

## **Prices in the Medieval Near East and Europe**

Johan Söderberg  
Department of Economic History  
Stockholm University  
SE-106 91 Stockholm  
e-mail [Johan.Soderberg@ekohist.su.se](mailto:Johan.Soderberg@ekohist.su.se)

## Introduction

This paper explores some questions related to the price history of the Near East and Europe during medieval times:

- How did price levels and trends in the Near East compare to those in Europe?
- Did price volatility in the Near East differ from European levels? Was volatility reduced over time in any of these regions?
- Can any price integration be discerned within the Near East, or between the Near East and Europe?
- Were grain prices in the Near East affected by climatic factors to a higher degree than were European prices?

These questions can be related to a wider issue: When did the economic decline of the Near East relative to Europe begin? Did Europe perform better during the medieval era?

According to one prominent historian, Eliyahu Ashtor, the Mamluk period (1250-1517) comprises two distinct economic phases. The first century, up to the Black Death, was characterized by a stable regime, demographic growth, and economic prosperity with monetary stability. A long period of peace prevailed in Egypt. Few epidemics are recorded in Egypt as well as in Syria, suggesting an improvement of public health.

This phase of growth came to a stop with the Black Death beginning in 1347. Population declined, as well as agricultural and industrial production. The Near East suffered from impoverishment during the second half of the fifteenth century, according to Ashtor. Grain prices fell because of declining demand. Compared to the previous century, standards of living were reduced for the great majority. Egypt was still often able to export considerable quantities of wheat and barley, but could no longer store sufficient stocks of grain for times of bad harvests. Salaries for many occupations were declining. The populations of the Near East could no longer afford to eat white bread, and shifted to cheaper grains such as barley and millet. Many Syrian peasants abandoned their villages, and economic trends were even more unfavourable in this region than in Egypt. The economic deterioration of the Near East, Ashtor argues, contrasts against the upswing in most countries of Europe where large segments of the population enjoyed rising living standards.<sup>1</sup>

The price history of the Near East thus has a central place in Ashtor's interpretation that Europe began to surpass the Near East in economic development during the late Middle Ages. His view is not unambiguous, however. Falling nominal grain prices should have offset the decline in salaries, and it is not a priori clear which trend was dominating the course of real wages. Though Ashtor reported a large amount of prices quotations for the Near East, he seldom converted them to Western measurement equivalents, and he rarely expressed them in silver prices that would allow convenient comparison with European prices. For reasons of time and space, the comparative study of real wages between the Near East and Europe is not carried out in this paper.

The outline of the paper is as follows. After an introductory presentation of the data used, long term levels, trends, and volatility in grain prices in the Near East and Europe are compared. The next section deals with aspects of price integration as indicated by correlations in short-term price fluctuations in the Near East and Europe. The third section discusses the

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<sup>1</sup> Ashtor 1976: 288-331; Ashtor 1983: 434-40. Ashtor's gloomy view that the economy of fifteenth-century Egypt was in a state of crisis is shared by Darrag 1961: 57-107, and by Lopez, Miskimin, and Udovitch 1970: 115-20. The latter authors, however, place greater weight at the devastating long-term effects of the plague than on the policies of the Mamluk rulers. See also Chaudhuri 1990: 104, who sees the decline of Egypt and Syria after 1400 as part of a phase of long-term contraction in a wider region.

impact of climatic factors on Cairo grain prices, e.g. through the effects of the inundation of the Nile. The paper ends with a concluding discussion.

## Data

This study relies on prices already published, notably in the monumental work of Ashtor.<sup>2</sup> Focus is on grain prices, not only because these were decisive in determining the standard of living, but also because relatively abundant series are available for wheat, in particular. For the Mamluk period (1250-1517) price series are more comprehensive than previously. Wheat prices are of particular interest since this was the most important crop in the Near East, playing a major part in the diet of the population.<sup>3</sup>

The Cairo series has a far better coverage than the series for Syria and Mecca. Most of the discussion to follow will deal with comparisons between this city – the largest in the Near East – and Europe.

In order to allow comparison with European data, all prices have been converted to silver values. Grain price quotations in the Near East are originally usually given in silver or copper dirhams. These prices have been converted to silver following two steps. First, gold dinar prices were calculated utilizing the exchange ratio of the silver or copper dirham to the dinar. Second, prices in gold have been converted to silver by means of the bimetallic ratio.<sup>4</sup> Bimetallic ratios for Cairo have been calculated by previous researchers for a large number of years. The gaps have been interpolated. As the bimetallic ratio was relative stable, fluctuating around 10:1, this does not seem to be too risky.

Yet, conversion to silver prices is not unproblematic. A large part of the available prices refer to the fifteenth century, a century during most of which Egypt lacked a silver currency (most transactions being done in copper coins). The silver prices calculated thus should not be seen as actually having been paid in the market. Still, this procedure appears preferable to any alternative, and has the advantage of facilitating comparison with prices from Europe and other parts of the world.

