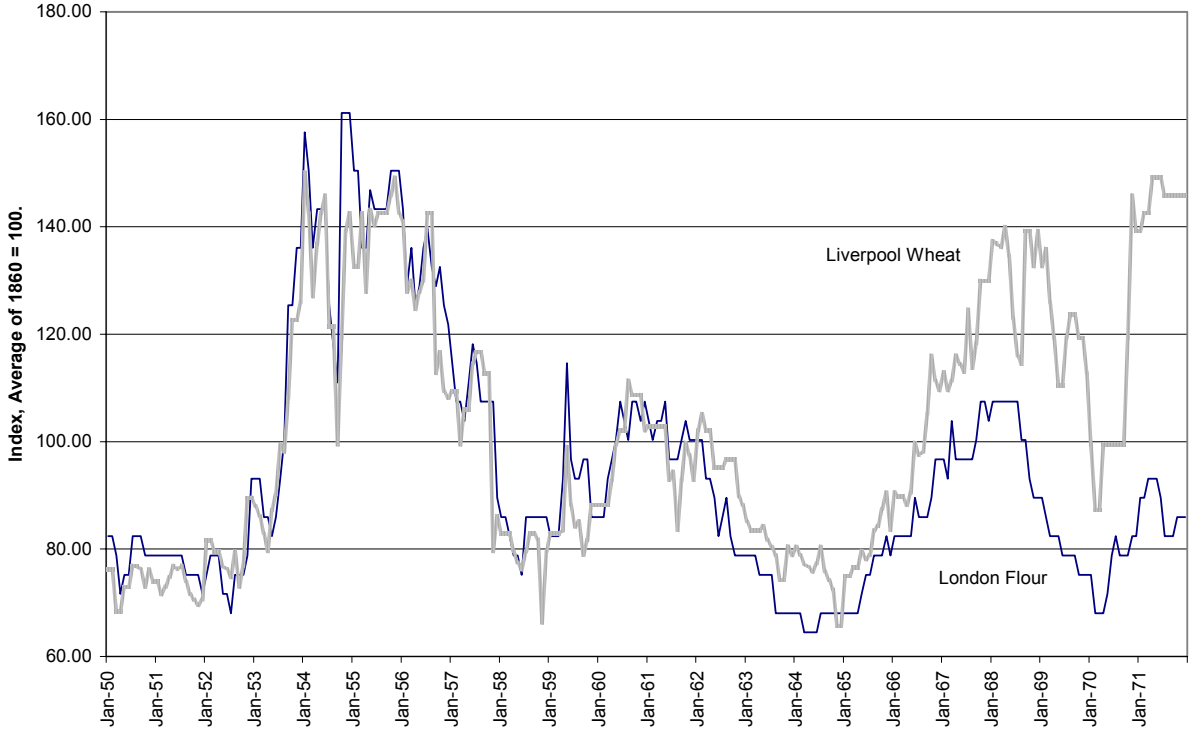


Figure 5. Liverpool Red Wheat and London Flour Price Indexes, Monthly, 1850 - 1871.



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, noted earlier, 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 25 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. Perren's observation requires that the main commodity arbitrage in breadstuffs must have been the shipment of wheat not flour and those shipments of flour constituted small marginal adjustments. Liverpool and London flour prices quite naturally follow the general trend of wheat prices although a price gap between the two markets in this commodity, evident in the 1850s, was not present in the 1860s.

To review, the London and Liverpool prices pairs in all commodities groups we report on appear to move closely together throughout the January 1850 to December 1871 period. 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.

Tests for Market Integration

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

- Liverpool and London wood products;
- Liverpool and London iron products;
- Liverpool and London processed foods and oil;
- Liverpool (English) red wheat and London (Norfolk) red wheat;
- Liverpool (imported Superfine #2) flour and London best millers' flour; and
- Liverpool (English) red wheat and London (best millers') flour.

All of the above are 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, 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 Liverpool and London price pair is described by a pth-order vector autoregression, VAR(p):

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

where Y_t is a vector of the Liverpool and London prices in logs and ε_t is vector of forecast innovations. When Y_t is a multivariate unit root process, which arises when at least one root of φ_j is on (or inside) the unit circle, the price levels (in logs) cannot exhibit mean reversion. There is evidence the prices series contain stochastic trends. Thus, maintaining the unit root hypothesis appears reasonable.[9]

Unit roots in a price pair yield regressions that have non-standard interpretations. Given the data has a multivariate unit root representation, 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.

This situation requires that a London and Liverpool price pair shares a common trend, or are cointegrated, according to Granger and Engle (1987). 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, conditional on a trend 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 often employed to test for cointegration and estimate cointegrating vectors as described by Johansen (1988, 1991). The VECM of the VAR(p) of Y_t is:

$$\Delta Y_t = \alpha + \delta Z_{t-1} + \sum_{i=1}^{p-1} \gamma_j \Delta Y_{t-1} + \varepsilon_t \qquad (2)$$

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 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 for the sample period 1852*M*1-*1872M12*, with data back to 1850*M*1 available for lags. 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)].[10] 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 $Z_{t\,t}$. The former model leaves the intercept of the VECM unrestricted, while the latter model adds an unrestricted linear trend.[11]

Table 2. Cointegrations Tests for Liverpool - London Pair-wise Price Indexes.

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

[9] Augmented Dickey-Fuller tests of the price series are available from the authors upon request.
[10] These correspond to MacKinnon, Huag and Michelis (1998) type II and type IV models.

[11] 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 Liverpool - London flour price pair.

Johansen λ–max and trace tests appear in Table 2. The lag lengths of the levels bivariate ARs were selected using likelihood ratio (LR) tests with Sims (1980) degrees-of-freedom modification.[12] These tests allow us to conclude there is evidence to support a common trend in each of the Liverpool – London 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. This is evidence the London and Liverpool markets share a long-run equilibrium relation because prices (forecasts) in these two markets are not independent. Thus, the data favours long-run convergence in the six price pairs we study, which is compelling historical evidence in support of the 'Law of One Price' hypothesis 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 Liverpool and London price pairs is unpredictable, given the VECM (p-1) regressors. The idea is that an unobserved feature common to prices in Liverpool and London is the only source of fluctuations in their growth rates (e.g., inflation rates). Hence, the transitory or cyclical movements in Liverpool and London prices are driven by shocks to the serially correlated common feature.[13] A serially correlated common feature is consistent with short-run market integration. Otherwise, an arbitrage opportunity would be available on the basis of information that can be used to predict short-run price movements in Liverpool and London.

