Did European Commodity Prices Converge Before 1800?

by Süleyman Özmucur and Sevket Pamuk

The New Comparative Economic History,
Conference in Honour of Jeffrey G. Williamson

Weatherhead Center for International Affairs,
Harvard University,

November 4-5, 2005
Did European Commodity Prices Converge Before 1800?
by Süleyman Özmucur and Sevket Pamuk

I- Introduction

Until recently, the dominant view of the European economy during the early modern era was that it was unable to generate long term economic growth. This interpretation was based, at least in part, on the available evidence for stagnating land productivity and urban real wages. It was also consistent with the prevailing interpretations of the Industrial Revolution. During the last two decades, however, this picture of the stagnant economy that supposedly preceded the Industrial Revolution began to change. The new and downwardly revised estimates of per capita income increases for the eighteenth and early nineteenth centuries implied higher levels of per capita income for the earlier period. In addition, economic historians of the early modern period began to point out that the industrialization of the late eighteenth and early nineteenth centuries was made possible by structural changes that had taken place earlier. Increases in agricultural productivity, urbanization, national patterns of specialization, the emergence and development of international trade networks have been cited amongst the important changes that facilitated the rises in income or so called Smithian growth in the early modern era, or at the very least, made faster growth possible during the era of the Industrial Revolution.

This recent literature and the findings on the early modern era thus point to market integration as one of the key processes inducing structural change in early modern Europe. Since the contribution of technological innovation remained limited, according to this view, improvements in productivity were generated by the development of trade between previously distinct markets and the requirements of an interregional and increasingly international division of labor. In short, various types of market integration was considered as one of the key characteristics of Europe before the Industrial Revolution.

---

1 This pessimist interpretation was articulated, amongst others, by Abel, Postan and Leroy Ladurie.
In this paper we will explore the extent to which one may speak of integration between selected long distance markets across Europe during the early modern era. We will utilize annual price data for identical commodities from Istanbul in the Ottoman Empire, Madrid and Barcelona in Spain, western Holland and southern England to examine whether there was price convergence between long distance markets inside the Mediterranean and also between the Mediterranean and northwestern Europe for the period 1500 to 1800. Our list of commodities include wheat which has been studied in relation to this question both for other periods and regions but also other commodities such as olive oil, rice, honey, sugar, soap, meat and butter.

There is no question that these markets were linked during the early modern era and trade did take place amongst them although not always on a regular basis. Although maritime trade and overseas discoveries have often loomed large in explanations of European ascendancy and economic growth in the early modern era, it will be interesting to see the extent to which long distance markets were integrated across Europe. Such an inquiry should help us learn more about the extent and possibly the limits of market integration in early modern Europe.

II- Market Integration in Early Modern Europe

Market integration can be defined as the opening and development of trade between previously autonomous markets and their integration into a single operative entity or a single division of labor. The concept carries with it important implications for structural change as the fabric of each economy is tailored to the requirements of an interregional and increasingly international division of labor. Improvements in productivity are thus generated by the territorial expansion of the division of labor and a re-allocation of resources within regions or national economies. For market integration to have an independent influence on an economy, two conditions must be fulfilled: i) trade-creating forces must change domestic commodity prices; and ii) changes in domestic commodity prices must induce a reshuffling of resources. While price convergence is not a sufficient reason for market integration and it is possible to think about causes of price convergence without market integration such as large scale
climactic changes, without the tendency for prices to converge, it is clear that the process of market integration loses much of its force.  

The causes of market integration and price convergence can be grouped under two headings. One important cause is technological change, bringing about decline in transportation costs and related costs associated with storage and spoilage. The decline in freight costs is usually seen as the most important cause of trade growth and price convergence in international and intercontinental markets during the nineteenth century, for example,. A similar case can be made about the importance of railroads in bringing about price convergence in overland transportation. Recent literature emphasizes that the decline in transportation costs can not explain all or most of price convergence, however. Even for the nineteenth century for which there is strong evidence of declining transportation costs, that evidence can explain only part of the observed decline in price differentials inside Europe and in European trade with the rest of the world.

