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ASSESSING THE EFFICIENCY OF GRAIN MARKETS IN  
EIGHTEENTH- AND NINETEENTH-CENTURY INDIA***

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***INDIA AND THE GREAT DIVERGENCE:  
ASSESSING THE EFFICIENCY OF GRAIN MARKETS IN  
EIGHTEENTH- AND NINETEENTH-CENTURY INDIA<sup>1</sup>***

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## Abstract

By analysing a newly compiled data base of grain prices, this article finds that prior to the nineteenth century the grain trade in India was essentially local, while more distant markets remained fragmented. It was only in the second half of the nineteenth century that market integration accelerated, so that by the end of the century a national grain market had emerged. The paper also contributes to the comparative *great divergence* debate, in that it rejects, for India, the claim of the *California School* of 'Asia' having reached a similar stage of economic development as Europe before the late eighteenth or early nineteenth century. In a larger context, this contribution can thus be seen as part of the larger counter-revolution against the iconoclasm of the *California School*.

## Introduction

In recent years, the Great Divergence has become one of the most contentious issues in economic history. The debate centres on when and why Western Europe pulled economically ahead of the rest of the world; that is, when and why the Great Divergence in terms of economic performance and structure happened.

Until recently, the widely accepted view has been that Europe's path of economic development was unique already in early modern times. It had better institutions, a scientific culture which led to technological progress, superior commercial organisation, and more favourable social structures and demographic patterns. As a result, Europe's economic progress was outstripping that of the rest of the World so that it had become the clear leader in terms of economic performance even *well before* the Industrial Revolution brought about far-reaching structural changes and made Europe's supremacy even more pronounced.<sup>2</sup>

Spearheaded by Ken Pomeranz's *The Great Divergence*, Andre Gunder Frank's *ReORIENT*, and Bin Wong's *China Transformed*, recent years have seen a popularisation of a different view on this matter. According to this school of thought, which came to be labelled the *California School*, the bifurcation leading to the rise of the West only really happened towards the end of the eighteenth or at the beginning of the nineteenth century, and depended on a relatively sudden shift of relative European and East Asian economic trajectories, rather than a European take-off in the context of long-standing European dynamism versus long-standing Asian stagnation. Before, it is asserted, 'Asia' – particularly China, but also India and other regions – was comparable to Europe in terms of economic performance, as measured by various indicators. Placing the divergence in the nineteenth century, of course, also affects explanations of the European success vis-à-vis other parts of the world. In these revisionist accounts, the explanations shift away from the traditional factors, and coal and co-

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<sup>2</sup> Probably the best-known writings which represent this view are North and Thomas, *The Rise of the Western World*; Landes, *The Wealth and Poverty of Nations*; Jones, *The European Miracle*. However, this view and the varying explanations thereof go all the way back to the classical economists like Smith, Malthus, and Marx; for their assessments concerning India see Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, p. 206; Malthus, *An Essay on the Principle of Population*, p. 119; Marx, 'The British Rule in India', pp. 332–7.

lonial exploitation take centre stage.<sup>3</sup> One of the features of this debate is that the comparisons are based on fragile evidence.

While there is a long tradition of quantitative historical research on economic performance for most European countries, there has been no comparable tradition for Asian countries. Over the last few years, however, the lively debate has encouraged scholars in quantitative economic history to improve the inter-continental comparisons on indicators for economic performance – such as living standards, market efficiency or demography.<sup>4</sup> This undertaking is still at an early stage and many of the broad conclusions about the efficiency of Asian economies remain to be examined in greater detail and to be tested quantitatively. Moreover, in these recent studies, China has attracted the bulk of attention, while the quantitative investigation for the second of the ‘big two’ in Asia – India – has hardly begun. Undoubtedly, the prime reason for this shortage of quantitative studies is the paucity of historical economic data, which is much more pronounced for India as compared with European and even some other Asian countries. But this shortage is not limited, in the Indian case, to specific variables; there is a pronounced scarcity of all economic data prior to the nineteenth century.<sup>5</sup> This, in turn, is also a symptom of a more general phenomenon which has been plaguing Indian historiography, namely a general shortage of non-European sources on India.

It is therefore hardly surprising that quantitative studies on all aspects of Indian economic history have mostly been confined to the time after 1860; that is, when the British administration started to systematically collect and publish official statistics. For what may be labelled the ‘pre-statistical’ period – before 1860 – economic data becomes scanty and is scattered around in numerous sources and regional studies, and nearly no systematic efforts have yet been made to amass the economic data available and to explore it in an all-Indian or international context.<sup>6</sup> This is where the present paper comes in. Here, grain

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<sup>3</sup> For the *California School* position: Pomeranz, *The Great Divergence*; Frank, *ReORIENT*; Wong, *China Transformed*; Parthasarathi, ‘Rethinking Wages’.

<sup>4</sup> See for instance Allen et al., ‘Wages, Prices, and Living standards’, Allen, Bengtsson and Dribe, *Living Standards in the Past*; Bassino and Ma, ‘Japanese Unskilled Wages’; Broadberry and Gupta, ‘The Early Modern Great Divergence’; Shiue and Keller, ‘Markets in China and Europe’, 2004 and 2005 versions of the paper.

<sup>5</sup> See for instance Kumar, ‘South India’, p. 358.

<sup>6</sup> A recent exception is Haider, ‘Prices and Wages in India (1200–1800)’ who amasses and presents a good deal of the well-known data sources on prices and wages in India. However, this data consists mostly of isolated data points, but not of series. Also, his welcomed contri-

prices stretching from 1700 to 1914 are compiled for both India and Europe with the aim of assessing and comparing the efficiency of Indian grain markets through time. For that purpose, correlation analysis is applied and price convergence and price volatility are examined to gauge the relative level of and changes in grain market integration in India throughout the eighteenth and nineteenth centuries.<sup>7</sup>

The contribution of an inquiry of this nature is twofold: First, as the *quantitative* studies on Indian market integration are presently confined to the time after 1860, such a study signifies a substantial extension back into the pre-statistical era that will help to establish a much more complete chronology of Indian market integration. This all the more as there is to date no study *at all* which looks at market integration in eighteenth-century India. Second, by performing the same tests with a new European database and by discussing the results obtained for India against the background of recent studies on historical market performance in Europe and China, India's place in the *Great Divergence* can be ascertained. Grain market efficiency has featured as one of the prominent indicators for economic sophistication and potential in the Divergence debate. This is understandable as most economists and economic historians would agree that efficient market structures are both a testimony of economic sophistication and prosperity as well as prerequisites for further economic growth.

As a consequence, determining the efficiency of Indian grain markets vis-à-vis their European counterparts will help to assess the accuracy of the contradictory claims made by both camps in the debate, positions that ultimately determine the explanations as to why Europe industrialised first. Does the Indian case support the traditional line of argument in that Indian market efficiency was already substantially lower on the eve of the Industrial Revolution? Or are the results in line with the revisionist California School argument contending that the extent of trade and the efficiency of grain markets remained comparable in India until the end of the eighteenth and the beginning of the nineteenth centuries?

Before looking into this issue, we first need to become acquainted with the sources of evidence and the background to the question.