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 3 reports on tests for a common feature in the price pairs. The tests for a serially correlated 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

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[12] 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.

[13] Tests for serially correlated common features are used by Engle and Issler (1995), Issler and Vahid (2001), and Wakerly, Scott, and Nason (2003) in a variety of models.

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".

The common features tests yield three common feature relations in the six Liverpool – London 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 Liverpool – London flour price pair. A Liverpool – London price common feature relation indicates short-run price fluctuations respond almost entirely to shocks to the common cycle and little to idiosyncratic shocks. Thus, there is no evidence for unexploited arbitrage opportunities in these markets, conditional on the VECM(p -1) information set.

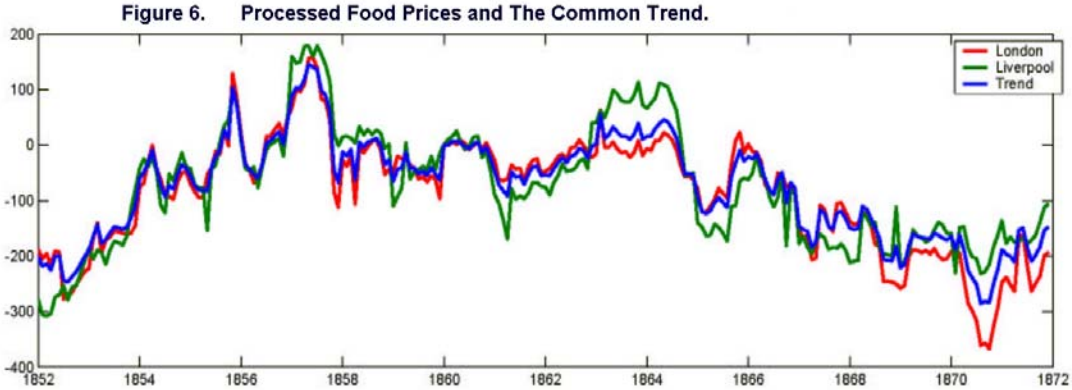
Table 3. Common Features Tests for Liverpool - London Pair-wise Price Indexes.

Number of Observations = 224

Commodity Groups	**Processed Food**	**Wood Products**	**Iron Products**	**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 0.25	0.21 0.25	0.24 0.43	0.19 0.23	0.17 0.18	0.22 0.32
Chi-square test	18.74 87.35 #	53.16 # 117.53 #	57.32 # 185.80 #	46.17 102.31 #	41.58 # 86.96 #	56.07 141.37 #
Rao's F-test	0.70 1.62 #	2.00 # 2.15 #	1.66 # 2.74 #	1.27 1.38 #	1.52 ## 1.54 #	1.53 # 1.93 #

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

Figure 6. Processed Food Prices and The Common Trend.



Processed Food Price Common Cycle.

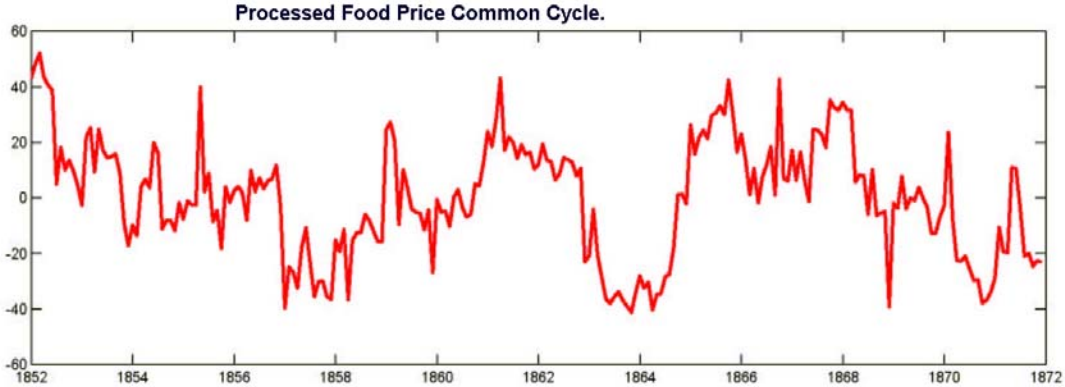
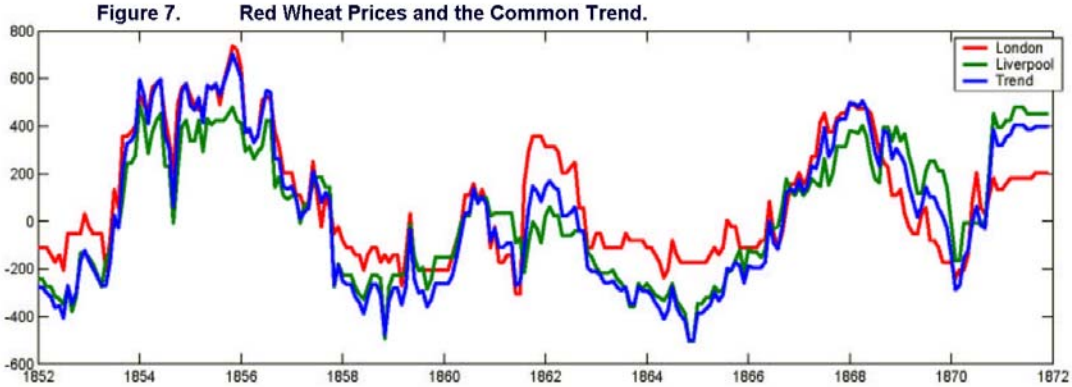
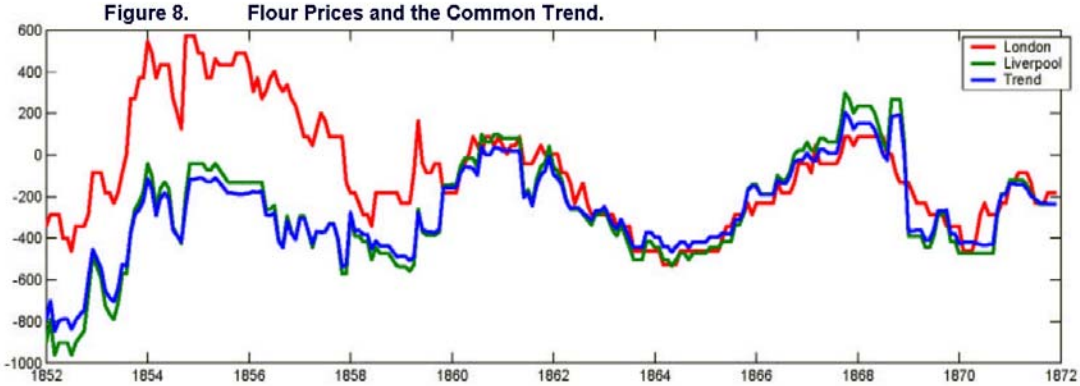