A second reason for market integration and price convergence is the removal or lowering of a wide range of institutional and other barriers. The presence of national borders, or more generally of different jurisdictions was often an important barrier and/or the source of a variety of barriers. Not only tariffs and other policy instruments but payments mechanisms, monetary regimes and inter-state conflict need to be included under this heading. In an important recent study S. R. Epstein emphasizes that in late medieval and early modern Europe market structures which determined regional growth paths depended upon the complex social, economic and political struggles between sovereigns, feudal lords, cities and rural communities and could differ significantly between regions. In grains, for example, jurisdictional fragmentation was the main cause price volatility. The decline of predatory states and political centralization increased domestic stability and reduced coordination failures between markets. He cites empirical evidence from different parts of western Europe for 1300-1650 indicating that even though transportation costs did not decline significantly, market integration as measured by price dispersion did take place. Innovations that reduce transaction costs by increasing mobility of capital or by lower information costs such as bills of exchange or manuals or those that spread risk such as marine insurance can also be

---

3 Jacks (2000).

included under this heading. Epstein thus concludes that pre-modern Smithian growth which was a function of market integration depended ultimately on the progress of political integration and institutional change rather than technical change in the period from the Black Death to the Industrial Revolution. 5

A large part of the institutional changes that Epstein observes for early modern Europe, however, applies to regional or short and medium range trade. Although maritime trade and overseas discoveries have often loomed large in explanations of the late medieval recovery and European ascendancy during the early modern era, it is not clear whether the political and institutional changes he emphasizes would apply to long distance and international trade around Europe and beyond before the nineteenth century. It may thus be useful to make a distinction between short and medium range trade, on the one hand, and long distance trade on the other when discussing market integration and Smithian growth in early modern Europe.

While some economic historians are emphasizing the importance of market integration and price convergence, others point out that little or no market integration took place and price differentials persisted throughout the early modern era. These authors argue that the available and admittedly fragmentary evidence on freight rates within Europe during the early modern era do not point to significant decreases in transportation costs. Freight rates in Europe appear to have moved together with commodity prices from the fourteenth century until the end of the eighteenth. On the basis of the available data on freight rates, one can not make a case for a pre-modern European transport revolution led by technical innovations. The evidence on freight charges before the nineteenth century is rather limited but it appears that in the mid-eighteenth century they were only slightly lower than their levels in the best years of the high Middle Ages in both nominal and real terms. Productivity gains rooted in better techniques appear to have played only a minor role in the growth of trade in these centuries. 6

As a result, national markets in the most widely traded pre-modern commodity, wheat, did not develop, for the most part, before the late eighteenth century and the rise of an integrated European and Atlantic wheat market occurred only after the introduction of railroads and steamships in the nineteenth century. Moreover, for most countries domestic trade was much more important than international trade until the nineteenth century. The volume of long

distance maritime trade and international long distance trade was still small in comparison to domestic trade and overland trade before 1800 and they were all sharply lower than the levels reached at the end of the long nineteenth century.

One may take a more nuanced perspective, of course. While it is clear that most of Europe did not become engrossed in a complete and overarching system of markets, some regions within the continent were becoming increasingly more integrated within themselves and perhaps among one another during the early modern era. For example, there is evidence that the wheat markets in the Baltic-North Sea region showed a tendency towards greater integration especially during the first half of these three centuries until 1650 and these gains were not reversed after 1650. 7

Another reason for the recent rise in interest in the history of market integration is the current wave of globalization and the studies by economists and economic historians of earlier episodes of globalization. Some historians have argued that the discovery of the Americas and the oceanic route to Asia integrated the continental markets and ushered in a new and global era beginning around 1500. In two recent but by now well known articles, Kevin O’Rourke and Jeffrey Williamson have explored whether there occurred an earlier episode of globalization after the voyages by Columbus and Vasco da Gama. O’Rourke and Williamson define globalization as commodity market integration and emphasize since an increase in trade volume may be due to shifts in demand and/or supply curves, the best way to gauge that process is to measure the extent to which prices of the same commodities converged over time worldwide. After studying a large set of prices of commodities subject to intercontinental trade, however, they find no price convergence in intercontinental markets in the three centuries before 1800. In the absence of any decline in transportation costs or the human made barriers to trade such as tariffs or trade monopolies, they conclude that the increases in European incomes was the most important cause of the intercontinental trade boom during the early modern era. 8

It is interesting that O’Rourke and Williamson observe no price convergence during a period for which Epstein does observe significant reductions in price dispersion. It is worth noting, however, that, spatially speaking, these studies are examining market integration at

---

7 Jacks (2000).
8 O’Rourke and Williamson (2002a) and (2002b).
different ends of the spectrum. While Epstein focuses on regional, short to medium range trade, the focus by O'Rourke and Williamson examine intercontinental trade.