In converting Syrian and Mecca prices to silver, the bimetallic ratio of Cairo has been used, as well as the exchange rate between dirhams and dinars for Egypt. This seems reasonable, given that Syria had a very similar monetary regime to Egypt during the Mamluk period. Known differences have of course been taken into account.<sup>5</sup> The same procedure was used for Mecca, which is more questionable since Mamluk control of this town was often weak.

Prices for Syria and Mecca are biased upwards, since they were at several occasions reported in connection with extreme conditions during famine. This problem is most pronounced in the thirteenth and fourteenth century data, and diminishes as prices were recorded more regularly in the fifteenth century.<sup>6</sup>

<sup>2</sup> The major work on prices in the Near East is Ashtor 1969.

<sup>3</sup> Mortel 1989: 304.

<sup>4</sup> The gold dinar contained 4.25 grams of gold up to 1425 and thereafter 3.41 grams, further reduced to 3.37 grams from 1468; Bacharach 1973: 82-83, 91.

<sup>5</sup> Ashtor 1969: 388-392.

<sup>6</sup> Mortel 1989: 303.

## Grain price levels and trends

Table 1 gives an overview of grain price levels and trends for the Near East and a number of European towns and cities.

Table 1. Wheat and barley prices per hectolitre (beans per irdabb of 69.6 kg) at Cairo, Syria, and Mecca, and wheat prices in selected European cities and towns 1260-1512, in grams of silver

Place	Mean	Median	Time trend	Start year	N
<i>Near East</i>					
Cairo, wheat	59.2	44.6	-.136	1264	131
Syria, wheat	148.4	126.9	-.185	1260	38
Mecca, wheat	483.9	330.6	-.340**	1277	69
Cairo, barley	34.6	25.3	-.041	1264	75
Cairo, broad beans	39.1	32.6	.049	1277	74
<i>Europe</i>					
London	26.1	24.4	-.615**	1260	253
Chester	26.9	24.4	-.460**	1378	88
Exeter	26.5	24.4	-.552**	1316	190
Douai	29.8	27.9	-.146*	1329	180
Leuven	21.9	21.2	-.232**	1404	91
Brugge	34.0	30.9	-.716**	1365	164
Brussels	24.5	21.9	-.186*	1401	98
Leiden	43.0	37.1	-.248**	1392	79
Strasbourg	17.7	16.5	-.514**	1342	99
Stiftklosterneuberg (Austria)	13.2	10.2	-.129	1371	76
Tuscany	40.5	36.5	-.302**	1264	213
Valencia	36.4	36.2	-.287**	1413	93
Aragon	26.9	26.7	-.368**	1397	66

\*\* Correlation significant at the 5 per cent level (two-sided test). \* Correlation significant at the 10 per cent level.

Sources : Cairo prices : Ashtor 1969 : 283-292, 295-300; Ashtor 1977: 209-211; Shoshan 1983 : 63-67; Allouche 1994: 99-109; Popper 1957: 82 Cairo exchange rates dinar/dirham: Ashtor 1969: 277-78; Bacharach 1983: 179-180; Spufford 1986: 300-06; Shoshan 1986: 32-34; Allouche 1994: 95-98. Syria: Ashtor 1969: 392-95. Mecca: Mortel 1989: 305-11. Tuscany and Brugge: International Institute of Social History, Prices and Wages. Other series: Robert C. Allen–Richard W. Unger Database.

Notes: Syria prices date from 1260 to 1514, Mecca prices from 1277 to 1518.

Time trend refers to the  $r_{xy}$  correlation between time and the log of price.

One extreme wheat price quotation from Cairo, from winter 1348-49 (Ashtor 1969: 285), has not been used in this paper, since it is about ten times higher than any other quotation in the series.

The weight of one hectolitre of wheat is assumed to have been 72 kg, that of barley 62 kg. Popper 1957: 100 (wheat), Hinz 1955: 57 (barley). As the hectolitre weight of beans is not known, the price is given per irdabb of 69.6 kg.

The exchange ratio between the dinar and the copper dirham for the early sixteenth century has been assumed to be 500, which is slightly higher than the figure of 450-460 for the late fifteenth century as reported by Spufford (1986: 302).

Tuscany prices refer to Pisa up to 1300, thereafter to Florence.

Due to the bias towards high-price years in the Near East series, the median is preferable to the mean as a measure of central tendency. The median of silver prices at Cairo is substantially higher than at any place in Europe included in Table 1.

European silver prices vary between three zones. In this dataset, the first zone includes Germany and Central Europe (Stiftklosterneuberg in Austria and Strasbourg), which show low median prices of substantially less than 20 grams of silver per hectolitre. The second zone comprises north-western Europe, where several places exhibit a median price of 20 to 30 grams. The third zone is characterized by a high level of more than 35 grams of silver, documented from Valencia and Tuscany (but also, as a deviant case, from Leiden in Holland). These zones conform to those discerned by Braudel and Spooner for the fifteenth century.<sup>7</sup>

Wheat prices at Cairo thus exceeded the highest prices among European cities studied, and were nearly twice as high as in England and other medium price level centres in the north-west.