Figure 7. Red Wheat Prices and the Common Trend.

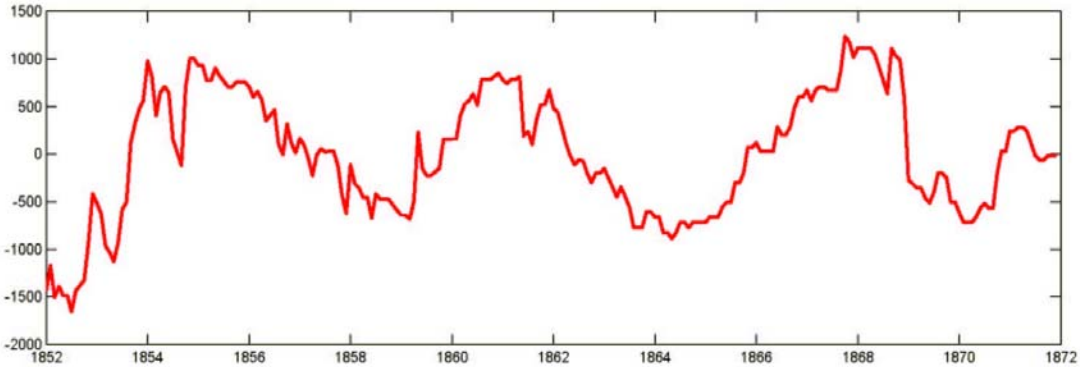


Red Wheat Price Common Cycle.

Figure 8. Flour Prices and the Common Trend.



Flour Price Common Cycle.



Vahid and Engle (1993) show that bivariate time series which possess a common trend and a common cycle have a simple BNSW decomposition. The BNSW-VE 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 6, 7 and 8. 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.[14] 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.[15]

Of particular interest from Figures 6, 7 and 8 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. The processed foods (including linseed oil) were all imported goods that were shipped long distances. The disruption to world shipping associated with the US Civil War, and uneven commodity flows as a result, 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 commodity prices in the Liverpool and London market during the early 1860s.

Issler and Engle (1995) and Issler and Vahid (2001) describe a method to generate the FEVD of the common trend-common cycle decomposition. A FEVD shows the percentage of the variation in the level of Liverpool and London prices explained by a given shock. The FEVDs of the processed food, red wheat, and flour price pairs appear in Table 4. 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

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

[15] Vahid and Engle (1993) show that bivariate time series that 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' 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.

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.

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 a long-run version of the 'Law of One Price'. The markets for three of the price pairs were also linked together because they shared a common cycle. Transitory shocks accounted for less than 20 per cent of the fluctuations in these price levels at a one year forecast horizon, on average, in these cases. This was rapid even by the standards of present-day highly integrated markets [Mohanty, Meyers and Smith (1999)].

Table 4. Forecast Error Variance Decomposition of Liverpool – London Commodity Index Pairs with Common Co-features.

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

Conclusions

We find evidence of long-run price convergence among the six Liverpool-London commodity pairs. Support for this version of the Law of One Price arises because wood products, iron products, processed food, red wheat, flour and the combination of Liverpool wheat and London flour price pairs share a common trend. Wood products, iron products and the combination of Liverpool wheat and London flour are restricted only by their common trends. A serially correlated common features links the processed food, red wheat, and flour price pairs.

Since a disturbance to the price, say, of processed food in Liverpool was common to London, and *vice versa*, it indicates a high degree of market integration in the short-run for these commodities.

The cointegrating relation and common feature in the processed food, red wheat, and flour price pairs allows us to invoke the common trend - common cycle Beveridge and Nelson (1981), Stock and Watson (1988), and Vahid and Engle (1993) and compute the associated forecast error variance decomposition. We find that trend shocks dominate price level fluctuations in all but one of these price pairs at forecast horizons of 12 months or more. Our evidence is consistent with Persson (2002) because trend shocks are often associated with permanent movements in technology. He argues that technological innovations are important to understand that price convergence began as early as the mid-19th century for the trans-Atlantic market in grain prices.

We argue our evidence presents a challenge to the current view of market integration and price convergence during the 19th century. First, it focuses greater attention on the strategic importance of Liverpool in the North Atlantic trades. It also helps place the debate about market integration into an earlier part of the 19th century and suggests the need to examine at greater depth the prices and volumes at other British import markets, such as Glasgow. 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 Charleston, New York, Montreal, and Quebec.

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Appendix A. Liverpool and London Price Indexes, Monthly, 1850 – 1871.

The prices are those reported on the third Thursday of each month or in the absence of a quotation, the nearest trading day. The category indexes are the geometric means of the commodities listed in Table 1. The mean of indexes in 1860 = 100.