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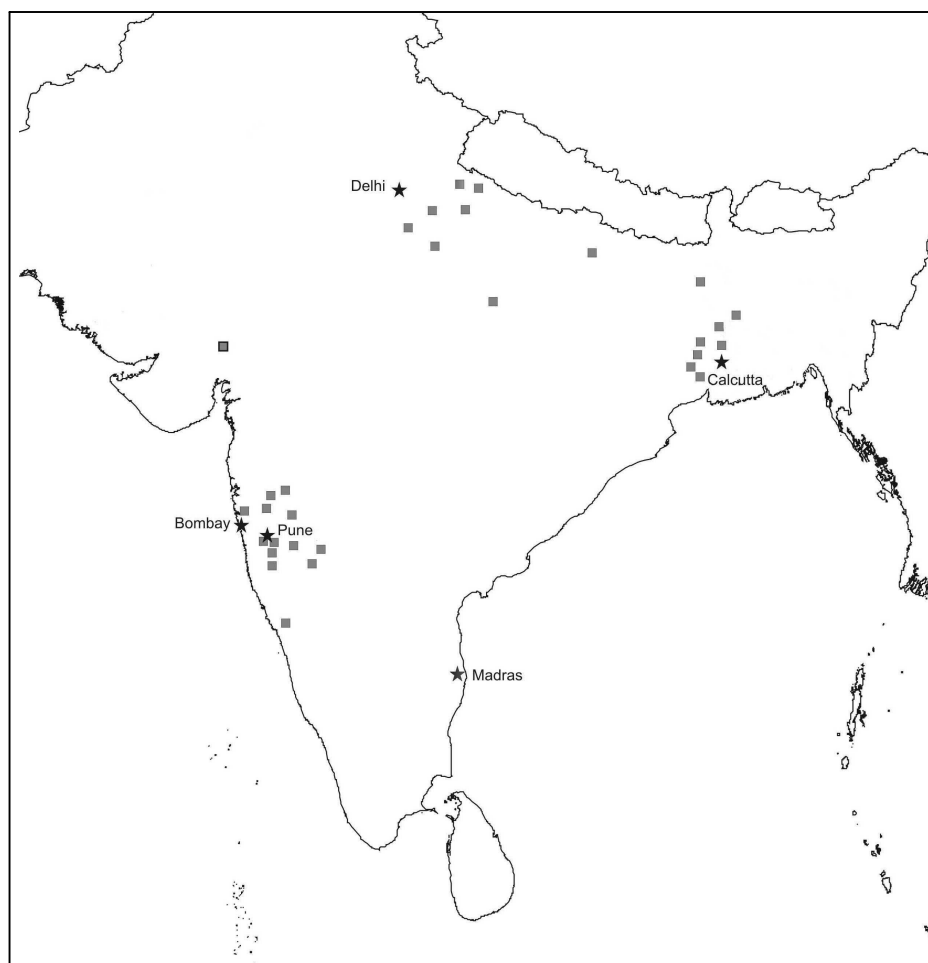
bution only presents the sources without analysing them. Moreover, there is more data around.

<sup>7</sup> The various methods used all have their strengths and weaknesses, so that applying all of them should increase the reliability of the results. Also, the slightly varying data requirements of the methods are beneficial for the analysis as the data at hand is very heterogeneous.

## Grain Prices and Grain Trade in India

For the intended investigation, grain price quotations for India, which encompass the period from 1700 to 1914, have been collected from a variety of sources, including government papers, old statistics journals and the secondary literature. The early series are normally based on information from civil or military authorities (both Indian and English), Indian revenue functionaries (mamludars), or wholesale traders. Only the two most widely recorded grains – wheat and rice – were included, and the price series represent annual average prices, either for calendar years or for harvest years (June–May).<sup>8</sup> In total, 54 price series for 35 different cities could be compiled for the pre-statistical era, of which 10 cities or market places are located in eastern India, 16 in western India, 8 in northern India and only one in Madras in the south (see Figure 1).

**FIGURE 1: LOCATION OF MARKETS WITH PRE-1860 PRICE SERIES**



<sup>8</sup> It needs to be said, however, that many sources do not indicate exactly how many observations were used to calculate averages. The prices are (with the exception of one series from Madras) always for one town or market. Also, almost no interpolations have been used: price series with gaps have generally been omitted.



For reasons of temporal comparison, some additional markets for the period after 1860, for which an abundance of price data is available, have been included in the study, so that the final database for the present investigation consists of 70 different price series (36 for wheat and 34 for rice) for 46 cities, which are spread all over the subcontinent. In many senses, this dataset is quite limited and heterogeneous, the latter not only in respect to the wide variety of sources it draws upon. The markets, for which data was available, vary greatly in their economic importance – from local to metropolitan – as do the time periods that the various price series cover. The average number of years a price series continuously covers is 47, the minimum number and maximum numbers being 19 and 160, respectively. And while a majority of the series were recorded under British rule, many were not and several price series even pre-date British arrival in that particular part of the country by half a century or more.<sup>9</sup>

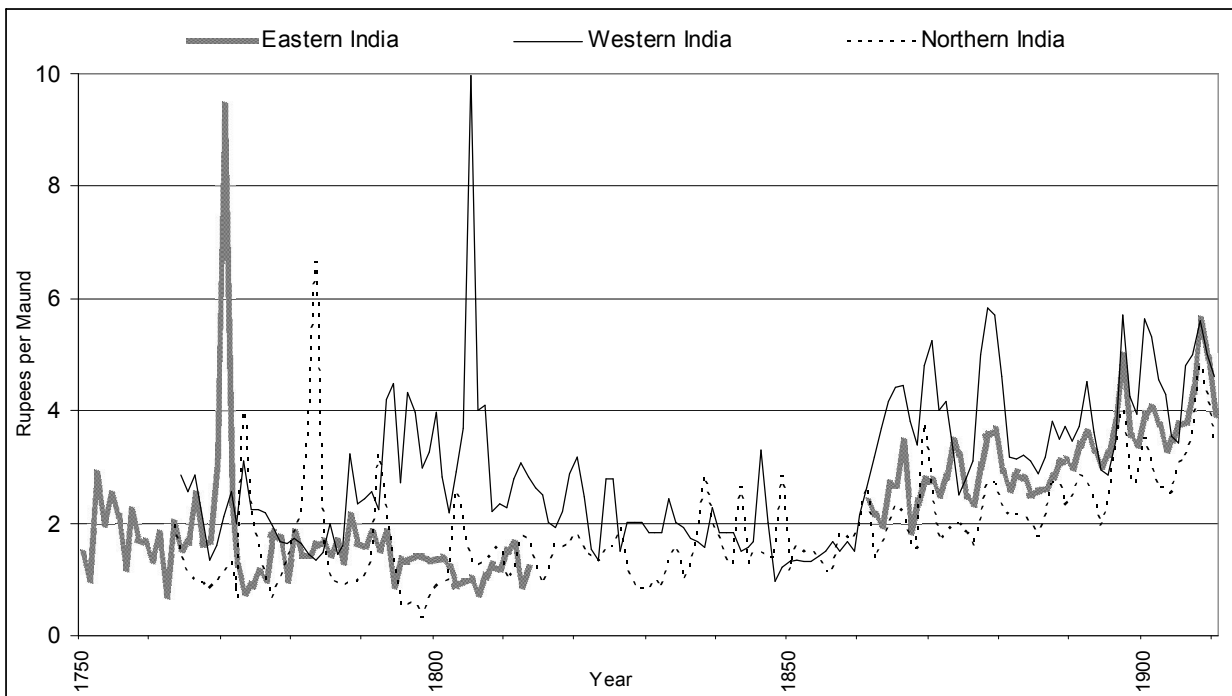
To further acquaint the reader with the data, Figure 2 presents wheat price series for the different major regions in India between 1750 and 1914. These long price series already reveal some general features of the grain prices in eighteenth and nineteenth-century India. For and foremost, Figure 2 reveals that the comparative price pattern before the 1850s looks fundamentally different from the post-1850 pattern.

In the pre-1850 period, the price levels in all regions remained in the long run fairly stable, while shorter periods of rising or falling prices can be observed. Generally, prices fluctuated massively from year to year in all parts of India, yet price levels were higher in the west than in Bengal or in the north. These year-to-year price movements seem in this early period completely unrelated between these distant places; even the massive price spikes did not coincide. The enormous price inflations are also an impressive testimony of the severity of the harvest failures that led to the Bengal famine of 1770 and to famines in the north (1783) and the west (1804) of the country. The fact that the magnitude of the price rises during these crises was even massively higher than the ones during the terrible famines of 1876/77 and 1896/97 bode ill for the social and demographic impacts of the earlier famines, about which little is known.

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<sup>9</sup> For a critical discussion of the data and its usage, including all relevant information about the sources and the nature of the new price series, please consult the extended version of this paper, available on the author's web page, currently at [www.nuff.ox.ac.uk/users/studer](http://www.nuff.ox.ac.uk/users/studer).

**FIGURE 2: CONVERGENCE OF WHEAT PRICES**



In the post-1850 period, prices rose permanently in all regions until the outbreak of the World War. Not only did prices inflate similarly in all three regions during this later period, but the short-term variations also looked very similar. This feature contrasts starkly with the totally asynchronous price movements observed for the early period.

As this newly compiled grain price database shall primarily serve the purpose of assessing Indian grain market efficiency in the eighteenth and nineteenth centuries, some basics about grain production and grain transport are first sketched out before making use of the new database.