The median price level for Syria is incredibly high, amounting to nearly three times the Cairo level. This raises the question if the price level of Syria has been incorrectly calculated. The most likely source of bias is that the Syrian wheat series is considerably sparser than the one for Cairo, leaving greater room for extraordinarily high prices. However, years of scarcity should have been more frequent in Syria than in Egypt due to the higher level of political unrest, the wars with the Crusaders, and the Mongol invasions of 1260, 1299 and 1400. Despite these shocks, Syria was often able to export grains to Cyprus and other regions. In times of distress, Syria imported Egyptian grains.<sup>8</sup>

Mecca prices are even higher than those of Syria, and they should be. Agricultural conditions in the dry regions around Mecca were poor, and the town was dependent on supplies from outside. Much grain had to be imported from Egypt, Yemen, and East Africa, involving considerable transport costs. The caravan routes to Mecca were sometimes severed by Bedouin attacks, war, and political instability. On at least one occasion, a blockade against Mecca was lifted in return for the merchants' payment of large sums of protection money, which of course translated into higher prices. Another factor is that prices often refer to the season of the pilgrimage (*hajj*). Increased demand from the thousands of pilgrims arriving at the city drove prices upwards. This bias is most pronounced in the early years of the series, since prices during the fifteenth century were recorded at more frequent intervals.<sup>9</sup>

The silver price of wheat thus was clearly higher in the Near East than in Europe. To some extent, this could be an effect of the fact that years of famine are disproportionately represented in the early price records from the Near East. However, the use of the median as a robust measure of central tendency should eliminate the effects of observations from unusual years of scarcity. The large differences in median prices within the Near East suggest that this region was not an integrated market for wheat. The price differentials between Cairo, Syria and Mecca were much larger than within Europe.

The Near East and Europe also differ with regard to time trends in prices. As shown in Table 1, the silver price of wheat declined over time in most places in Europe, particularly in the north-west. In the Near East, neither Cairo nor Syria exhibits any significant decline in the grain prices.<sup>10</sup> The downward price trend in Mecca may be due to improved provisioning during the fifteenth century, but it may also be the result of the bias towards high prices in the early years of the series.

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<sup>7</sup> Braudel and Spooner 1967: 396-97.

<sup>8</sup> Ashtor 1969: 383-84.

<sup>9</sup> Mortel 1989: 290-94, 303, 314, 317.

<sup>10</sup> This result differs from Ashtor's statement (1976: 313; 1977: 212-214) that wheat prices in Egypt were falling in the long term during the Mamluk period.

## Price volatility

Table 2 reports three measures of volatility: the coefficient of variation (CV) in the arithmetic and log scales as well as the standard deviation of the residual from a first-order autoregressive model. The last column gives the time trend of the absolute values of this residual as a means towards assessing if, and to what extent, volatility did change over time.

Table 2. Volatility in grain prices in the Near East and Europe: coefficient of variation (CV) in the arithmetic and log scales, the standard deviation of the residual from a first-order autoregressive model, and the time trend of the absolute values of this residual.

Place	CV	CV (logs)	Standard deviation of AR(1) residual	Time trend of residual
<i>Near East</i>				
Cairo, wheat	.789	.200	.660	-.037
Syria, wheat	.651	.124	.566	.107
Mecca, wheat	.802	.129	.756	-.142
Cairo, barley	.852	.241	.705	-.415**
Cairo, broad beans	.828	.229	.674	-.400**
<i>Europe</i>				
London	.412	.115	.248	-.042
Chester	.316	.095	.264	.077
Exeter	.370	.101	.255	-.153*
Douai	.475	.111	.306	.140
Leuven	.341	.111	.279	.099
Brugge	.431	.129	.242	.004
Brussels	.382	.111	.275	.144
Leiden	.390	.096	.294	.146
Strasbourg	.364	.125	.263	.075
Stiftklosterneuberg (Austria)	.726	.204	.460	-.165
Tuscany	.414	.108	.311	-.028
Valencia	.161	.045	.151	.061
Aragon	.255	.073	.217	-.129

\*\* Significant at the 1 per cent level. \* Significant at the 5 per cent level.

Sources : See Table 1.

Notes : CV (Coefficient of variation) is standard deviation divided by mean in the arithmetic scale; CV (logs) is the same calculation in the log scale.

Time trend refers to the  $r_{xy}$  correlation between time and the standard deviation of the AR(1) residual, calculated from the logs of prices.

The CV in the arithmetic scale gives great weight to years of high prices, since these contribute more towards a large standard deviation than do years of unusually low prices. The CV in the log scale treats years of high and low prices symmetrically. Both these measures have the advantage of utilizing the total number of observations. The third measure, the standard deviation of the residual from a first-order autoregressive model, is probably preferable as a volatility indicator since it contains less of a time trend and eliminates a large

part of the otherwise strong autocorrelation in the series. This measure is, however, inevitably based on a smaller number of observations because of missing values in the series.<sup>11</sup>

All three volatility measures are markedly higher in the Near East than in most places in Europe. In Europe only Stiftklosterneuberg (Austria) comes close to the Near East in terms of the CV, in the arithmetic as well as in the log scale. As seen in Table 1, Stiftklosterneuberg has the lowest wheat prices of all European urban centres studied, so we are dealing with fluctuations around a low mean. In the log scale CV the differentials between various places are smaller than in the other volatility indicators, but the general European level still is lower than in the Near East. An inspection of Figure 1 c confirms the impression that volatility was much higher in Cairo than in London.