	Liverpool					London				
	Proc. Foods	Timber	Iron	Wheat	Flour	Proc. Foods	Timber	Iron	Wheat	Flour
Jan-50	91.81	88.34	93.64	76.23	51.78	97.87	91.89	92.27	86.68	82.38
Feb-50	91.99	88.34	93.64	76.23	48.32	98.62	90.20	93.14	86.68	82.38
Mar-50	92.38	88.34	93.64	68.41	47.17	98.77	90.37	92.67	84.40	78.80
Apr-50	90.70	89.32	93.64	68.41	50.62	96.25	92.78	91.71	79.84	71.63
May-50	88.25	89.32	93.64	72.92	52.93	93.93	91.16	91.71	84.40	75.21
Jun-50	87.83	88.62	93.64	72.92	50.62	93.64	91.53	91.71	84.40	75.21
Jul-50	92.46	87.94	78.74	76.89	50.62	96.37	93.26	91.71	91.24	82.38
Aug-50	92.71	87.94	78.74	76.89	50.62	96.46	91.53	91.71	93.52	82.38
Sep-50	94.33	87.94	78.74	76.23	50.62	97.98	90.78	88.38	86.68	82.38
Oct-50	95.19	88.62	78.74	72.92	50.62	102.08	92.13	86.44	79.84	78.80
Nov-50	95.77	88.62	78.74	76.23	50.62	102.24	90.04	86.44	82.12	78.80
Dec-50	96.17	91.00	81.43	73.98	50.62	102.34	94.24	90.36	79.84	78.80
Jan-51	96.34	91.00	82.53	73.98	49.47	102.82	96.46	90.36	75.27	78.80
Feb-51	96.17	94.17	82.10	71.59	47.17	102.07	99.37	90.36	75.27	78.80
Mar-51	94.97	95.29	80.75	72.92	46.02	101.62	99.37	90.36	75.27	78.80
Apr-51	94.78	95.10	80.44	74.77	43.72	99.95	100.26	90.36	75.27	78.80
May-51	91.45	96.15	79.10	76.89	44.87	95.31	96.73	90.36	72.99	78.80
Jun-51	87.82	96.15	78.47	76.23	44.87	95.35	96.73	88.87	77.55	78.80
Jul-51	87.40	89.74	78.47	76.89	47.17	94.09	98.10	88.87	72.99	78.80
Aug-51	86.91	89.08	78.47	73.98	44.87	94.09	97.46	88.87	79.84	75.21
Sep-51	86.11	89.74	78.47	71.59	42.57	92.46	98.17	88.87	77.55	75.21
Oct-51	82.82	88.82	78.47	70.53	41.42	92.20	98.17	88.87	79.84	75.21
Nov-51	80.97	90.38	76.38	69.60	41.42	87.30	99.52	88.87	79.84	75.21
Dec-51	79.32	90.38	76.38	70.53	46.02	86.51	98.17	88.92	77.55	71.63
Jan-52	79.29	94.91	77.74	81.67	47.17	85.46	104.88	86.12	91.24	75.21
Feb-52	77.52	94.91	77.25	81.67	51.78	84.33	106.32	84.33	91.24	78.80
Mar-52	77.36	94.91	76.41	79.55	44.87	84.97	106.32	84.33	91.24	78.80
Apr-52	77.62	94.91	76.90	79.55	47.17	83.40	106.03	84.33	88.96	78.80
May-52	79.60	94.91	79.21	76.89	47.17	85.29	104.95	85.81	86.68	71.63
Jun-52	79.85	94.91	82.25	76.23	47.17	85.16	101.22	85.81	88.96	71.63
Jul-52	81.00	94.91	84.15	74.77	44.87	79.35	101.22	88.51	84.40	68.05
Aug-52	79.25	97.10	89.62	79.55	47.17	80.04	103.53	89.50	95.80	75.21
Sep-52	80.81	95.07	99.71	72.92	48.32	80.17	104.94	107.39	95.80	75.21
Oct-52	81.01	93.17	112.11	76.89	49.47	81.13	104.94	121.20	95.80	75.21
Nov-52	82.41	93.17	117.03	89.49	57.53	81.95	105.75	121.20	95.80	78.80
Dec-52	84.02	93.17	141.27	89.49	66.73	82.72	110.37	139.90	102.65	93.12
Jan-53	85.70	104.89	148.87	88.03	63.86	83.09	110.37	156.47	98.08	93.12
Feb-53	84.32	106.25	144.57	86.17	60.98	86.88	112.02	153.59	95.80	93.12
Mar-53	85.42	108.12	142.82	82.86	54.65	89.00	112.72	145.91	95.80	85.96
Apr-53	85.07	109.30	129.75	79.55	52.93	85.00	115.58	141.71	95.80	85.96
May-53	83.64	110.50	129.84	87.23	51.78	86.72	116.93	138.95	84.40	82.38
Jun-53	85.43	110.50	124.99	90.15	55.23	87.14	117.60	135.28	93.52	85.96
Jul-53	86.56	108.21	122.21	99.43	62.13	87.90	117.60	129.51	111.77	93.12
Aug-53	86.35	105.76	129.84	98.11	62.13	87.76	118.99	129.51	104.93	100.29
Sep-53	86.06	119.29	130.84	108.18	73.64	87.59	127.53	129.51	134.58	125.36
Oct-53	87.32	128.86	130.84	122.63	80.54	87.49	132.02	129.51	134.58	125.36
Nov-53	90.95	132.65	132.32	122.63	82.84	87.59	132.02	134.54	136.86	136.10
Dec-53	93.59	135.03	138.38	125.95	86.29	88.72	132.69	135.28	139.14	136.10
Jan-54	96.57	135.03	138.38	150.08	96.65	93.84	136.97	137.07	155.11	157.59
Feb-54	97.95	135.03	137.69	142.52	92.04	94.46	136.41	137.07	150.55	150.43
Mar-54	96.81	135.87	141.07	127.01	80.54	97.57	140.13	147.27	145.99	136.10
Apr-54	98.26	133.47	142.13	136.82	87.44	99.96	139.05	147.27	159.67	143.27
May-54	96.02	137.63	142.13	142.52	89.74	96.54	137.14	147.27	161.95	143.27
Jun-54	91.36	135.27	145.40	145.83	87.44	94.97	139.05	147.27	161.95	143.27
Jul-54	90.32	130.80	150.66	121.44	74.79	92.80	139.05	150.82	143.70	125.36