There is no doubt that the concept of market integration remains highly useful for understanding long term change in early modern Europe. Determining the extent and limits of market integration is very important for further understanding the economic changes in early modern Europe. At the same time, however, this review of the recent literature suggests that a more nuanced, more disaggregated view of market integration is necessary for making better sense of these trends.

**III- Convergence in Prices: Methodology**

In its simplest form, the theory of market integration is distilled into the so-called law of one price. As inter market trade commences, any observed differentials in the prices of goods will tend to decline and eventually disappear subject to transportation and institutional costs cited above. Since demand or supply curves may be shifting in the meantime, the only irrefutable evidence that market integration is taking place is not the rise in trade volumes but a decline in price differentials or in the dispersion of prices or what might be called commodity price convergence. The simplicity of the theory of market integration, however, conceals the difficulties in empirical measurement. In the literature on the history of and contemporary commodity markets, there have been numerous proposals for the correct measure of market integration.

The traditional approach to market efficiency looks at the correlation of prices or the speed of adjustments to an equilibrium price differential between markets in bilateral trade. This latter approach makes the determination of equilibrium differentials quite easy: price differences shall not exceed transport and transaction (including tariffs) costs and prices must adjust to that equilibrium. However arbitrage in the world economy is normally multilateral and therefore bilateral LOOP might not hold for markets when they do not trade with each other. However, they can still be integrated by trading with a common third market.

Can markets be efficiently integrated without trading directly with each other? Does adjustment speed depend on whether you trade directly with another market or just indirectly through a common third market?
The convergence literature relies heavily on the income convergence concept introduced by Baumol (1986), and Barro & Sala-i-Martin (1992, 1995). Using cross-country data, researchers of economics of growth indicated that growth in the ratio of incomes in two countries is negatively related to the ratio of incomes at the base period. As a result of this finding, they concluded that the difference between per capita incomes is expected to diminish in time. This is called the beta converge. However, researchers do not solely rely on beta-convergence. The sigma-convergence, which is measured as the standard deviation of incomes at a given period, is also utilized. The variation of incomes, measured as the standard deviation, among various countries should also decrease in time to conclude that there is convergence of incomes. There are many critics of the method, and almost as many alternatives or variants (Quah, 1993, 1996; Linden, 2002; Johnson, 2000; Rassekh, Panik & Kolluri, 2001 are some examples).

Recently, there is resurgence of the study of convergence largely because of the issues related to the European Monetary Union, where member and candidate countries are expected to satisfy certain criteria associated with certain targets such as inflation, interest rates, budget deficit and debt. There are alternative methods introduced to tackle this very problem. Since, the convergence in EU is an ongoing process, it necessitates the use of several related concepts such as long-term convergence, catching up, and common trend (Bernard & Durlauf (1995, 1996); Oxley & Greasley (1995), Greasley & Oxley (1997), Camarero, Esteve & Tamarit (2000)). Since we are dealing with history, where the process is already over, problems that we have to deal with are not as complicated as the ones dealing with EU.

Bernard & Durlauf define long-run convergence between two countries if the long-term forecasts of the prices are equal sometime in the future, say at time $t+k$, given the information at time $t$. More formally,

$$\lim_{k \to \infty} E(P_1(t+k)-P_2(t+k) \mid \text{Information at time } t) = 0$$

This definition is satisfied if $[P_1(t+k)-P_2(t+k)]$ is a stationary process with mean zero (Cameroro, Esteve, Tamarit, 2000). If the variables are trend-stationary, then this implies that time trends for two countries are the same.
A simple price equation may be used to explain some of the concepts which are going to be used below.

\[ \log(P_{1t}) = \alpha_1 + \beta_1 t + \varepsilon_{1t} \]

where, \( P_{1t} \) is the price in the first city, \( t \) is time (year) and \( \alpha_1 \) and \( \beta_1 \) are parameters to be estimated. The stochastic disturbance term \( \varepsilon_{1t} \) is assumed to be serially uncorrelated.