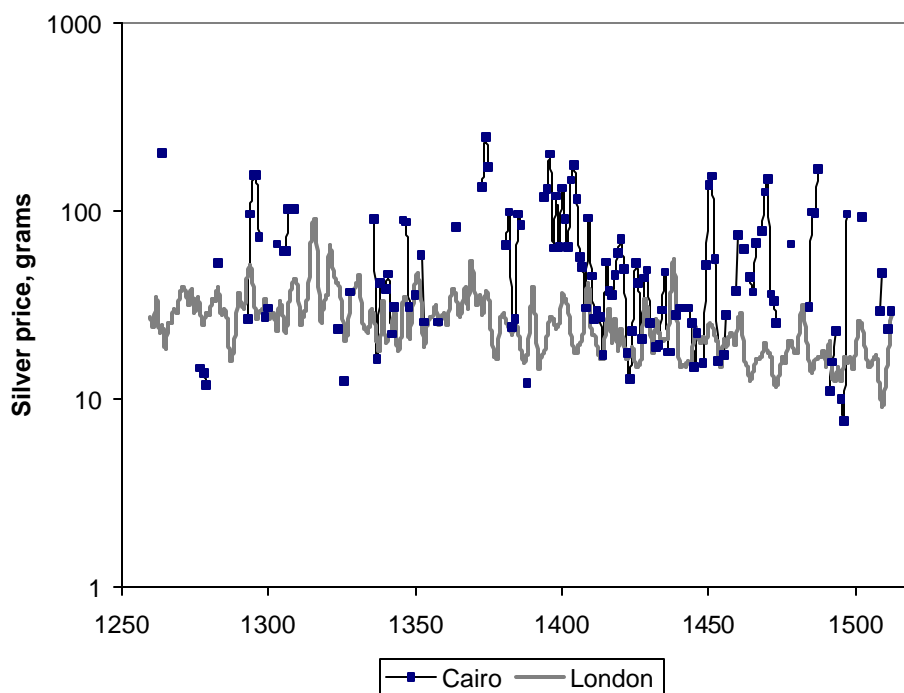


Figure 1. Wheat price per hectolitre (log scale) in Cairo and London, 1260-1512  
Sources: See Table 1.

<sup>11</sup> An alternative used in the literature, using the standard deviation from a random walk model (Persson 1999), is not used here since a first-order autoregressive process fits the data appreciably better than does a random walk model. The random walk model does not remove serial correlation among the residuals in these data.

What happened with volatility over time? The residuals from a first-order autoregressive model have a negative time trend (significant at the 1 percent level) in the barley or beans prices at Cairo, as reported in Table 2. The other Near East series do not show any clear sign of decreasing volatility. Neither does volatility decline in the European series (with the exception of a weak trend in Exeter).<sup>12</sup> The observation of declining volatility at Cairo is supported by a calculation of the coefficient of variation in the log scale. This was reduced from .295 to .209 for barley between 1264-1399 and 1400-1512, and from .280 to .207 for beans between the same periods.

Volatility thus decreased over time in the cheap grains at Cairo, but not elsewhere in the Near East and not in European wheat prices. This could be the result of improved efficiency over time in the Cairo barley and beans markets, but it could also be an effect of climatic fluctuations becoming more favourable to the production of these crops. This issue will be discussed below in connection with the effects of temperature and the inundations of the Nile.

The Cairo wheat market was probably the largest in the Near East during late medieval times. Why was price volatility so high?

Cairo depended upon the flow of grains on the Nile from Upper Egypt (the southern part of the country), where the general price level was lower. In 1416, the Mamluk government purchased wheat in for 530 dirhams per *irdabb* of 69.6 kg and sold it to Cairo millers for 600 dirhams. The latter price should have covered the cost of transport and presumably also allowed some profit. The transport cost, then, can hardly have exceeded 10 percent of the price at Cairo. Another sign of efficiency is that boats handling transports on the Nile could be quite large, carrying as much as 350 tons (5,000 *irdabbs*) of grain.<sup>13</sup> Transport costs cannot have been the key problem in supplying Cairo with grain.