Aug-54	95.78	115.30	148.46	121.44	72.48	92.59	126.42	157.92	132.30	118.19
Sep-54	94.76	112.60	143.53	99.43	70.18	92.17	127.00	157.92	118.61	111.03
Oct-54	96.94	111.23	141.37	119.32	85.14	94.64	110.86	157.92	150.55	161.17
Nov-54	98.83	108.67	138.35	139.20	96.65	95.93	112.39	148.72	159.67	161.17
Dec-54	96.82	105.59	131.36	142.52	96.65	96.09	110.49	136.62	161.95	161.17
Jan-55	96.56	105.59	127.83	132.58	96.65	94.36	114.18	131.90	155.11	150.43
Feb-55	94.24	104.01	117.21	132.58	96.65	93.28	118.80	129.31	150.55	150.43
Mar-55	93.81	110.30	114.32	142.52	94.35	92.41	118.80	119.95	148.27	136.10
Apr-55	93.81	110.30	114.32	127.80	94.35	92.42	114.07	117.57	145.99	136.10
May-55	87.96	110.30	107.08	143.18	96.65	95.67	110.71	117.57	159.67	146.85
Jun-55	96.40	110.30	114.33	140.27	94.35	96.63	106.78	122.39	159.67	143.27
Jul-55	97.07	110.30	117.81	142.52	92.04	99.08	104.57	122.76	161.95	143.27
Aug-55	100.48	104.78	111.42	142.52	89.74	98.63	100.38	127.11	150.55	143.27
Sep-55	102.95	104.78	111.42	142.52	89.74	102.53	107.14	128.17	164.23	143.27
Oct-55	103.76	104.78	132.37	145.83	89.74	99.87	119.08	130.40	173.36	150.43
Nov-55	108.38	104.78	128.13	149.15	89.74	111.34	119.08	126.52	184.76	150.43
Dec-55	106.30	104.78	127.78	142.52	89.74	107.28	128.63	126.13	182.48	150.43
Jan-56	100.65	111.48	126.80	141.06	89.74	101.70	133.65	125.71	171.08	143.27
Feb-56	96.54	111.48	130.91	127.80	89.74	97.24	112.85	128.20	136.86	128.94
Mar-56	96.23	123.66	130.91	129.92	89.74	96.28	112.85	125.11	136.86	136.10
Apr-56	96.79	122.19	130.91	124.62	89.74	94.52	107.97	126.13	132.30	125.36
May-56	93.82	116.94	130.91	127.80	80.54	95.45	107.97	126.13	134.58	128.94
Jun-56	96.81	112.26	130.91	129.92	80.54	97.10	111.06	121.02	152.83	136.10
Jul-56	99.27	112.26	121.79	142.52	81.69	101.31	111.06	120.25	155.11	139.68
Aug-56	100.18	112.94	121.79	142.52	71.33	101.38	111.06	120.25	152.83	132.52
Sep-56	100.46	114.58	121.79	112.69	69.03	102.44	107.12	120.25	136.86	128.94
Oct-56	100.99	116.51	120.24	116.67	78.24	103.28	111.03	120.25	130.02	132.52
Nov-56	98.38	114.61	120.24	109.38	73.64	101.42	118.34	117.27	118.61	125.36
Dec-56	104.05	109.94	120.24	108.18	71.33	104.20	120.23	117.90	118.61	121.78
Jan-57	114.25	108.95	121.67	109.38	78.24	105.74	120.23	119.85	118.61	114.61
Feb-57	113.14	107.15	122.12	109.38	78.24	108.64	117.66	120.29	109.49	107.45
Mar-57	113.35	104.93	121.75	99.43	73.64	108.32	117.66	120.00	109.49	107.45
Apr-57	116.00	108.18	121.40	106.06	69.03	109.65	109.83	120.00	104.93	103.87
May-57	116.02	113.12	122.13	106.06	73.64	113.92	109.83	120.85	107.21	111.03
Jun-57	114.27	114.43	120.47	114.55	73.64	114.02	108.66	119.10	123.18	118.19
Jul-57	116.03	106.47	119.51	116.67	73.64	112.28	110.63	119.10	109.49	114.61
Aug-57	114.54	106.47	121.90	116.67	75.94	107.19	109.14	120.85	98.08	107.45
Sep-57	112.76	106.47	122.39	112.69	75.94	106.73	105.51	120.85	109.49	107.45
Oct-57	110.07	106.47	120.24	112.69	71.33	103.79	104.08	119.10	104.93	107.45
Nov-57	101.69	91.58	116.39	79.55	62.13	93.19	104.08	117.26	95.80	107.45
Dec-57	99.88	91.58	115.89	86.17	62.13	91.07	104.08	111.28	98.08	89.54
Jan-58	101.23	107.51	120.38	82.86	78.90	97.79	104.08	110.42	93.52	85.96
Feb-58	101.34	103.63	110.80	82.86	72.32	96.88	98.31	113.63	91.24	85.96
Mar-58	101.06	103.63	110.80	82.86	72.32	98.54	96.64	111.78	91.24	82.38
Apr-58	100.29	103.63	106.73	79.55	70.68	91.48	98.86	111.78	88.96	78.80
May-58	102.80	101.49	104.14	77.42	70.68	99.49	100.13	111.78	88.96	78.80
Jun-58	101.58	101.49	103.68	76.23	65.75	98.86	97.14	108.16	84.40	75.21
Jul-58	102.34	96.74	103.68	79.55	69.03	99.77	94.19	108.16	88.96	85.96
Aug-58	101.61	99.43	103.68	82.86	67.39	100.58	94.19	107.27	91.24	85.96
Sep-58	102.27	100.23	102.04	82.86	67.39	100.79	94.19	107.27	91.24	85.96
Oct-58	101.84	100.23	102.04	81.80	67.39	99.29	95.32	104.48	86.68	85.96
Nov-58	99.48	100.23	102.04	66.29	65.75	95.67	97.47	105.34	88.96	85.96
Dec-58	100.16	96.29	102.41	79.55	64.10	96.43	97.47	105.34	86.68	85.96
Jan-59	91.25	96.29	102.41	82.86	63.92	96.04	98.65	107.64	88.96	82.38
Feb-59	92.56	94.34	102.41	82.86	63.92	98.31	100.11	109.02	88.96	82.38
Mar-59	93.71	100.67	102.41	82.86	62.82	97.98	100.11	109.02	79.84	82.38
Apr-59	100.33	100.67	102.41	83.52	64.43	98.20	98.91	108.03	88.96	93.12
May-59	95.05	100.67	101.37	98.99	80.54	96.99	98.91	108.03	102.65	114.61
Jun-59	96.10	97.99	98.76	88.16	73.58	96.66	98.91	103.89	86.68	96.70
Jul-59	96.36	97.99	98.76	84.19	72.48	95.02	96.87	103.89	84.40	93.12
Aug-59	96.89	97.99	96.96	85.11	72.48	95.35	96.87	103.89	84.40	93.12
Sep-59	96.38	94.67	101.59	78.88	72.48	94.64	97.46	102.36	84.40	96.70
Oct-59	98.35	94.67	100.61	81.67	73.58	95.46	99.51	101.43	84.40	96.70
Nov-59	96.38	97.26	100.61	88.16	88.59	94.96	98.86	100.70	84.40	85.96
Dec-59	98.85	97.92	101.05	88.16	88.59	92.25	98.44	100.10	84.40	85.96
Jan-60	100.00	97.92	101.05	88.16	88.76	100.12	99.60	100.99	84.40	85.96
Feb-60	100.86	98.57	101.05	88.16	88.76	99.94	99.60	100.99	84.40	85.96
Mar-60	101.32	99.20	101.05	88.16	95.33	100.57	100.73	100.99	88.96	93.12
Apr-60	102.13	99.20	100.61	92.80	98.62	100.08	100.73	100.99	93.52	96.70
May-60	100.30	99.20	100.61	99.43	98.62	100.68	100.73	100.99	98.08	100.29