The spatial and temporal growing patterns of rice and wheat – as with all Indian agricultural products – were (and to some extent still are) above all determined by the monsoon, in particular the southwest monsoon (June–September), which supplies India with most of its annual rainfall. Rice, as a crop with a high water requirement, was the dominant crop in regions with high annual rainfall, such as Bengal, the eastern Indo-Gangetic plains, the coast of Konkan, Malabar, Tamil Nadu and the Krishna-Godavari delta. It was grown in the summer or ‘kharif’ growing season, which coincides with the southwest monsoon. Wheat, with a considerably lower water requirement (a ‘rabi’ or dry-season crop) was planted in the post-monsoon season (October–November) and harvested in Feb-

ruary–March.<sup>10</sup> The most important wheat growing regions were the Punjab and the western Indo-Gangetic plains. But in pre-railway India, the monsoon not only shaped production of food grains but also their transport. As the heavy rainfall rendered road, river and sea transport virtually impossible, trade was predominantly carried out in the dry winter months from November to April.<sup>11</sup>

Historiography contends that grain, as other goods, was traded on three different levels in pre-British India: local, regional, and long-distance, and much of that trade was in the hands of special merchant communities such as the Vanjari or the Banjara. Of the food grains traded, rice and wheat were certainly the most important. While the qualitative picture – what was traded, by whom and when – is well known, the quantitative aspect – how much grain (and other goods) was traded on the different levels and how efficient the markets for various products were on the subcontinent – is largely unknown, and is an issue of debate due to the aforementioned shortage of economic data for the period preceding the British takeover in 1858.<sup>12</sup>

In the absence of widespread statistics on the volume of trade or on transport costs and transport capacities, such an assessment (of the efficiency and extent of grain trade) can arguably only be gauged using price data. The comparative analysis of grain prices from different markets has proved to be a valuable and reliable means for inferences about the extent of trade, the efficiency of markets, and the processes of integrating or disintegrating markets, and it has been applied for many countries in numerous studies. This makes sense as prices of widely consumed and traded goods – and grain was the most important in all pre-industrial economies – show several characteristics in integrated markets that they do not in fragmented markets, while the processes of increased (decreased) integration also exhibit characteristic price patterns. As a consequence, there are various formal methods for using grain prices for determining both the extent of market integration as well as the processes of integration or disintegration, and we now begin by determining the former.

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<sup>10</sup> Sykes, ‘Prices of Cerealia’, pp. 291–3, Roy, *Economic History*, pp. 98–9.

<sup>11</sup> Divekar, *Prices and Wages*, p. 24.

<sup>12</sup> Comparing Roy, *The Economic History*, p. 26, 31–3, and Rothermund, *Economic History*, p. 3, on the one hand with Frank, *ReORIENT*, pp. 176–82, on the other side, illustrates the massive discrepancies in the estimated extent of trade in grain and other goods.

## Gauging the Extent of Grain Market Integration

When market areas expand and formerly separated market places become part of one single market, the way prices are determined in these markets fundamentally changes. In totally unconnected markets, the local price of a product is determined by its local demand and supply. In the case of grain, it is the supply side – the annual harvest – which is by far the most important factor to have affected prices in pre-industrial societies. Demand, by contrast, was very stable in the short term, as grain dominated the diet of the people and was difficult to substitute. In modern terms, it was an inferior good with a low price elasticity. At the other extreme, when markets are perfectly integrated, the domestic price is independent of the local harvest: if the domestic market is small relative to the rest of the ‘world’, local harvest fluctuations only change the volume of imports or exports, while the domestic price equals the world price plus a transport cost. It should be noted that ‘world’ should not be taken literally; it simply stands for the geographical extension of the single market, of which the domestic market constitutes a small part.

Over the last centuries, most places on earth have witnessed a dramatic change from a situation of nearly complete isolation to a state of close integration into a global market. This secular trend has not been without setbacks, and it has varied greatly for different products. Grain markets, with which this paper is concerned, became integrated considerably later than markets for many other products. This is because grain has a very high bulk-to-value ratio, and therefore requires a much more effective transport infrastructure than goods with a low bulk-to-value ratio such as fine cloth or spices.

Turning to India, we will be looking at such a transition towards more integrated markets when examining the grain trade in the eighteenth and nineteenth centuries. As a consequence, we will often be confronted with ‘partial integration’ of two markets, meaning that the domestic price of grain is influenced by the local harvest *and* the ‘world’ grain price. Hence it is appropriate to gauge both the importance of the local harvest and of the world price on the domestic price. However, as only price data and no harvest data is available, it is only possible to gauge to what extent the domestic price is connected to the world price; that is to say, how much the actual situation resembles the polar case of perfect integration. In perfectly integrated markets, it is the ‘law of one price’ that determines the domestic price. The underlying logic of this so-called ‘law’ is that once trade participants in two markets share the same information and transport costs become small, price differentials between markets offer opportunities for arbitrage up to the point that prices are either the same in the two mar-

kets or reach a stable ratio where the difference in price equals transport costs. As a consequence, the two price series are expected in the long-run to show a linear relationship, while small local price shocks, which temporarily create disequilibria in this stable relationship, are quickly corrected for by arbitrage. Testing to what extent the newly compiled grain prices show these characteristics therefore serves as the basic means for gauging the extent of grain market integration in India before 1914.

We begin by scrutinising a first characteristic of prices in integrated markets, which is whether they show a stable linear long-term relationship. The tool that is often applied to test for the presence of a linear relationship between stationary data series is *correlation analysis*, as it is a method to measure the strength or degree of linear association between two variables.<sup>13</sup> Contrary to the related regression analysis, correlation analysis treats any (two) variables symmetrically, so that one single number, the so-called correlation coefficient, describes the association between these variables. Correlation coefficients indicate the quality of the binary relationship, because the closer the absolute value of the coefficient to unity, the stronger the association between the variables. Hence higher coefficients suggest a more integrated market, and they are expected to decrease with the distance between two markets as transport costs rise. This interpretation of correlation coefficients is, however, not without problems. High correlations of price series from two markets might also result from sources other than an integrated market. The most likely other source of high correlation is very similar weather conditions in the two places, which would – also assuming similar production methods – lead to similar variations in yields. Consequently, as prices in fragmented markets are largely determined by local harvests – which, in turn, are heavily dependent on local weather – one would expect similar price movements in these two markets, even though they might be totally unconnected. As we will see, the correlation coefficients obtained make such an explanation highly unlikely. The problem of spurious correlation gets amplified if one were to use monthly data instead of annual data, as in this case part of the correlation may stem from the fact that seasonal price patterns are often very similar over large geographical areas, irrespective of how closely markets are linked.<sup>14</sup>

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<sup>13</sup> As many of the price series, in particular all the post-1870 series, were non-stationary, all price series have been differenced for the analysis.

<sup>14</sup> Monthly data for correlation analysis is for instance used in Shiue and Keller, ‘Markets in China and Europe’, NBER paper, pp. 16–20, tables 2a and 2b, so that their results may be influenced by spurious correlation.

The results of the correlation analysis are presented in Table 1, and they have been grouped and aggregated into three different time periods and according to the distance between the two markets. For the period from 1750 to 1830, 25 markets could be analysed, while prices from only 15 cities were available for the years 1825–1860. In the later years from 1870 up to World War I, even though there is an abundance of data, the analysis was restricted to 20 different markets.<sup>15</sup> Combining the price series of these cities with each other, 450 binary relations (correlations) were examined in total, of which 83 for the first period under consideration, 74 for the second and 293 for the third. For various reasons, the number of binary relations (n) actually analysed is – in particular for the pre-1860 periods – far below the potential number of binary relationships that could be analysed combining prices from the respective numbers of markets in a sample. As mentioned before, the years covered by the individual series vary a lot, in particular for the earlier series. For instance, for the examination period from 1750–1830, none of the price series covers the entire period, and many price series do not overlap sufficiently to allow a reliable statistical

**TABLE 1: PRICE CORRELATIONS IN INDIA**

	<b>1750–1830</b> [n = 83]	<b>1825–1860</b> [n = 74]	<b>1870–1914</b> [n = 293]
<35 km	0.91 (0.07)		
35–70 km	0.46 (0.30)		
70–150 km	0.33 (0.16)	0.48 (0.18)	
150–300 km	0.26 (0.25)	0.35 (0.30)	0.75 (0.19)
300–600 km	0.02 (0.16)	0.14 (0.30)	0.73 (0.16)
600–1000 km		0.15 (0.28)	0.66 (0.19)
1000–1500 km		–0.01 (0.26)	0.56 (0.20)
>1500 km	–0.06 (0.19)		0.41 (0.21)

n: total number of market pairs examined; standard deviations in parenthesis.  
Distance ranges with  $n \leq 3$  are not reported

<sup>15</sup> Of which there are 5 for each major geographical region (north, south, east, and west). The choice of markets to include also had to be made so as to ensure that there was a good distribution of the distances between markets places in order to be able to detect differences according to distance.

examination.<sup>16</sup> Also, for some markets only wheat or rice prices are at hand, and wheat (rice) prices were only compared to wheat (rice) prices. The same applies to the unit of measurement, which were harvest years in some cases and calendar years in others. Moreover, only ‘sensible’ relationships were included, meaning that very unlikely connections (such as a tiny market in the western hinterlands and an eastern trading centre) were dropped for the early period, which might bias the coefficients upwards compared to other studies.