If \( \varepsilon_{1t} \) is a stationary process, then the price variable is called trend-stationary. In this case, deviations from the deterministic trend line are only temporary. There is an error correction mechanism at work. A shock to the system will be corrected in the following period by an adjustment with the opposite sign. However, if \( \varepsilon_{1t} \) is a non-stationary process, say order one, or more formally integrated of order one, i.e. I(1), then the price variable is difference stationary. In this case, a shock to the system will have a permanent effect on the price level.

The first difference of the logarithm of the price refers to the percentage changes in the price. In both cases, the effect on the percentage changes in the price will be temporary.

\[ \Delta \log(P_{1t}) = \beta_1 + \Delta \varepsilon_{1t} \]

In a similar way, the price equation for the second city may be written as:

\[ \log(P_{2t}) = \alpha_2 + \beta_2 t + \varepsilon_{2t} \]

where, \( P_{2t} \) is the price in the second city, \( t \) is time (year) and \( \alpha_2 \) and \( \beta_2 \) are parameters to be estimated. The stochastic disturbance term \( \varepsilon_{2t} \) is also assumed to be serially uncorrelated.

The ratio of prices

\[ \log(P_{1t}/P_{2t}) = \log(P_{1t})-\log(P_{2t}) = (\alpha_1 - \alpha_2) + (\beta_1 - \beta_2) t + (\varepsilon_{1t}-\varepsilon_{2t}) \]

If \( \varepsilon_{1t} \), \( \varepsilon_{2t} \), and \( \varepsilon_{1t}-\varepsilon_{2t} \) are stationary processes, then the price ratio variable is going to be trend-stationary, where deviations from the deterministic trend will only temporary. Otherwise, any shock to the system will have permanent effects.
If one considers the first difference of the logarithm of the price ratio:

$$\Delta \log \left( \frac{P_1}{P_2} \right) = \Delta \log (P_1) - \Delta \log (P_2) = (\beta_1 - \beta_2) + \Delta (\varepsilon_1 - \varepsilon_2)$$

This result indicates that there is convergence if prices in both cities have the same trend behavior ($\beta_1 = \beta_2$), percentage changes in prices are identical, ignoring temporary random deviations.

Here, it is assumed that prices of two countries converge if the ratio becomes stable in the long-run. This definition is similar to the one used by St. Aubyn (1999). A difference in growth rates is the primary source of long-term divergence, regardless of initial levels. The concept of long-term equilibrium price is the key to understanding these cases. It is assumed that prices of two countries converge if the ratio becomes stable in the long-run.

In testing a series for the presence of a unit root Augmented Dickey-Fuller (1979), and Phillips-Perron (1998) tests were used. Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) test was also implemented if two tests gave contradictory results (4 out of 55).

Given a simple auto-regressive process:

$$Y_t = \alpha + \delta Y_{t-1} + \varepsilon_t$$

where, $Y$ is the logarithm of the ratio of prices in two cities, i.e. $Y = \log (\text{Price in Istanbul}/\text{Price in Madrid})$ and $\alpha$ and $\delta$ are parameters to be estimated. The stochastic disturbance term $\varepsilon$ is assumed to be serially uncorrelated.

If $|\delta|>1$, then $Y$ is a non-stationary series and the variance of $Y$ increases with time and approaches infinity. If $|\delta|<1$, then $Y$ is a stationary series. Thus, the hypothesis of stationarity can be evaluated by testing whether the absolute value of $\delta$ is less than one, $|\delta|<1$.

The standard DF test is carried out by estimating the equation after subtracting $Y_{t-1}$ from both sides of the equation:
\[ Y_t - Y_{t-1} = \alpha + (\delta - 1) Y_{t-1} + \epsilon, \]
or
\[ \Delta Y_t = \alpha + \beta Y_{t-1} + \epsilon \]

where, \[ \Delta Y_t = Y_t - Y_{t-1} \] and \[ \beta = \delta - 1. \]
The null and alternative hypotheses may be written as

\[ H_0: \beta = 0, \quad H_1: \beta < 0 \]

and evaluated using the conventional -ratio for:

\[ t = \frac{b}{\text{standard error (b)}}, \text{where b is the sample estimate of } \beta. \]

Dickey and Fuller (1979) show that under the null hypothesis of a unit root, this statistic does not follow the conventional t-distribution, and they derive critical values for various test and sample sizes using Monte Carlo methods. MacKinnon (1991) estimates response surfaces, permitting the calculation of Dickey-Fuller critical values for arbitrary sample sizes. MacKinnon critical value calculations are used by in constructing tests.