Jun-60	99.32	99.20	99.69	102.08	98.62	100.24	100.73	100.99	109.49	107.45
Jul-60	99.94	99.20	98.69	102.08	95.33	99.31	99.81	100.10	109.49	103.87
Aug-60	101.21	96.94	98.69	111.36	108.48	99.92	99.81	98.47	114.05	100.29
Sep-60	101.38	98.80	100.49	108.71	105.19	100.34	99.81	98.47	107.21	107.45
Oct-60	98.17	100.23	100.06	108.71	105.19	99.41	99.81	98.47	111.77	107.45
Nov-60	99.11	102.81	99.69	108.71	108.48	100.35	99.81	98.47	107.21	103.87
Dec-60	96.24	108.75	98.35	102.08	108.48	99.04	98.85	100.10	91.24	107.45
Jan-61	92.79	110.07	98.74	102.83	106.84	97.76	98.85	100.10	98.08	103.87
Feb-61	91.58	106.95	96.72	102.83	106.84	94.92	98.85	100.10	86.68	100.29
Mar-61	89.49	109.33	95.57	102.83	106.84	94.78	100.73	100.10	86.68	103.87
Apr-61	86.83	109.97	95.91	102.83	106.84	95.05	98.83	98.12	88.96	103.87
May-61	93.64	109.97	95.91	102.83	106.84	97.06	98.83	97.23	88.96	107.45
Jun-61	92.18	104.45	95.91	92.80	85.47	96.48	96.98	95.23	77.55	96.70
Jul-61	92.64	100.54	94.90	94.38	87.11	96.59	98.85	90.63	77.55	96.70
Aug-61	92.26	99.34	94.12	83.52	82.18	94.69	98.85	91.60	114.05	96.70
Sep-61	93.08	98.08	94.12	92.80	90.40	96.86	98.75	91.60	127.74	100.29
Oct-61	94.52	92.21	94.96	99.76	95.33	97.73	98.75	91.60	134.58	103.87
Nov-61	94.56	91.87	94.58	97.44	96.98	98.02	97.40	92.31	134.58	100.29
Dec-61	94.02	98.63	94.58	92.80	103.55	95.84	101.35	92.31	134.58	100.29
Jan-62	93.90	98.63	94.58	102.08	95.33	96.12	101.35	92.31	130.02	100.29
Feb-62	92.78	107.67	94.12	105.15	93.69	96.57	104.53	92.31	130.02	100.29
Mar-62	94.56	107.67	94.12	102.08	90.40	97.30	104.53	92.31	130.02	93.12
Apr-62	95.53	103.32	93.61	102.08	83.83	98.31	101.80	91.60	127.74	93.12
May-62	97.20	102.65	93.61	95.12	80.54	98.65	100.42	90.63	118.61	89.54
Jun-62	96.12	101.26	92.77	95.12	80.54	97.91	100.42	90.63	118.61	82.38
Jul-62	96.26	94.89	93.15	95.12	80.54	99.57	100.42	90.63	120.89	85.96
Aug-62	96.54	94.89	93.27	96.70	78.90	99.72	100.42	90.63	123.18	89.54
Sep-62	97.59	103.19	94.96	96.70	77.25	100.74	101.02	96.64	104.93	82.38
Oct-62	98.00	97.45	99.63	96.70	75.61	99.96	103.57	95.89	104.93	78.80
Nov-62	96.50	102.77	99.63	89.74	78.90	98.86	103.57	95.89	91.24	78.80
Dec-62	103.36	109.09	97.99	88.16	78.90	98.17	100.68	95.89	91.24	78.80
Jan-63	103.36	109.09	97.21	85.10	80.54	98.74	104.89	95.89	95.80	78.80
Feb-63	105.30	109.09	96.80	83.52	77.25	105.43	105.94	93.99	95.80	78.80
Mar-63	104.20	107.69	96.72	83.52	73.96	99.69	105.94	92.62	91.24	78.80
Apr-63	106.04	107.69	96.72	83.52	72.32	99.69	105.94	92.62	91.24	75.21