Large amounts of grain were collected by sultans and emirs through the tax system. The Mamluk elite became the major suppliers of grain to Cairo and the other urban markets of Egypt. The sultans controlled large grain reserves, normally amounting to more than 20,000 tons. This may be compared to a cautious fifteenth-century estimate of the total consumption of grain at Cairo at 25,000 tons a year (or 1,000 *irdabbs* daily). Cairo's population is estimated to have been in the range 250,000 to 500,000 by the mid-fourteenth century, declining to between 150,000 and 300,000 by the fifteenth century. The rulers' granaries would then have been sufficient to feed the population of Cairo during nearly a whole year.<sup>14</sup>

Sultans and emirs sometimes disrupted the normal grain trade in order to make profits, for instance by forcing merchants to buy wheat at higher prices than the market rate. Other sultans, though, took steps to supply Cairo with grain in times of bad harvests, and at times sold grain at prices that were considerably lower than the market price. It also happened that sultans distributed free grain or bread to the poor. Other measures could be taken as well. In 1336, for instance, the sultan ordered grain to be imported from Syria and Palestine.<sup>15</sup> Egypt and Syria imported grain from Sicily, Cyprus, and other places in times of shortage.<sup>16</sup>

Obviously, these measures were not sufficient to bring wheat price volatility down to European levels. Scarcity was frequent. Cairo was affected by ten major famines during Mamluk rule, and food shortage was a constant fear among the inhabitants. Famines and epidemics became more frequent during the fifteenth century.<sup>17</sup> Grain riots expressed popular

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<sup>12</sup> Epstein 2001: 159-160 reports a substantial decline in the volatility in European wheat prices during the medieval era. I have been unable to reproduce his results. For instance, Epstein finds a long-term reduction in volatility at Douai, whereas my calculations do not indicate any downward trend.

<sup>13</sup> Shoshan 1980: 464 note 9.

<sup>14</sup> Shoshan 1993: 1, 58, 122 note 46.

<sup>15</sup> Shoshan 1993: 61.

<sup>16</sup> Ashtor 1983: 236, 239, 465-66.

<sup>17</sup> Sabra 2000: 168. The ten major food shortages occurred in 1264, 1295-96, 1336, 1373-75, 1394-96, 1402-04, 1415-16, 1449-52, 1469-70, and 1486-87; Sabra 2000: 138-164.

discontent with high prices and shortages and emerged as a distinct activity in Cairo around 1350. The market inspector often was the target of public anger, but sometimes crowds also protested directly to the sultan. Occasionally, crowds responded by the pillaging of grain in parts of Cairo, or, as in 1513, by demanding that grain shipments to Syria should cease.

In Cairo as well as in Europe, the repercussions of price volatility were dampened by the fact that the prices of bread varied less than those of grains. Some inhabitants of Cairo baked their own bread and were thus directly affected by grain price volatility. Others bought their bread from the bakers, while yet others prepared their own dough and carried it to the bakers to be baked. It is not known how many people resorted to these various ways of getting their bread. As a response to high prices in 1415, rationing was imposed on private consumers in Cairo: no person was allowed to buy more than one *irdabb* of grain. This suggests that the grain market for private consumption was not negligible.<sup>18</sup> Demand probably shifted from ready-made bread to grain in times of famine, as families then tried to hand mill their grain to avoid paying for this work.<sup>19</sup>

Price history always is linked to social history and the study of living conditions. There are good reasons to view price volatility as a welfare indicator. Price instability was one of the major problems of pre-industrial economies. High volatility means that consumers suffered from large fluctuations in real income and standards of living. Given the rigidity of nominal wages, the larger the fluctuations, the greater the risk that high prices would lead to poverty, famine, and health damage. Stable prices enhanced welfare.<sup>20</sup>

In this perspective, the Near East appears to have experienced more of a welfare problem than did Europe. The European situation was advantageous in two respects. First, the price level – as far back as the comparison can be made – was substantially lower in London and other European cities than in Cairo. Second, European consumers should have benefited from the long term decline in wheat prices.<sup>21</sup> No grain price decline is seen in Cairo. The difference in price trends between Cairo and London is evident in Figure 1.

On the other hand, the volatility in Cairo barley and beans prices (but not in wheat prices) was reduced over time, whereas few signs of such a time trend can be discerned in European wheat prices. Despite this levelling of prices, volatility in barley and beans prices at Cairo for the period as a whole exceeded the volatility of wheat prices in any place in Europe included in Table 2.

These results can be related to the argument of David Farmer, Gregory Clark and others that an efficient market for wheat, the largest commodity of the English economy, had emerged at least by the beginning of the thirteenth century. Local prices differed little from the national price level, indicating that local weather conditions did not determine prices, and that wheat could be traded freely and extensively within the limits posed by transport costs.<sup>22</sup> This observation accords with the fact that the volatility of English wheat markets is far smaller than in the Near East. It should be emphasized, though, that English volatility does not differ much from that other parts of north-western Europe. The English wheat market was not unique.

Furthermore, Clark finds no evidence that the English wheat market was becoming more integrated spatially in the course of the medieval period. The fact that volatility did not decrease over time, according to Table 2, lends some indirect support to this conclusion. A more direct test is to find out whether or not there is a time trend in the price differential

<sup>18</sup> Shoshan 1993: 63.

<sup>19</sup> Sabra 2000: 167.

<sup>20</sup> Persson 1999: 23, 31.

<sup>21</sup> Falling grain prices should have been beneficial not only to a large part of the urban population, but also to the probably substantial part of the rural population which did not produce a grain surplus. Epstein 2001: 5, 47-48.

<sup>22</sup> Farmer 1988: 742-743; Clark 1999; Galloway 2000.

between London and Exeter wheat prices (absolute values of residuals in logs from a linear time trend). No such time trend can be discerned, as the correlation is practically zero. It is possible, then, that the English wheat market early reached a level of integration that was not to change much for a long time.