The simple Dickey-Fuller unit root test described above is valid only if the series is a first order autoregressive process. The Augmented Dickey-Fuller (ADF) test makes a correction for higher-order correlation by adding lagged difference terms of the dependent variable to the equation:

\[ \Delta Y_t = \alpha + \beta Y_{t-1} + \chi \Delta Y_{t-1} + \gamma \Delta Y_{t-2} + \ldots + \eta \Delta Y_{t-k} + \epsilon \]

There are two practical issues in performing a unit root test: the choice of including a constant, a constant and a linear time trend, or neither, in the test regression. Second, the specification of the number of lagged difference terms to be added to the test regression. A constant is used in the test regression. The number of lags is determined using Akaike and Schwartz criteria. Eviews software by the Quantitative Micro Software (QMS, 2005) is used in calculations.
Phillips and Perron (1988) propose a nonparametric method of controlling for serial correlation when testing for a unit root. The Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) (1992) test differs from the other two in that the series is assumed to be trend-stationary under the null. KPSS test is used in cases where ADF and PP tests give contradictory results.

Panel-based unit root tests may be used for multiple-series. These tests, which may have higher power, are similar to tests based on individual series. They differ in the assumption regarding the persistence parameters. Im, Pseran, Shin (2003), Fisher-ADF and Fisher-PP tests allow the persistence parameters to vary freely across cross-sections. The latter two are based on the idea that a test statistic may be derived from individual test, suggested by Fisher (1932) and proposed by Maddala & Wu(1999) and Choi (2001). On the other hand, Levin, Lin, Chu (2002), Breitung (2000), Hadri (2000) assume a parameter common across cross-sections. Hadri test is similar to KPSS test for a single series.

Given a simple auto-regressive process (ignoring other deterministic components such as trend or fixed effects):

\[ Y_{it} = \alpha_i + \delta_i Y_{i,t-1} + \varepsilon_{it} \]

where, \( Y_i \) is the logarithm of the ratio of prices in two cities, i.e. \( Y_i = \log(\text{Price in Istanbul}/\text{Price in Madrid}) \) and \( \alpha_i \) and \( \delta_i \) are parameters to be estimated. The stochastic disturbance term \( \varepsilon \) is assumed to be serially uncorrelated.

As in the standard Dickey-Fuller test, the \( Y_{it-1} \) is subtracted from both sides of the equation:

\[ Y_{it} - Y_{i,t-1} = \alpha_i + (\delta_i - 1) Y_{i,t-1} + \varepsilon_{it} , \]

or

\[ \Delta Y_{it} = \alpha_i + \beta_i Y_{i,t-1} + \varepsilon_{it} \]

where, \( \Delta Y_t = Y_t - Y_{t-1} \) and \( \beta_i = \delta_i - 1 \).

The null hypotheses may be written as
IV- Empirical Results

We are now in a position to directly test for market integration in long distance markets across Europe in the early modern period. We utilize annual price data for identical commodities from Istanbul in the Ottoman Empire, Madrid and Barcelona in Spain, western Holland and southern England for the period 1500 to 1800. These cities or regions were all linked to each other by maritime trade during the early modern era. Our commodities include wheat which has been frequently used in market integration and price convergence studies both for this and other periods and regions but also other commodities such as olive oil, rice, honey, sugar, soap, meat and butter. The first five of these seven commodities were subject to long distance maritime trade in the early modern era, but there was little trade in the last two, meat and butter during the early modern era. Nonetheless, we chose to include them in our study.

Standard weight and monetary units are adopted by converting all prices to grams of silver per metric unit. In addition, 25-year moving averages are used in the analysis due to two reasons. First, there are large fluctuations in agricultural prices, largely due to weather related crop failures. The procedure of taking moving average of available data gives a relatively smooth series. Since the ultimate goal is to study long-term tendencies, rather than annual changes, averaging would be an appropriate method of concentrating on long-term relationships. Furthermore, there is a large number of missing observations in the Istanbul prices series. Taking moving averages help to create a relatively continuous series comparable to others.