May-63	108.60	105.66	96.72	84.27	75.61	100.45	105.94	92.62	91.24	75.21
Jun-63	107.98	105.66	96.22	81.67	72.32	99.41	105.94	94.49	91.24	75.21
Jul-63	106.88	102.93	98.84	80.46	69.03	98.84	105.01	94.49	91.24	75.21
Aug-63	106.65	102.93	104.40	78.88	65.75	99.00	105.01	95.39	95.80	68.05
Sep-63	106.65	102.93	111.50	74.24	65.75	98.21	103.12	101.89	93.52	68.05
Oct-63	107.81	107.95	115.89	74.24	65.75	98.92	104.28	112.82	93.52	68.05
Nov-63	109.92	107.95	117.60	80.46	70.68	100.66	104.28	112.82	93.52	68.05
Dec-63	106.23	107.95	117.60	78.88	70.68	98.47	102.87	120.24	93.52	68.05
Jan-64	105.69	101.00	133.21	80.46	69.03	99.46	102.87	120.24	91.24	68.05
Feb-64	106.48	101.40	133.21	78.88	69.03	99.19	98.89	130.61	91.24	68.05
Mar-64	107.34	105.91	129.84	77.30	65.75	100.68	101.97	130.61	88.96	64.47
Apr-64	109.77	102.08	128.81	76.56	65.75	100.70	103.47	130.61	86.68	64.47
May-64	109.47	105.05	125.87	75.82	64.10	101.85	102.82	125.44	82.12	64.47
Jun-64	109.02	101.75	122.21	77.30	65.75	101.47	102.82	125.44	84.40	64.47
Jul-64	106.93	98.19	117.34	80.46	67.39	100.74	102.82	121.68	93.52	68.05
Aug-64	105.38	98.59	119.02	75.82	67.39	99.27	102.82	117.58	88.96	68.05
Sep-64	101.12	96.34	118.50	74.24	65.75	96.97	102.82	117.58	86.68	68.05
Oct-64	95.53	96.69	119.02	72.48	67.39	95.33	102.82	117.58	86.68	68.05
Nov-64	95.60	98.39	117.21	65.71	67.39	95.47	101.96	117.58	86.68	68.05
Dec-64	95.90	100.76	115.57	65.70	67.39	94.94	98.91	115.84	86.68	68.05
Jan-65	88.98	97.75	110.45	74.98	67.39	93.62	99.21	114.06	86.68	68.05
Feb-65	88.45	100.04	109.76	74.98	69.03	90.46	99.21	111.90	86.68	68.05
Mar-65	87.30	99.25	112.07	76.56	69.03	90.49	99.21	111.90	86.68	68.05
Apr-65	87.34	98.30	113.14	76.56	69.03	91.15	95.97	111.17	88.96	68.05
May-65	88.77	99.79	112.42	79.63	70.68	92.20	94.64	111.17	91.24	71.63
Jun-65	88.39	94.00	112.42	78.14	70.68	93.73	94.64	112.09	88.96	75.21
Jul-65	87.61	96.04	113.45	78.88	70.68	92.99	94.06	113.85	91.24	75.21
Aug-65	86.59	93.88	113.45	83.52	75.61	92.35	94.06	112.98	100.36	78.80
Sep-65	91.18	94.93	112.71	84.27	75.61	97.30	94.06	112.98	98.08	78.80
Oct-65	91.32	96.06	112.71	87.42	78.90	100.65	94.06	111.98	98.08	78.80
Nov-65	94.73	101.44	112.71	90.48	87.11	101.88	94.06	111.98	91.24	82.38
Dec-65	95.21	111.33	112.71	83.52	88.76	98.83	101.97	112.71	91.24	78.80
Jan-66	94.93	104.38	112.71	90.48	88.76	100.15	101.97	113.64	91.24	82.38
Feb-66	95.96	112.26	112.71	89.74	85.47	99.06	101.97	113.64	91.24	82.38
Mar-66	98.58	114.32	112.42	89.74	85.47	98.90	100.99	111.98	91.24	82.38