The results of the correlation analysis reveal above all a story of fundamental change. For the second half of the eighteenth century and the beginning of the nineteenth century, the law of one price is confirmed only in a local context; neighbouring villages or cities less than 35 km apart clearly exhibit a common price regime. But already the mean coefficient for the next distance range, spanning from 35 to 70km, is drastically lower (0.46), while the variation between the coefficients (summarised by the standard deviation) shoots up compared with the local level (0.30 compared to 0.07). This suggests that the prices of some market pairs in this distance range were still closely connected, while for others, such a connection was already very weak. The connection of prices becomes very weak for markets which are 70 to 300km apart from each other, while for prices in cities that are separated by more than 300km, no mutual influence is discernible.

Only a cautious interpretation can be attempted about how this situation of highly fragmented and localised markets changed over the next decades (1825–1860). Since prices from fewer cities were available for this period, and none were located closer than 100km of each other, the local and regional situation escapes our view. Judging from the slightly increased coefficients at all distance levels for which data are available for both periods, one might draw the conclusion that there was some, albeit very limited, progress.

The pace of market integration, however, increased dramatically in the period of the railway construction after 1860. The coefficients for the years from 1870 to 1914 increased for all distances to such an extent that one could already talk about a national market in which the prices in two cities, no matter how far apart, were interconnected. Over a century, progress was so far-reaching that price patterns of places that are 1000–1500km apart appear to be more similar

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<sup>16</sup> The minimum number of years used for an analysis was 19.

to each other than prices in cities within a very close range of 35–70km had been 100 years before.<sup>17</sup>

We now turn to the comparative aspect motivated by the *Great Divergence* debate to assess India's relative economic performance. For this purpose, a database of wheat and spelt prices has been collected for Europe, which – in order to assure a maximum degree of comparability – shares some of the features of the Indian database. It consists of 20 markets, which like in the Indian case also vary greatly in their economic importance, but which again are spread over the whole continent while yielding information for all distance ranges. Also, most markets are not located on the coastline but are as in the Indian case in landlocked territories. Prices are also annual rather than monthly, even though the latter type of data is widely available for Europe and has often been favoured for studies on European market integration. Finally, the dataset encompasses like the Indian one the period 1700–1914. However, as sources on grain prices for Europe are much more abundant than in the Indian case, the coverage is much more complete, so that the average number of years covered by a price series is now 170 years, the maximum and minimum number being 205 and 45.<sup>18</sup>

As a consequence, the correlation analysis could be extended back to 1700, while the first examination period used in the analysis for India (1760–1830) could be subdivided into two separate periods. The later examination periods, 1825–1860 and 1870–1914, are the same. Over the whole period 1700–1914, 547 binary relations (correlations) were examined in total, and the numbers of market pairs examined in each sub-period are again indicated in square brackets. While the presentation of the correlation results for Europe in Table 2 is identical to the one for India in Table 1, the results themselves are far from it.<sup>19</sup>

In the first half of the eighteenth century, regional markets in Europe were already closely connected as indicated by a correlation coefficient of 0.73 for a distance range of 35–70km. Also, prices up to 300km show a considerable amount of co-movement. Yet long-distance trade in grain must still have been

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<sup>17</sup> We see, however, still a lot of variation in this later period 1870–1914. This points to a very uneven degree of market integration still prevalent on the subcontinent, especially for long-distance trade.

<sup>18</sup> The cities in the European dataset are Amsterdam, Antwerp, Basle, Berlin, Bern, Krakow, Geneva, Lausanne, Lisbon, London, Lucerne, Milan, Munich, Paris, Schaffhausen, St Gall, Toulouse, Ueberlingen, Vienna and Zurich.

<sup>19</sup> As most prices series show longer periods of price increases, I have again worked with differenced series throughout to avoid spurious correlation.



very limited, as the connection between prices becomes very weak for all markets that were more than 300km apart. This picture of fragmented long-distance markets does not alter over the next decades. Regional and intra-regional markets, however, become more and more integrated; for the period 1750–1790 prices in markets up to a distance of 300km were clearly heavily influenced by the same market forces. At around the turn of the nineteenth century, the geographical expansion of markets started to extend to the long-distance trade; in the 1790–1820 period the correlation coefficient is 0.5 or higher for markets up to a range of 600km.

**TABLE 2: PRICE CORRELATIONS IN EUROPE**

	<b>1700–1750</b> [n = 74]	<b>1750–1790</b> [n = 137]	<b>1790–1820</b> [n = 134]	<b>1825–1860</b> [n = 111]	<b>1870–1914</b> [n = 91]
<35 km					
35–70 km	0.73 (0.10)	0.78 (0.24)	0.83 (0.20)		
70–150 km		0.76 (0.16)	0.78 (0.17)	0.83 (0.21)	
150–300 km	0.51 (0.08)	0.60 (0.18)	0.65 (0.07)	0.71 (0.15)	0.75 (0.11)
300–600 km	0.27 (0.17)	0.25 (0.28)	0.50 (0.35)	0.58 (0.28)	0.74 (0.18)
600–1000 km	0.35 (0.19)	0.14 (0.17)	0.44 (0.38)	0.61 (0.23)	0.76 (0.15)
1000–1500 km	0.26 (0.19)	0.15 (0.27)	0.33 (0.31)	0.48 (0.22)	0.72 (0.14)
>1500 km	0.25 (0.20)	–0.12 (0.30)	0.36 (0.30)	0.27 (0.12)	0.60 (0.08)

n: total number of market pairs examined; standard deviations in parenthesis.  
Distance ranges with n<3 are not reported

The difference to India is striking: There, correlation coefficients of 0.5 or higher were restricted to local markets closer than 35km during the first examination period (1760–1830). Meanwhile, in Europe many markets even up to distance of 1000km were now (1790–1820) reasonably connected, as can be deduced from the large standard deviation (0.38) for the distance range of 600–1000km. An encompassing integration of the long-distance trade in grain, however, needed decades more of steady market expansion, driven by the emergence of modern transport and information systems and less protective trade policies. By the late nineteenth century there seems to have been a truly European grain market, depicted in Table 2 by consistently high correlations coefficient and low standard deviations for all distance ranges in this period (1870–1914). When comparing these numbers for the last period with the results obtained for the first examination period, it becomes apparent how far-reaching

the changes in the eighteenth and nineteenth centuries have been in terms of economic integration: correlation coefficients that were in the early eighteenth century typical of regional markets within a range of 35–70km were by the late nineteenth century typical of markets as far apart as 1000–1500km. This was a truly revolutionary development.

The comparative picture emerging from Tables 1 and 2 is one of similar trends but stark differences in terms of the timing and level of market integration. In both Europe and India, the extent of trade and the degree of market integration in 1900 were radically different from what they had been in 1700 or 1750. By the turn of the twentieth century both regions had grain markets that spanned their entire continent or sub-continent respectively and both were closely integrated into the world markets for grain.

Yet the *level* of market integration was higher in Europe throughout the entire examination period. Moreover, this difference varied greatly over time. Europe started at a considerable higher level of market integration than India; the correlation results suggest that Europe's level at the beginning of the eighteenth century already surpassed the one India attained in the late eighteenth and early nineteenth centuries. By the latter time period, due to an early and steady expansion of European markets during the eighteenth century, the extent of trade and the efficiency of markets were radically different in these two regions. This early expansion of European markets compared to India continued through the first half of the nineteenth century and made the differences even more pronounced. India's economic integration only gathered pace in the second half of the nineteenth century, but then it proceeded at a very fast pace, so that in comparative terms, this was a period of rapid catch-up for India. Nevertheless, the improvements were not quite far-reaching enough to close the gap; market efficiency as measured by correlation coefficients remained higher in Europe still.

Another relevant comparative aspect is how these new results for Europe and India compare with existing studies using correlation analysis to gauge the extent of trade and market integration. One of the most extensive studies using this technique is by Carol Shiue and Wolfgang Keller, where they focus on comparing Europe and China in the eighteenth century. Their results are reproduced in Table 3, and they are based on a sample of monthly grain prices for 34 Chinese and 15 European markets.<sup>20</sup>

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<sup>20</sup> Shiue & Keller, 'Markets in China and Europe on the Eve of the Industrial Revolution', NBER paper, 2004, pp. 16–20, and Tables 2a and 2b.