Convergence is tested for five cities and eight commodities. Five cities are Istanbul, Barcelona, Madrid, London, and Amsterdam. Results based on five percent level of significance (or 95% level of confidence) are summarized in Table 1. There is no indication of convergence in prices of six out of eight commodities. These are butter, honey, meat, rice, olive oil, and soap. There is convergence between sugar prices in Madrid and London.
is also convergence between wheat price in Barcelona, Madrid, and Amsterdam. Panel data unit root tests also indicate that there is no convergence at the five percent level.

Detailed test results are given in Tables 2 through 5. According to these tests there is no convergence in Istanbul/London, and Istanbul/Amsterdam. There is convergence in prices of only a single commodity, namely meat, in Istanbul/Barcelona, and Istanbul/Madrid (Table 2). It should be noted that this is significant at the ten percent only. According to Dickey-Fuller test there is no price convergence between Barcelona and Madrid. Phillips-Perron test indicates that there is price convergence in meat and wheat at the five percent significance level (Table 3). For these two conflicting results KPSS test is also used. KPSS test supports the convergence hypothesis at the five percent level for a single commodity, namely wheat (Table 4). For Barcelona and London both ADF and PP tests indicate convergence in sugar prices at the ten percent significance level. For Barcelona and London both ADF and PP tests indicate convergence in wheat prices at the five percent significance level. There are two commodities (butter and sugar) that both test indicate convergence between Madrid and London. However, butter is only significant at the ten percent level. Tests give conflicting results between Madrid and Amsterdam. ADF test indicates that there is convergence in soap prices, while PP test indicates that there is convergence in wheat prices, both at the one percent level of significance. KPSS test support stationarity in wheat prices. Both tests indicate that there is no convergence between London and Amsterdam prices.

Panel data unit root tests yield similar results. Results based on the test by Im, Pesaran, Shin are given in Table 5. Tests based on multiple goods (8 goods) indicate that there is no convergence. In addition to Im, Pesaran, and Shin results on other tests are also reported. For example, Breitung test indicates that there is convergenge in prices of goods in Istanbul and Amsterdam, but only at the ten percent level. The table also provides results based on multiple cities, for 8 goods.

V- Conclusion

There is evidence that parts of Europe were becoming increasingly more integrated within themselves and with other parts of the continent during the early modern era. Even though transportation costs did not decline significantly, market integration as measured by price
dispersion did take place in different parts of western Europe during 1300-1650. The presence of national borders, or more generally of different jurisdictions was often an important barrier and/or the source of a variety of barriers. It has been argued that market integration in this case was due to the the removal or lowering of a wide range of institutional and other barriers. For example, the decline of predatory states and political centralization increased domestic stability and reduced coordination failures between markets. There is also some evidence that the wheat markets in the Baltic-North Sea region showed a tendency towards greater integration from 1500 until 1650 and these gains were not reversed until the end of the eighteenth century.

In contrast, our study of the prices of a variety of commodities in markets in the Mediterranean and in northern Europe indicate that market integration as measured by price convergence did not occur between these markets during the early modern centuries. Our analysis shows that even in the case of the two closeset markets, London and Amsterdam, price convergence did not take place in any of the five commodities. Our results thus parallel the recent findings by O’Rourke and Williamson who concluded that price convergence did not occur in European intercontinental trade in the three centuries before 1800.