Apr-66	95.48	110.22	112.42	88.16	85.47	97.64	100.99	111.98	93.52	82.38
May-66	95.18	111.17	112.42	90.48	85.47	94.20	100.99	111.98	93.52	82.38
Jun-66	92.54	110.45	109.05	99.76	92.04	93.38	100.99	108.77	107.21	89.54
Jul-66	91.15	108.16	109.05	97.44	90.40	92.78	100.99	107.85	95.80	85.96
Aug-66	92.38	106.10	109.05	98.19	90.40	95.89	100.99	106.91	91.24	85.96
Sep-66	95.84	102.65	110.51	105.15	93.69	95.64	100.99	106.91	95.80	85.96
Oct-66	85.99	105.72	109.43	116.00	100.26	93.87	101.31	106.91	104.93	89.54
Nov-66	93.51	108.52	107.83	111.36	101.91	94.39	101.31	106.91	114.05	96.70
Dec-66	92.93	110.99	105.34	109.51	101.91	93.49	101.31	106.91	114.05	96.70
Jan-67	86.24	100.76	101.51	112.94	105.19	88.16	101.31	105.11	118.61	96.70
Feb-67	87.22	106.72	103.28	109.51	101.91	86.86	101.31	105.11	114.05	93.12
Mar-67	85.75	106.72	102.71	111.36	101.91	87.40	101.31	102.85	116.33	103.87
Apr-67	85.00	106.72	102.01	116.00	106.84	84.22	101.31	101.43	125.46	96.70
May-67	86.58	106.72	102.01	114.43	106.84	84.40	101.31	101.43	125.46	96.70
Jun-67	87.45	106.72	102.01	112.94	105.19	91.36	101.31	99.27	141.42	96.70
Jul-67	87.04	103.64	100.93	124.54	105.19	90.82	101.31	98.53	145.99	96.70
Aug-67	85.50	103.64	100.52	113.68	105.19	88.57	98.81	98.53	136.86	96.70
Sep-67	85.76	103.64	100.52	118.32	113.41	87.82	98.81	98.53	136.86	100.29
Oct-67	85.65	103.64	99.64	129.92	128.21	91.63	98.81	98.53	143.70	107.45
Nov-67	86.20	101.85	99.64	129.92	124.92	91.69	98.81	97.61	145.99	107.45
Dec-67	85.43	101.85	99.34	129.92	118.34	90.50	97.45	98.34	145.99	103.87
Jan-68	83.85	103.33	97.98	137.35	121.63	89.20	97.45	97.51	150.55	107.45
Feb-68	83.98	104.98	97.45	136.88	121.63	88.75	97.45	97.51	150.55	107.45
Mar-68	84.13	103.31	97.45	136.14	121.63	88.89	97.45	96.56	148.27	107.45
Apr-68	90.38	104.98	96.00	139.95	121.63	90.41	98.41	96.56	148.27	107.45
May-68	89.74	106.01	96.00	134.56	118.34	90.23	98.41	95.58	148.27	107.45
Jun-68	88.56	106.01	96.00	122.96	111.77	88.76	98.41	94.87	145.99	107.45
Jul-68	89.05	98.89	96.76	116.00	105.19	86.18	98.41	95.94	136.86	107.45
Aug-68	85.68	100.21	97.29	114.43	101.91	85.91	99.78	97.88	127.74	100.29
Sep-68	84.97	103.43	100.52	139.20	124.92	81.50	99.78	96.78	123.18	100.29
Oct-68	84.83	103.43	100.22	139.20	124.92	81.50	99.78	97.61	120.89	93.12
Nov-68	84.66	103.51	100.22	132.58	124.92	81.43	102.27	97.61	109.49	89.54
Dec-68	91.12	103.43	100.22	139.20	105.19	81.17	102.27	97.61	109.49	89.54
Jan-69	83.39	108.11	100.52	132.58	72.32	80.64	102.27	97.61	111.77	89.54
Feb-69	84.09	108.10	100.52	135.89	72.32	81.04	103.36	97.61	102.65	85.96
Mar-69	85.06	108.10	100.52	125.95	72.32	84.64	103.36	96.04	98.08	82.38
Apr-69	88.06	108.10	99.72	119.32	72.32	85.49	103.36	96.04	95.80	82.38
May-69	87.22	106.80	99.29	110.44	69.03	85.38	103.36	96.95	95.80	82.38
Jun-69	87.09	106.80	99.29	110.44	69.03	85.08	101.28	97.13	102.65	78.80
Jul-69	86.44	106.80	98.85	119.32	72.32	85.36	99.89	97.13	104.93	78.80
Aug-69	86.81	106.80	97.67	123.69	78.90	84.92	99.89	96.10	93.52	78.80
Sep-69	88.06	106.80	97.96	123.69	78.90	85.62	99.89	96.10	93.52	78.80
Oct-69	89.05	106.03	97.96	119.32	78.90	84.64	99.89	96.10	91.24	75.21
Nov-69	88.62	106.03	109.15	119.32	70.68	84.21	98.42	96.98	86.68	75.21
Dec-69	87.60	106.03	110.15	112.69	70.68	84.35	98.42	99.33	86.68	75.21
Jan-70	87.60	106.03	105.85	99.43	67.39	85.21	98.42	99.33	86.68	75.21
Feb-70	82.53	106.03	104.61	87.27	67.39	85.15	98.42	99.33	82.12	68.05
Mar-70	88.41	106.03	104.61	87.27	67.39	85.05	99.30	102.53	84.40	68.05
Apr-70	88.44	107.13	104.46	99.43	67.39	81.87	99.30	101.79	84.40	68.05
May-70	85.68	107.94	104.46	99.43	67.39	78.84	100.59	104.26	88.96	71.63
Jun-70	84.55	107.94	105.83	99.43	67.39	77.96	100.59	104.26	107.21	78.80
Jul-70	84.30	106.50	106.56	99.43	67.39	76.80	100.59	104.26	118.61	82.38
Aug-70	82.46	106.50	106.56	99.43	67.39	74.03	102.09	104.26	104.93	78.80
Sep-70	82.69	106.50	107.04	99.43	67.39	74.30	102.09	105.00	102.65	78.80
Oct-70	83.60	112.98	107.34	119.32	78.90	73.64	102.09	104.11	109.49	78.80
Nov-70	85.80	113.72	107.34	145.83	85.47	76.12	102.09	102.51	116.33	82.38
Dec-70	87.32	113.72	106.56	139.20	85.47	78.28	102.09	102.51	111.77	82.38
Jan-71	89.26	113.72	105.21	139.20	90.40	81.38	102.09	101.62	111.77	89.54
Feb-71	86.26	116.03	105.21	142.52	90.40	82.01	102.09	101.62	114.05	89.54
Mar-71	87.13	116.03	105.69	142.52	90.40	81.10	107.84	101.62	116.33	93.12
Apr-71	86.44	115.41	105.69	149.15	90.40	80.29	107.84	101.62	116.33	93.12
May-71	86.57	115.41	105.21	149.15	88.76	87.11	107.84	101.62	116.33	93.12
Jun-71	86.90	115.41	105.98	149.15	85.47	87.42	107.84	101.62	116.33	89.54
Jul-71	86.25	115.41	106.60	145.83	83.83	83.42	107.84	101.62	116.33	82.38
Aug-71	86.69	114.13	109.20	145.83	82.18	80.30	107.84	104.24	116.33	82.38
Sep-71	87.38	115.98	114.74	145.83	82.18	81.28	107.84	118.03	118.61	82.38
Oct-71	89.07	115.98	120.77	145.83	82.18	82.12	110.57	118.28	118.61	85.96
Nov-71	91.02	107.43	120.50	145.83	82.18	84.67	111.85	118.28	118.61	85.96
Dec-71	91.58	111.03	136.11	145.83	82.18	85.16	111.85	126.61	118.61	85.96