### Price integration

#### *Climate and prices in the Near East*

Table 3 reports correlations between wheat price fluctuations within the Near East. The series have been detrended by calculating residuals from a linear trend in the logs of prices.<sup>23</sup> None of the correlations between the series of Cairo, Syria, and Mecca are significant, but the series are so sparse that such an analysis is perhaps less meaningful.

Table 3. Correlations between the detrended wheat prices (residuals from a linear time trend) in the Near East, 1260-1518 (N within parenthesis)

Region	Syria	Mecca	Temperature	Temperature, lag 1
Cairo	-.065 (21)	.027 (38)	.221* (131)	.173* (131)
Syria		-.134 (18)	-.204 (38)	-.136 (38)
Mecca			.145 (69)	.122 (69)
Temperature				.322** (263)

\*\* Significant at the 1 per cent level. \* Significant at the 5 per cent level.

Sources : Wheat prices: see Table 1. Temperature: Jones et al 1998.

The temperature series used is a northern hemisphere temperature reconstruction (Jones et al 1998). Temperature variation seems to have had an impact on Cairo prices, whereas no substantial correlations can be observed for Syria or Mecca, possibly due to the fairly small number of observations available. Climatic factors related to Cairo prices will be discussed further below in connection with the inundations of the Nile.

The short-term movements of wheat prices in the Near East do not appear to be linked to European prices. In particular, Mediterranean wheat prices (Tuscany and Valencia) are practically uncorrelated with Cairo, Syria, and Mecca prices.<sup>24</sup>

#### *The north-western European cluster of integration*

Several urban centres in Europe appear to have been economically integrated to a considerable degree. Table 4 summarizes the correlations between the residuals from a time

<sup>23</sup> Due to the large number of missing values, it is not meaningful to study market integration within the Near East by calculating correlations between the first differences of grain prices.

<sup>24</sup> There is, however, a significant correlation between Cairo and London wheat prices:  $r_{xy} = .226$  at lag zero when both series are measured as residuals from linear time trends. This should probably not be interpreted as evidence of an economic linkage; no grain trade took place between these cities. Possibly, this correlation could result from the fact that temperature is positively correlated with wheat prices in both cities, as is clear from Tables 3 and 5.

trend of the log of wheat prices. The co-variation is far from being restricted to England. London and Exeter prices correlate not only with each other but also with prices in Brugge, Leuven and the French inland town of Douai; in addition, there is a weaker correlation with Brussels. London also correlates with Strasbourg Brugge, Leuven, Brussels, and Douai are centrally placed in this network: prices there are significantly correlated (at the 5 per cent level or better) with all other towns included in Table 4.

There thus existed a cluster of cities and towns in north-western Europe within which short-term price movements were similar. Coastal as well as inland towns were part of this network. Among inland towns, Leuven and Brussels show strong internal connections, as do Leuven and Douai. It appears as if contacts were systematic in several directions between England, The Netherlands, and France. Strasbourg also belongs to this cluster, since prices there vary with those at several other towns: London, Leiden, Douai, Brugge, Brussels, Leuven, and Douai.

Table 4. Correlations between the detrended wheat prices (residuals from a linear time trend) in European cities and towns, 1260-1512

Place	Exeter	Leiden	Brugge	Leuven	Brussels	Douai	Strasbourg
London	.797**	.170	.364**	.413**	.251*	.383**	.339**
Exeter		.055	.291**	.445**	.210*	.198**	.107
Leiden			.674**	.671**	.578**	.646**	.381**
Brugge				.664**	.657**	.570**	.431**
Leuven					.687**	.588**	.613**
Brussels						.349**	.623**
Douai							.416**

\*\* Significant at the 1 per cent level. \* Significant at the 5 per cent level.

Sources : Brugge: International Institute of Social History, Prices and Wages. Other series: Robert C. Allen–Richard W. Unger Database.

Price integration was weaker outside north-western Europe. Tuscany, for instance, shows significant correlations only with Valencia and Douai, and not very strong ones ( $r_{xy} = .300$  and  $.182$ , respectively). Valencia correlates, apart from Tuscany, only (and rather weakly) with London and Aragon. Aragon shows no other significant correlation than with Valencia. The Mediterranean region thus stands largely separate from the north-western cluster; it is also internally less integrated than is north-western Europe.<sup>25</sup> The north-western cluster was separated from the Mediterranean market. Only in times of extremely high prices, such as in the famine of 1317, was grain taken from the Mediterranean to north-western Europe.<sup>26</sup> In central Europe, Stiftklosterneuberg (Austria) has an even more peripheral position, price fluctuations there being unrelated to those anywhere else in this dataset.

Stephan Epstein has advanced the general argument that political centralisation gave rise to greater market integration during the late medieval era. According to him, jurisdictional fragmentation was the main cause of grain price volatility.<sup>27</sup> Epstein specifically

<sup>25</sup> Spufford discerns two semi-integrated grain markets in medieval Europe. One centred on Paris, London, and the Low Countries. The other was in the south, stretching from Andalusia to the grain-producing areas around the Black Sea and feeding the north Italian cities (Spufford 2002: 288). This characterization would appear to overstate the degree of integration of the southern market. As seen above, prices in Spain and northern Italy did not correlate well. The relatively integrated north Italian market comprised not more than a small part of the vast southern region as delineated by Spufford.