While these results do not appear to offer a simple picture, one way or another, it would be useful to make a distinction about short and medium range trade on the one hand, and long distance trade on the other, when discussing market integration and Smithian growth during the early modern era. In the absence of a decline in transportation costs before the nineteenth century, price convergence and market integration may have occurred in some regional markets and in some short and medium range trade thanks to institutional changes in parts of Europe. On the other hand, although maritime trade and overseas discoveries have often loomed large in explanations of the late medieval recovery and European ascendancy during the early modern era, it is clear that the political and institutional changes he emphasizes would apply to long distance and international trade around Europe and beyond before the nineteenth century. What O’Rourke and Williamson may have concluded with respect to European intercontinental trade appears to be true with respect to long distance trade inside Europe as well. In the absence of any decline in transportation costs or institutional barriers such as tariffs or national borders, the increases in the volume of long distance trade was due to shifts in demand and/or supply and above all due to increases in incomes.
The available evidence thus indicates that Europe did not become engrossed in a complete and overarching system of markets during the early modern era. The absence of price convergence and market integration in long distance, international trade in early modern Europe should not mean the end of the concepts of market integration and Smithian growth, however. We should keep in mind that trade in Europe and, for that matter around the globe, was still mostly regional and domestic and not long distance or international before the nineteenth century and even well into the nineteenth century. For most countries the volume of long distance maritime trade and international long distance trade was still small in comparison to domestic trade and overland trade before 1800 and they were all sharply lower than the levels reached at the end of the long nineteenth century.

There is no doubt that the concept of market integration remains highly useful for understanding long term change in early modern Europe. At the same time, however, our results suggest strongly that market integration did not really apply to long distance trade inside Europe. Market integration and Smithian growth in early modern Europe needs to be considered in connection with short and medium range domestic trade.

REFERENCES


**Table 1: Summary of Tests of Convergence**  
(with 95% level of confidence)

<table>
<thead>
<tr>
<th></th>
<th>butter</th>
<th>honey</th>
<th>Meat</th>
<th>rice</th>
<th>olive</th>
<th>oil</th>
<th>wheat</th>
<th>sugar</th>
<th>soap</th>
<th>multiple goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Istanbul/Barcelona</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Istanbul/Madrid</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Istanbul/London</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Istanbul/Amsterdam</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Barcelona/Madrid</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Barcelona/London</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Barcelona/Amsterdam</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Madrid/London</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Madrid/Amsterdam</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>London/Amsterdam</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>multiple cities</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>butter</td>
<td>honey</td>
<td>meat</td>
<td>rice</td>
<td>olive oil</td>
<td>wheat</td>
<td>sugar</td>
<td>soap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>-----------</td>
<td>-------</td>
<td>-------</td>
<td>------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul/Barcelona</td>
<td>-1.85</td>
<td>-2.62</td>
<td>-1.71</td>
<td>-0.42</td>
<td>-1.01</td>
<td>-1.5</td>
<td>-1.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul/Madrid</td>
<td>-1.23</td>
<td>-1.21</td>
<td>-2.75</td>
<td>-0.39</td>
<td>-0.49</td>
<td>-0.88</td>
<td>-1.12</td>
<td>-2.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul/London</td>
<td>-1.88</td>
<td>-0.17</td>
<td>-1.33</td>
<td>-0.53</td>
<td>-1.02</td>
<td>-2.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul/Amsterdam</td>
<td>-0.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-1.54</td>
<td>-1.52</td>
<td>-1.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcelona/Madrid</td>
<td>-1.67</td>
<td>-2.57</td>
<td>1.96</td>
<td>-0.69</td>
<td>-2.19</td>
<td>-2.17</td>
<td>-2.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcelona/London</td>
<td>-0.64</td>
<td>-2.55</td>
<td></td>
<td></td>
<td>-0.92</td>
<td></td>
<td>-2.78</td>
<td>-1.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcelona/Amsterdam</td>
<td>-1.09</td>
<td></td>
<td></td>
<td></td>
<td>-3.29</td>
<td>-1.13</td>
<td>-1.99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid/London</td>
<td>-2.83</td>
<td>-0.6</td>
<td>-1.22</td>
<td></td>
<td>-1.03</td>
<td>-3.02</td>
<td>-2.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid/Amsterdam</td>
<td>-1.15</td>
<td></td>
<td></td>
<td></td>
<td>-2.18</td>
<td>-0.52</td>
<td></td>
<td>-3.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>London/Amsterdam</td>
<td>-1.99</td>
<td></td>
<td></td>
<td></td>
<td>-0.89</td>
<td>-1.47</td>
<td>-1.43</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* significant at the one percent level  
** significant at the five percent level  
*** significant at the ten percent level  

Note: Significance levels are based on MacKinnon(1991) response surfaces.
### Table 3: Phillips-Perron Test Results