**TABLE 3: PRICE CORRELATIONS IN CHINA AND EUROPE**

	Europe		China (Yangzi River)
	1770–1794 [n = 105]	1831–1855 [n = 105]	1770–1794 [n = 561]
<150 km	0.83 (0.09)	0.96 (0.03)	0.81 (0.09)
150–300 km	0.65 (0.15)	0.94 (0.03)	0.74 (0.12)
300–450 km	0.55 (0.21)	0.85 (0.07)	0.68 (0.10)
450–600 km	0.53 (0.17)	0.83 (0.06)	0.66 (0.09)
600–750 km	0.39 (0.15)	0.78 (0.08)	0.64 (0.10)
750–900 km	0.33 (0.16)	0.74 (0.02)	0.61 (0.11)
900–1050 km	0.30 (0.09)	0.72 (0.04)	0.57 (0.08)
>1050 km	0.30 (0.10)	0.57 (0.12)	

n: total number of market pairs examined; standard deviations in parenthesis. All the figures are taken from Shiue and Keller, ‘Markets in China and Europe’, NBER paper, tables 2a and 2b.

Clearly, Shiue and Keller’s results depict a very similar trend for Europe to the one shown in Table 2. Yet their coefficients are systematically larger across distances and time, hence suggesting a higher level of market integration than the one proposed by Table 2. The main factor accounting for these discrepancies surely is the very different sample of market used. While the large majority of cities used in the present study are located in landlocked parts of Europe, Shiue and Keller’s data is mostly for places with either direct or nearby access to the sea.<sup>21</sup> Since in the pre-railroad era, water transport was far cheaper and faster than overland transport, it is hardly surprising that Shiue and Keller find a higher degree of market integration for a sample where the option of shipping goods on the sea or on rivers was much more commonly available.<sup>22</sup>

What the present results and their comparison to recent studies on European market integration thus suggest is that the overall extent has probably some-

<sup>21</sup> In their eighteenth century sample, 11 out of the 15 markets either have a harbour or are situated in or at the edge of the lowlands of northern Germany, Holland, and Flanders where they were typically on a bank of a river with direct access to the sea. Regarding this point check the extended version of their article: Shiue & Keller, ‘Markets in China and Europe on the Eve of the Industrial Revolution’, version October 2005, map 3.

<sup>22</sup> See for instance Weber, *Untiefen, Flut und Flauten*, pp. 15–110.

times been overestimated. Landlocked Europe, which lacked Britain's or the Low Countries' endowment of natural waterways do indeed seem to have had well integrated grain market on a regional and inter-regional scale of up to, say, 300km. Yet the present evidence does not corroborate popular views on long-distance trade, such as Karl Gunnar Persson's claim of an 'emerging integrated European wheat market' in eighteenth-century Europe.<sup>23</sup> The expansion of commerce that included the widespread long-distance trade in bulky goods and led to the formation of a European grain market clearly seems to have been a nineteenth-century development. Such a conclusion does, of course, underline the importance the railways for the economic integration of Europe.

Let us conclude the correlation analysis by briefly looking at Shiue and Keller's results for China. Quite surprisingly, the coefficients are actually slightly higher than for Europe, suggesting that markets were at least as integrated in that part of China as they were in Western Europe and much more so than on the Indian subcontinent. Yet some caution is again recommended when making comparisons to the present landlocked samples, since the Chinese sample – 'Yangtze River' – is by definition biased towards markets with an exceptional natural endowment for cheap river transport.

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<sup>23</sup> Persson, *Grain Markets*, p. 100. Another recent study on European market integration that is using correlation analysis and finds very well-connected distant markets in eighteenth century Europe is David Jacks' 'Market Integration in the North and Baltic Seas', pp. 292–4 and Figures 4–6. Again, Jacks' focus is also on regions that are particularly well-endowed with natural waterways.

## Concomitants of Integrating Markets: Price Convergence and Decreasing Price Volatility

In the process of market integration, domestic prices that were formerly independent of the world price are becoming more and more determined by the latter. It logically follows from the law of one price that in the process of such a transition there has to be a convergence of the prices towards a single price or – due to transport costs – to a stable price ratio. Unsurprisingly, commodity price convergence is considered a reliable indicator for expanding markets, and history offers plenty of examples of convergence as a consequence of increased trade opportunities.<sup>24</sup>

Long-grain price series for the major regions of India from 1760 to 1914 confirm this and offer a powerful illustration about the timing and extent of grain market integration on the Indian subcontinent. Long wheat price series have already been shown in Figure 2, and the corresponding rice price patterns are shown below in Figure 3.

When looking at the course of the prices depicted in those two graphs, it can be said that price levels seem to have remained more or less stationary in all regions until about 1850, while prices for the same grain in different markets seem to have been totally unconnected: prolonged and massive differences in price levels were normal, price movements were asynchronous and big price spikes did not coincide. This strongly suggests that distant grain markets remained fragmented until the 1850s.

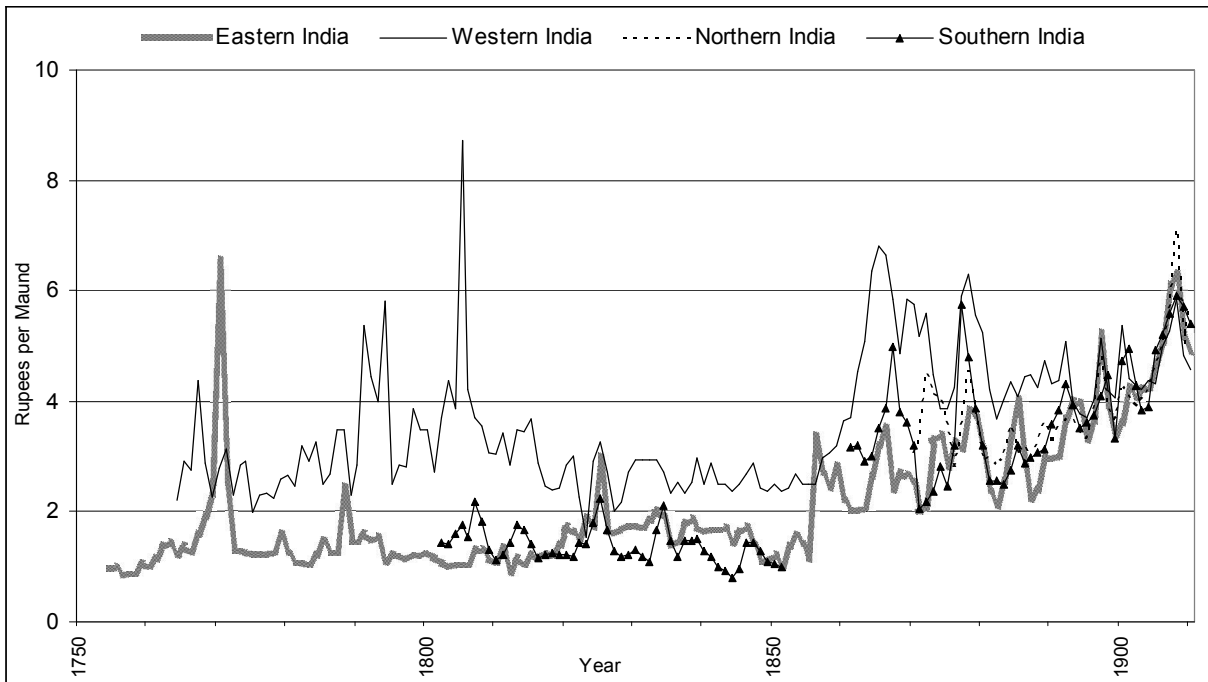
In the following decade, price movements in different markets started resembling one another, while the differences in the price levels were still rather big, a fact that can be explained by the persistence of fairly high freight rates in these years.<sup>25</sup> Around 1890 this situation changed as prices began to converge and price differentials began to disappear. This suggests that at the turn of the twentieth century, a national grain market seems to have evolved. Price patterns after 1850 also differ from earlier times in that price levels did no longer remain stationary, but were persistently rising until World War I.

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<sup>24</sup> See for instance O'Rourke & Williamson, 'When did Globalisation Begin?'; Findlay & O'Rourke, 'Commodity Market Integration'; Metzger, 'Railroad Development'.