<sup>26</sup> Spufford 2002: 288, 291.

<sup>27</sup> Epstein 2001: 159.

studies the expansion of Florence, which allowed weak rural communities to establish markets and fairs despite urban resistance. The strengthening of government facilitated road improvements, lowered transport costs and reduced tariffs on domestic trade.<sup>28</sup> While this stimulated market integration within north Italy, it is apparently not the type of price integration across rather large distances and several political borders that we can see in north-western Europe.

The observed correlations between various European towns could in principle be the result of a common climatic factor affecting yields and prices. This appears not to be the case, however, with regard to short-term movements. As reported in Table 5, correlations between northern hemisphere temperature and the residuals from a linear time trend of the log of wheat prices are significantly positive for Douai and London only. Here, and particularly at Douai, higher temperatures tended to be connected to higher prices. This is true at lag zero as well as at a one year lag in the temperature series. In most towns and cities, however, such a pattern is missing. The hypothesis of a common temperature effect on European wheat prices should not be totally discarded, but it is unlikely to have been substantial, and certainly not sufficiently strong as to generate the much higher correlations in Table 4.

Table 5. Correlations between detrended wheat prices (logs) in European cities and towns and Northern hemisphere temperature, 1260-1512

Place	Temperature	Temperature, lag 1
London	.147*	.134*
Brugge	.093	.141
Douai	.242**	.327**
Strasbourg	.186	.186
Stiftklosterneuberg	-.094	-.036
Tuscany	.061	.131
Valencia	.008	.104

\*\* Significant at the 1 per cent level. \* Significant at the 5 per cent level.

*Note:* Detrended prices are residuals from a linear time trend.

*Sources:* Prices: See Table 4. Temperature: Jones et al 1998.

A striking result from James Masschaele's study of transport costs in medieval England is that these costs were remarkably low in the fourteenth century. The ratio of the cost of land transport to river transport to sea transport was about 8:4:1. While sea and river transport were clearly cheaper than land transport, the latter cost was not prohibitive. A land trip of ten miles raised the price of wheat by only 4 per cent. Moreover, Masschaele finds no evidence of land transport costs being reduced from the fourteenth to the eighteenth century.<sup>29</sup> From the point of view of transport economics, nothing should have prevented a medieval price integration of the type observed above in north-western Europe. A calculation from a real example reported by Masschaele gives the result that the cost of transporting 42 hectolitres of wheat by sea

<sup>28</sup> Epstein 2000: 99-108, 116-121.

<sup>29</sup> Masschaele 1993. Harrison 1992 argues that the construction of a large number of high quality bridges in medieval England contributed towards creating reasonably good land transport conditions, and gives an indication of the increasing sophistication of the medieval economy. See also Spufford 2002: 180 on bridge-building as the most important part of road improvement in Europe from the late twelfth to the early fourteenth century.

from Hull to Ostende, a distance of 225 miles, added 24 per cent to the price at Hull.<sup>30</sup> This cost should have been far from being prohibitive, and most grain transports certainly were carried out at shorter distances.

Why, then, did the north-west distinguish itself from other parts of Europe with respect to price integration? Peter Spufford provides part of the answer. As a consequence of the urban growth of the thirteenth century, the cities of the Netherlands could not be provisioned by means of nearby food supplies only. Substantial amounts of grain were sent to Flanders from northern France. And this was not enough. Grain was also brought from the regions around the Rhine and the Meuse, from southern England, and from the Baltic. Internal waterways provided efficient means of transport for the grain coming in from Antwerp and Amsterdam. The total urban population of Flanders, Brabant, and Holland approached half a million by the mid-fifteenth century.<sup>31</sup> The feeding of this population required a large and regular grain trade across political borders.

The Baltic trade, taking place on a regular scale at least from about 1300 onwards and growing strongly in the fifteenth century, was of importance not only in allowing a higher degree of urbanization. It also exerted a downward pressure on grain prices in England and other parts of north-western Europe.<sup>32</sup> As shown in Table 1, wheat prices declined in the long term in many urban centres in the north-west. This clearly marks a difference between the price history of north-western Europe and that of Egypt.

Land transport in Europe seems to have revived versus sea transport in the second half of the fifteenth century. One reason for this could be the improved safety of land transport. France and several other parts of Europe were increasingly pacified with the creation of standing armies. Sea transport in the Mediterranean, on the other hand, became less safe. The bitter wars between Muslim and Christian brought higher risk. Piracy was a serious additional problem in the western Mediterranean.<sup>33</sup> Sea transport costs in the Mediterranean may thus have risen, not only relative to the cost of land transport but also in relation to the cost of sea transport in north-western Europe. This should have given the north-western cluster a cost advantage compared to shipping in the Mediterranean.