<table>
<thead>
<tr>
<th></th>
<th>butter</th>
<th>honey</th>
<th>meat</th>
<th>rice</th>
<th>olive oil</th>
<th>wheat</th>
<th>sugar</th>
<th>soap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Istanbul/Barcelona</td>
<td>-1.99</td>
<td>-2.78</td>
<td>-1.81</td>
<td>-0.48</td>
<td>-1.08</td>
<td>-1.43</td>
<td>-1.83</td>
<td></td>
</tr>
<tr>
<td>Istanbul/Madrid</td>
<td>-1.41</td>
<td>-1.24</td>
<td>-2.81</td>
<td>-0.15</td>
<td>-0.59</td>
<td>-0.83</td>
<td>-1.35</td>
<td>-2</td>
</tr>
<tr>
<td>Istanbul/London</td>
<td>-1.84</td>
<td>-0.3</td>
<td>-1.13</td>
<td>-0.73</td>
<td>-1.12</td>
<td>-2.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul/Amsterdam</td>
<td>-0.05</td>
<td>-1.62</td>
<td>-1.88</td>
<td>-0.15</td>
<td>-0.59</td>
<td>-0.83</td>
<td>-1.35</td>
<td></td>
</tr>
<tr>
<td>Barcelona/Madrid</td>
<td>-1.82</td>
<td>0.72</td>
<td>-0.86</td>
<td>3.12</td>
<td>-2.33</td>
<td>-1.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcelona/London</td>
<td>-0.2</td>
<td>-2.48</td>
<td>-1.12</td>
<td>2.68</td>
<td>-1.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcelona/Amsterdam</td>
<td>-1.12</td>
<td>2.87</td>
<td>-1.14</td>
<td>-1.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid/London</td>
<td>-2.65</td>
<td>-0.25</td>
<td>-2.57</td>
<td>-1.49</td>
<td>3.73</td>
<td>-1.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid/Amsterdam</td>
<td>-1.3</td>
<td>-3.48</td>
<td>-0.19</td>
<td>-2.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>London/Amsterdam</td>
<td>-1.75</td>
<td>-1.3</td>
<td>-2.67</td>
<td>-1.43</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*significant at the one percent level
**significant at the five percent level
***significant at the ten percent level

Note: Significance levels are based on MacKinnon(1991) response surfaces.

### Table 4: Kwiatkowski, Phillips, Schmidt, and Shin Test

<table>
<thead>
<tr>
<th>KPSS</th>
<th>butter</th>
<th>honey</th>
<th>meat</th>
<th>rice</th>
<th>olive oil</th>
<th>wheat</th>
<th>sugar</th>
<th>soap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcelona/Madrid</td>
<td>0.70</td>
<td>0.378</td>
<td>0.992</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid/Amsterdam</td>
<td>0.276</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: asymptotic critical levels: 0.739 for 1%, 0.463 for 5%, and 0.347 for 10% level. The null hypothesis is “stationary”

*significant at the one percent level
**significant at the five percent level
***significant at the ten percent level
### Table 5: Panel Data Unit Root tests (Im, Pesaran, and Shin)

<table>
<thead>
<tr>
<th></th>
<th>Butter</th>
<th>honey</th>
<th>meat</th>
<th>rice</th>
<th>olive</th>
<th>wheat</th>
<th>sugar</th>
<th>soap</th>
<th>Im, Pesaran and Shin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Istanbul-Barcelona</td>
<td>-0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul-Madrid</td>
<td>0.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul-London</td>
<td>0.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istanbul-Amsterdam</td>
<td>0.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>Barcelona-Madrid</td>
<td>0.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>Barcelona-London</td>
<td>-0.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcelona-Amsterdam</td>
<td>-0.77</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid-London</td>
<td>-1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>Madrid-Amsterdam</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a, p</td>
<td></td>
</tr>
<tr>
<td>London-Amsterdam</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Im, Pesaran and Shin</td>
<td>-0.05</td>
<td>-0.00</td>
<td>0.28b</td>
<td>0.76</td>
<td>1.71b</td>
<td>1.24</td>
<td>0.53b</td>
<td>-1.25</td>
<td></td>
</tr>
</tbody>
</table>

- **a** - significant at the ten percent level according to ADF - Fisher Chi-square
- **b** - significant at the ten percent level according to Breitung t-stat
- **p** - significant at the ten percent level according to PP - Fisher Chi-square