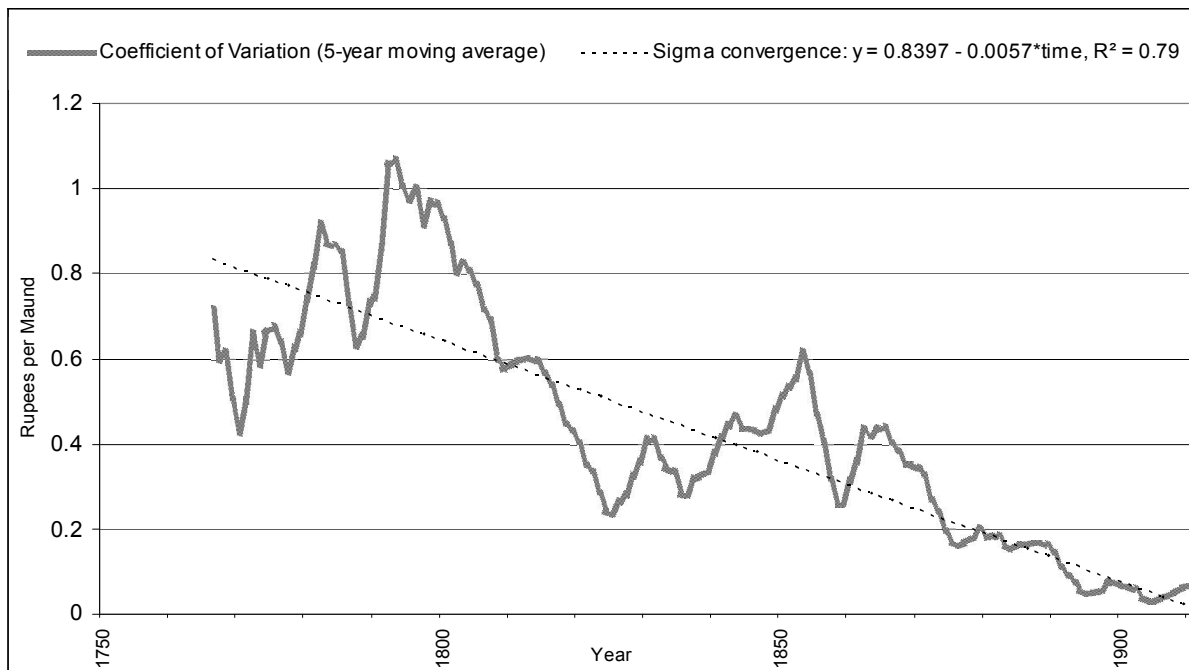
<sup>25</sup> Fairly high freight rates impeded the full utilisation of the railway network during the first decades of its existence. Subsequently, freight rates were reduced by one third between 1880 and 1900; the shipment of grain for export increased from 3 million to 10 million tons annually over these twenty years. Rothermund, *Economic History*, p. 36.

**FIGURE 3: CONVERGENCE OF RICE PRICES**



This process of price convergence is depicted even more persuasively when it is condensed into one single series, either into the coefficient of variation or into the so-called sigma convergence, i.e. the trend rate of decline of the coefficient of variation over time (Figure 4). For both indicators of convergence, the same regional rice prices as for Figure 3 have been used. Indeed, even for as long a period as 150 years, the sigma convergence yields highly significant coefficients, underlining the robustness of this trend of price convergence across India. As for the timing of the convergence, the coefficient of variation provides us with more precise information than Figure 3: A first drop in the price variation across regions is visible during the first two decades of the nineteenth century, while a second one starting in the 1870s and lasting up to the turn of the twentieth century lead to a near equalisation of prices across the subcontinent.

**FIGURE 4: SIGMA CONVERGENCE**

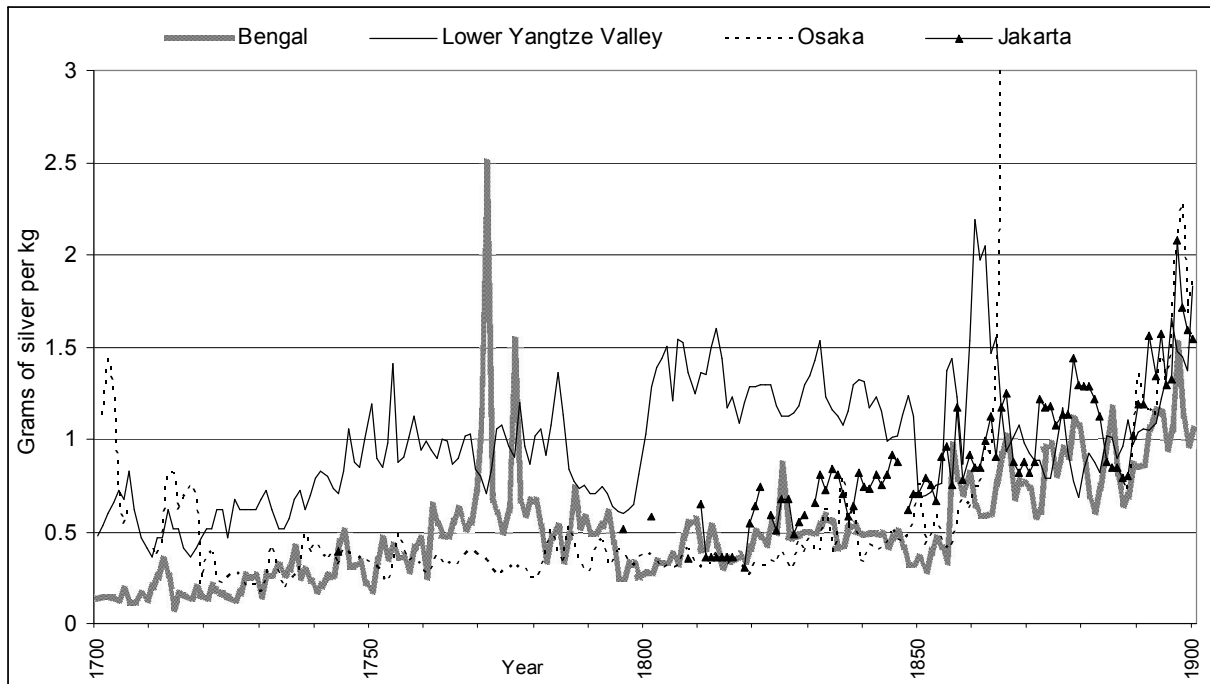


Looking at the bigger international picture it appears that the Indian national market for grain emerged around the same time as India became integrated into the Asian (or world) rice market. The levelling of prices in the Asian rice market is illustrated in Figure 5, which presents long price series from different locations in Asia. Throughout the eighteenth and the first half of the nineteenth century, differences in price levels were pronounced and short and medium-term price movements were independent in India, China, Japan and Indonesia. Rice in Bengal was mostly cheaper than in Indonesia, and much cheaper than in the Yangtze valley. Rice prices in Japan started at a very high level, but then decreased in the 1720s and remained mostly the lowest thereafter until the mid-nineteenth century. This is also when price gaps within Asia began to decrease substantially and from the 1870s onwards, a time of rapid market expansion, price movements also started to resemble each other.<sup>26</sup>

Consequently, the interpretation suggested by this graph is that at the end of the nineteenth century the extent of the rice trade in Asia was for the first time sufficient to have a clear effect on prices across the region. Judging by the extent of co-movements of prices, the degree of international integration was, however, not quite comparable to the national development.

<sup>26</sup> For the market expansion in late nineteenth-century Asia, see Latham and Neal, 'The International Market'.

**FIGURE 5: CONVERGENCE OF RICE PRICES IN ASIA**



A second concomitant of an expanding market is a decrease in the *single-market price volatility*. Price volatility is normally higher in fragmented markets compared to integrated markets; in the latter case, large variations in the local harvest (predominantly determined by local weather conditions) translate into only limited price shocks as they are damped by the possibility of geographical arbitrage between surplus and deficient regions.

The measure used here for price volatility in a market is the coefficient of variation, which is defined as the standard deviation divided by the mean.<sup>27</sup> The Indian markets, for which grain prices are at hand for several decades at the end of both the eighteenth and the nineteenth century, are markets that were amongst the most important at the time: the Mughal capital Delhi, the Maratha capital Pune and Calcutta, the raising centre of British power.

Table 6 shows that the wheat price volatility in these centres was massive in the second half of the eighteenth century, with an average annual price fluctuation of between 34% and 78% of the mean price. In the nineteenth century this changed dramatically so that the coefficients of variation fell below 20% in all three markets, suggesting a fundamentally different market structure. From the

<sup>27</sup> For non-stationary data, one needs to account for the fact that the mean is changing. As a consequence, the coefficients of variation for the 1870–1910 period has been calculated as the average of the coefficients calculated for each of the four decades.



same table it becomes equally apparent that the situation in Europe at the time was very different. At the end of the eighteenth century, the wheat price volatility in Indian markets was about 2 to 4 times higher than in a selection of big European markets.

**TABLE 4: COEFFICIENTS OF VARIATIONS**

	1764–1794	1870–1910
<i>Wheat Prices</i>		
Pune	0.34	0.19
Calcutta	0.79	0.14
Delhi	0.77	0.18
<hr/>		
Paris	0.16	0.14
London	0.16	0.14
Berlin	0.19	0.14
Milan	0.15	0.15
Amsterdam	0.17	0.16
<hr/>		
<i>Rice Prices</i>		
Calcutta	0.38	0.18
Pune	0.29	0.12
<hr/>		
Yangtze Val-	0.19	0.18
Osaka	0.20	0.17
<hr/>		

Comparing these findings with David Jack’s analysis of pre-modern European market integration suggests two things: First, the volatilities calculated for Europe and shown in Table 4 are comparable to the price volatilities he found for eighteenth century Europe and – second – not at any time after 1500 was the wheat price volatility in major European markets as high as in late eighteenth century India.<sup>28</sup> However, as the price volatility only decreased modestly in nineteenth-century Europe, volatilities in India and Europe had become comparable at the end of this century, even though prices in Pune and Delhi still fluctuated more than in any other city included in the sample.

An analogous comparison of the price volatility of rice in India versus China and Japan shows a similar pattern. The coefficients for India are on average about 70% higher than the ones in Osaka and the Yangtze valley in the late eighteenth century. But as volatility declined much more sharply in India than

<sup>28</sup> Jacks, ‘Market integration’, pp. 291–92 and Figure 2.

in the other places thereafter, rice price volatilities in Pune and Calcutta are by the late nineteenth century comparable to the ones in Osaka and the Yangtze valley.<sup>29</sup>

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<sup>29</sup> When attempting such geographical comparisons, one should bear in mind that factors other than the degree of market integration can affect the level of price volatility, such as the level of climatic variability or price interventions by the authorities. Interventionist policies were common in times of dearth in China, Europe and Japan. I would like to thank Ken'ichi Tomobe for pointing this out to me with respect to Japan.

## Political and Economic Fragmentation, and Imperial Integration

The results from the quantitative investigations presented in the preceding sections tie in well with both the general history of India and as with may be labelled the traditional or mainstream qualitative accounts of Indian market integration. Other than the revisionist accounts of Frank, Pomeranz, or Chaudhuri, this mainstream view contends that the emergence of integrated commodity markets in India – as opposed to markets for luxury or high-value goods – was a process that only really started in the second half of the nineteenth century. Before, it is argued, the markets for most products – for grain as a good with a high bulk-to-value ratio in particular – remained largely isolated due to high transportation costs and political fragmentation.<sup>30</sup> A very brief account on these issues will help to illuminate the grounds upon which these mainstream conclusions rest, and it will supply a historical narrative supporting the quantitative analysis.

In the century following the accession of Akbar (1556), most of India experienced an epoch of relative peace, political stability and prosperity, in which trade expanded and urban centres grew everywhere. This situation started to change, however, when under Aurangzeb's reign (1658–1707) the Mughal Empire expanded so much that it could hardly be ruled any longer. To finance his southern conquest, which had the aim of uniting northern and southern India under his rule, Aurangzeb's demand for revenue became increasingly oppressive. This, in turn, initiated widespread peasant revolts that added to an ever more rebellious climate in a situation of already decaying political stability. After Aurangzeb's death, the short succession of weak Mughals aggravated the situation further and led to a rapid erosion of Mughal central power. In the 1730s, the Marathas raided both Delhi, the Mughal capital, and Surat, which subsequently lost its role as the great port of the empire within a few decades. While Mughal power was rapidly diminishing, a struggle of regional powers for

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<sup>30</sup> For the mainstream view, see for instance Rothermund, *Economic History*; Kulke & Rothermund, *A History*; Roy, *The Economic History*, p. 30–1; Banerjee, *Internal Market*; Kessinger, 'North India'; Bhattacharya, 'Eastern India I'; Kumar, 'South India'; Divekar, 'Western India'; Divekar, *Prices and Wages*; McAlpin, 'Railroads, Prices and Peasant Rationality'. As already mentioned in the introduction, there is a revisionist view on this matter, which asserts that markets in pre-British India were efficient and comparable to European markets, and that grain was a widely traded good. This view has recently been popularised by Andre Gunder Frank's *ReORIENT* (see especially pp. 178–85) and Ken Pomeranz' *The Great Divergence* (p. 34 and Appendix A). Pomeranz' focus is, however, on China and he devotes only very limited space to India. Similar arguments are also made in Chaudhuri, *Trade and Civilisation*.

supremacy over parts of India emerged, with the Afghans, the Marathas, and several Mughal governors being the main contenders. The Europeans, meanwhile, remained still very marginal to the Indian political scene until the middle of the eighteenth century.

Not surprisingly, this decay of political stability and insecurity of life and property resulted in a dwindling trade. Merchants became an easy target for robbers and government officers alike, while trade routes became increasingly unsafe or were disconnected altogether. Long-distance trade seems to have suffered most, and some regions were far more affected than others.<sup>31</sup> Moreover, political regionalisation led to the introduction of new duties, thus further lowering incentives to trade. A related development arising from this political fragmentation was the deterioration of the transport infrastructure – a factor crucial to any market structure.

In the seventeenth century, the Mughals built and maintained a long-distance *road network*, which served both military purposes and commercial interests. This system of built roads, already rather limited in geographic coverage and density,<sup>32</sup> gradually started to decay with the decline of Mughal power. With the rise of the Marathas, the state of the road network deteriorated even further, as they were primarily fighters and not so much concerned with the development of infrastructure. As a consequence, even the few built roads were in a terrible condition by the mid-eighteenth century; old highways were overgrown by jungle, and Mughal works like bridges, wells, and caravanserais were in ruin.<sup>33</sup> Because of this lack of adequate roads, the use of bullock carts for transporting goods was impossible in most cases, and all the goods for inland trade had to be transported on the back of pack animals, such as bullocks, donkeys, camels, horses, and elephants. Inland trade was in the hands of specialised merchant communities such as the Vanjari and the Banjara, who traded throughout India with large bands of pack animals. In some regions not even bullock paths ex-

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<sup>31</sup> The south was badly affected in the second half of the eighteenth century. Kumar, 'South India', pp. 352–3; see also Chaudhuri, 'Eastern India II', pp. 295–332. While some routes for luxury and commodity trade were cut, it seems that in some cases local trade even benefited from prolonged warfare. Kessinger, 'North India', p. 251

<sup>32</sup> It seems that in some parts of India, such as in the whole of western India, there were practically no built roads up to about 1850. See Divekar, *Prices and Wages*, p. 9; Divekar, 'Western India', p. 339.

<sup>33</sup> See for instance Deloche, *Transport and Communications in India Prior to the Steam Locomotion*; Kessinger, 'North India', p. 258; Bhattacharya, 'Eastern India I', pp. 270–72; Divekar, 'Western India', pp. 339–40; Kumar, 'South India', pp. 353–55; McAlpin, 'Railroads, Prices and Peasant Rationality', pp. 673–4.

isted, so that all produce had to be carried on the head.<sup>34</sup> Moreover, during the rainy season, all this overland transport was put to a halt, and the internal traffic came to an almost complete stand-still.

Given the extremely poor state of inland transport, the prime way to transport goods over longer distances was by ship – either on navigable inland rivers or on the Indian Ocean. Though naturally navigable rivers provided by far the cheapest available transport, these were not abundant in India. *Inland navigation* was mostly confined to the Ganges river system and the Sind. In South India, there was very little inland navigation, while in western India, there were no navigable rivers at all. Also, river transport was ‘directional’, with downstream transport heavily outweighing upstream transport, and was highly seasonal due to the monsoon.<sup>35</sup>

The extent of the Indian *maritime trade* is debated but seems to have been rather limited compared to the situation in Europe before, say, the mid-nineteenth century. At Surat, the great port of the Mughal Empire, which experienced its greatest phase of expansion at the end of the seventeenth century right before the collapse of Mughal power, about 50 ships arrived every year during this period. In the same period, Amsterdam – one of the major ports in Europe – received about 3,000 ships each year.<sup>36</sup>

Some authors have come up with estimates of shipping capacity for Mughal India. While Moreland puts it at 52,000 to 57,000 tons for annual long-distance trade in the Indian Ocean at the beginning of the seventeenth century, Bal Krishna’s corresponding estimate is 74,500 tons. The comparative figure for European shipping capacity is between half a million and one million tons.<sup>37</sup>

Given this very poor transport infrastructure, which resulted in very high transport costs and very limited transport capacities, it is hardly surprising that that grain markets are widely believed to have been highly fragmented, and that inland grain trade was essentially local, so that ‘grain rarely reached the next regional markets, even in the presence of famines or rising prices’. People predominantly consumed local products, and only high value and luxury goods

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<sup>34</sup> For instance in parts of Western India. See Divekar, ‘Western India’, p. 339.

<sup>35</sup> Bhattacharya, ‘Eastern India I’, pp. 270–1; Kessinger, ‘North India’, p. 256.

<sup>36</sup> The figure for India is from Kulke and Rothermund, *A History*, p. 226; the one for Amsterdam from De Vries and Van der Woude, *The First Modern Economy*, p. 492.

<sup>37</sup> Frank, *ReORIENT*, p. 182.

were transported over longer distances.<sup>38</sup> Even on ships, grain seems to have played only a minor role, as merchants primarily transported high value goods such as spices, cotton and silk piece goods, ivory, or sugar. Wheat and rice regularly supplemented such freights, mainly because grain as a saleable bulky good was the most efficient ballast to stabilize sailing ships, and as it also served as a means to protect the more valuable cargo.<sup>39</sup>

Political and economic fragmentation, lack of security and regular warfare in some parts of the subcontinent characterised the socio-economic climate for the rest of the century – hence the term ‘crises of the eighteenth century’.<sup>40</sup> It was not until the battle for the supremacy in India had been decided that the political and economic stability *on the subcontinent as a whole* started to improve. The winner of this battle was, of course, the British East India Company, and it secured this position once it had decisively beaten the Marathas in their capital Pune in 1818, as the Marathas were by then the only serious contender left.

Having established their military supremacy on the subcontinent, the British slowly started to unite it politically and economically to a degree that went beyond any previous unification, which eventually led to a level of commercial activity unprecedented on the subcontinent.<sup>41</sup> Of the many obstacles to a flourishing economy in India, the British eradicated some in the 1830s that are generally believed to be significant, when they abolished all inland and town duties, introduced a universal measurement system and made the silver rupee the only legal tender.<sup>42</sup> So when British India officially became a part of the English Empire in 1858, the subcontinent was politically unified with an uncontested central power, a universal legal system, a single weight system, a single currency and a single official language, and was free of any internal customs.

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<sup>38</sup> Citation from Rothermund, *Economic History*, p. 4. Similar conclusions can be found in Roy, *The Economic History*, pp. 26, 30–1; Banerjee, *Internal Market*, p. 63; Kessinger, ‘North India’, p. 251; Bhattacharya, ‘Eastern India I’, pp. 279–81; Kumar, ‘South India’, pp. 353–55. Typical goods to be transported over longer distances were better cloth, spices, salt, betel nuts, and butter. Divekar, ‘Western India’, pp. 341–2, Kumar, ‘South India’, p. 353–5.

<sup>39</sup> Hence the contemporary name ‘cargo rice’. Creutzberg, ‘Changing economy’, p. 16; Chaudhuri, *Trade and Civilisation*, p. 184.

<sup>40</sup> Kulke and Rothermund, *A History*, p. 27. This generalising phrase needs qualification, however: See Marshall’s *The Eighteenth Century in Indian History*.

<sup>41</sup> Kessinger, ‘North India’, p. 256; Roy, *The Economic History*, p. 33.

<sup>42</sup> See Banerjee, *Internal Market*, chapter III.

Equally important was the dramatic improvement in the means of transportation that ensued. Although in some regions substantial progress was already achieved over the first half of the century, road construction and maintenance on a larger scale only started around 1850. Subsequently, the construction went ahead at a great speed so that at the end of the nineteenth century, there were about 37,000 miles of metalled roads and 136,000 miles of unmetalled roads in India. 'Thus, from the roadless situation at the beginning of the British rule, India had made considerable progress to gain what was the barest minimum urgently necessary for the commercial prosperity of the country.'<sup>43</sup>

The other major development that radically improved India's transport infrastructure – and it did occur very much at the same time as the improvement of the road network – was the construction of an extensive *railway network*. Helped by government guarantees that provided a secure 5 per cent return on all capital invested in this construction, independently of the profitability of the respective lines, it went ahead at a very rapid pace indeed: by 1900, there were about 25,000 miles of railway tracks. Railroads reduced freight rates for food grains by approximately 80% compared to rates for carts and rendered bulk shipments for grains possible.<sup>44</sup>

Finally, shipping technology and shipping connections also improved decisively, with the quantity of shipped goods experiencing a big surge in the nineteenth century. In the course of this process, the volume of shipped grain not only surged greatly in absolute terms, but also increased dramatically in relative terms vis-à-vis other goods, so that grain became the leading export commodity by 1900.<sup>45</sup>

To sum up, the processes of political and economic integration during the nineteenth century, coupled with the rapid improvement of transport facilities in the second half of the century, fundamentally transformed commercial activity leading to an unprecedented extent of trade in general, and of grain trade in particular. Previously highly fragmented markets became unified to such a degree that by the end of the century India not only had a national market for grain, but was integrated in the world markets for both rice and wheat.<sup>46</sup>

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<sup>43</sup> Banerjee, *Internal Market*, p. 80.

<sup>44</sup> Banerjee, *Internal Market*, pp. 81–108; Hurd, 'Railways', p. 268.

<sup>45</sup> External trade already experienced a substantial increase from the 1830 onwards. Rothermund, *Economic History*, pp. 37–42; *Statistical Papers relating to India*, p. 54.

<sup>46</sup> On national integration see Hurd, 'Railways'. On the integration into the world rice and wheat markets see Latham and Neal, 'The International Market'.

## Conclusion

With the prime aim of assessing the efficiency of grain markets, new databases of wheat and rice prices stretching from 1700 to 1914 were compiled. Three approaches were then applied to this price data to gauge the extent of market integration and to illustrate the process of integration: correlation analysis, price convergence, and single-market price volatility. While these procedures are all complicated by uncertainties or might also indicate factors other than market integration, it is reassuring that the results obtained by all these methods support one another and lead to the same general conclusions. These conclusions furthermore find support in both the general history of India and the mainstream accounts on market integration, and they can be summarized as follows.

Prior to the mid-nineteenth century, the grain trade in India was essentially local, while more distant markets remained fragmented. This is not to say that no grain was traded over longer distances, but the extent was very limited, as the prices from some 36 cities all over India still exhibited various characteristics of isolated markets. First, annual price fluctuations were extremely high. Second, differences in price levels between markets were very pronounced and persisted until well into the nineteenth century. Third, apart from neighbouring villages or cities, price series from different markets did not show co-movements at all.

It was in the second half of the nineteenth century that these backward structures got transformed rapidly, so that by the end of the century, price volatility had been massively reduced, prices across regions had converged, and prices for even very distant markets showed clear co-movements. Nevertheless, although it may be possible to speak of a national grain market at the turn of the twentieth century, the formation of an integrated market was still incomplete and showed distinct regional differences.

Turning to the comparative *Great Divergence* discussion, the claim of the *California School* of 'Asia' having a similar economic potency as Europe until the late eighteenth or early nineteenth century is rejected. At least as far as India is concerned, all indicators point to lack of economic development until the mid-nineteenth century as measured by the efficiency of grain markets. It seems safe to conclude that by the late eighteenth century, India was already very different from developed parts of the world such as large parts of Europe or as some advanced parts in China in terms of market performance. In view of the political history and the state of the transport infrastructure of the subcontinent, such a divergence between Western Europe and India needs to be shifted at least back to the seventeenth century, if not more.



The case of India indicates that the very generalising claim about 'Asia' being as economically advanced as Western Europe needs to be revised and replaced by a view that is geographically much more differentiated. Correlation analysis suggested that this may also apply for the intra-European interpretation. Instead of speaking of a 'Western European' level of market integration, one may prefer to refer to 'two Europes', lowland Europe and landlocked Europe. While the former already enjoyed a fairly high degree of integration in the eighteenth century, distance remained in the latter much more of an obstacle until the arrival of the steam engine.

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