It is possible, though not demonstrated, that north-western Europe was characterized by unusually low land and sea transport costs. In fourteenth-century western England, Exeter apparently had a choice of trading grain with London and eastern England on one hand, or Brittany on the other. Campbell (1997) argues that the grain trade in England had declined by 1400 as a result of demographic recession and decreasing market participation on the side of the seignorial economy. A well-integrated coastal wheat market embracing southern England, Flanders, Picardy, Normandy and other parts of the near continent existed before the Black Death, but declined after the plague.

Is there any sign that price integration was weak in the period following the Black Death? In order to explore this issue, the available series have been divided into two periods, 1360-1419 and 1420-1512. Table 6 reports the correlations between detrended wheat prices (residuals from a linear time trend of the logs of prices). Due to sparse data, this subdivision into periods cannot be done for all towns included in Table 4.

Correlations between three pairs of urban centres – London-Exeter, London-Brugge, and London-Douai – are similar across the two periods, indicating a considerable stability. The most notable change is that Strasbourg is being integrated into the north-western cluster

<sup>30</sup> Masschaele 1993: 273. My recalculation assumes a price of 6 shillings per quarter of wheat, a normal price in the period 1320-1340; Farmer 1988: 795.

<sup>31</sup> Spufford 2002: 104.

<sup>32</sup> Hybel 2002: 234-241. See also Hammel-Kiesow 2002: 55, 78-90 arguing that the direct route from Western Europe round northern Jutland to the Baltic Sea was well-established already by the mid-thirteenth century.

<sup>33</sup> Spufford 2002: 407.

after 1420, as prices in this town begin to vary with those at Brugge, Douai, and London. Also, the connection between Brugge and Douai is somewhat strengthened. The Exeter-Brugge and Exeter-Douai links are however weakened after 1420. The overall impression is one of expansion of the network eastwards to Strasbourg, while the position of Exeter became more peripheral

The north-western cluster clearly came into existence well before 1420. Several of the links within it were maintained between the post-plague decades and the later medieval era. Price integration in the north-western region is evident before as well as after the mid-fourteenth century. While Galloway and Campbell find indications of English grain markets contracting after the Black Death, results in this paper rather point to the possibility that the disruptions were counterbalanced by the continued existence and even growth of the north-western grain trade network. This is more in line with Epstein's argument that markets expanded as a result of rising labour productivity and increased political centralisation, reducing the costs of trade in the century after the Black Death.<sup>34</sup>

In explaining the successful formation of the north-western cluster we should then study the changing role of political and other barriers to the expansion of trade. Galloway points at several factors as significant in the early formation of an efficient internal grain market in England, including relative security for traders and travellers, the regular access of peasants to market places, a relatively stable currency, standardisation of weights and measures, the absence of large tariffs, and the means of enforcing contracts and settling disputes. These transaction costs are all linked to the emergence of a centralised political structure, which seems to have been more firmly established in England than in many parts of Europe.<sup>35</sup>

Table 6. Correlations between the residuals from a linear time trend of the log of wheat prices in European cities and towns, 1360-1419 and 1420-1512

(A) 1360-1419

Place	Exeter	Brugge	Douai	Strasbourg
London	.820**	.429**	.384**	.051
Exeter		.427**	.276*	-.190
Brugge			.514**	-.277
Douai				.022

(B) 1420-1512

Place	Exeter	Brugge	Douai	Strasbourg
London	.737**	.374**	.461**	.402**
Exeter		.233*	.207	.178
Brugge			.709**	.568**
Douai				.497**

\*\* Significant at the 1 per cent level. \* Significant at the 5 per cent level.

Sources : See Table 4.

Still, what remains to be explained is the existence of an integrated urban network crossing the political borders of north-western Europe, in which England did not necessarily hold the most central position. The spatial perspective should be widened, and the role of

<sup>34</sup> Epstein 2001: 54-73.

<sup>35</sup> Galloway 2000: 23.

transaction costs for the growth of the north-western cluster of integration deserves to be studied more closely.

### **Climate, inundation of the Nile, and Cairo grain prices**

The yearly inundation of the Nile is reported by contemporary observers to have been of great importance not only for actual harvests, but also for the formation of short-run price expectations. Near Cairo, the river reached its lowest point in mid-May and its maximum in late September. The minimum as well as the maximum were measured by means of the Nilometer. The critical level was 16 cubits (around 9.3 meters): if the Nile reached that height, people felt confident that the harvest would be good. This level was normally reached in July or August and was publicly proclaimed. Announcement of the rising of the Nile was prohibited until it had reached 16 cubits. In 1462, the sultan even contemplated destroying the Nilometer as a means of counteracting speculation and unrest.<sup>36</sup>

Grain dealers could take advantage of the anxiety among the population when there were signs that the annual flood might be insufficient. Merchants were accused of holding back supplies at these occasions, waiting for prices to rise. Harvest predictions based on the minimum level of the Nile also influenced the price of grain by stimulating actors to release surplus from previous years.<sup>37</sup>

Yet, researchers do not agree upon the impact of inundation on grain prices. Boaz Shoshan argues that inundation in the period 1450-70 cannot explain variations in wheat prices since water levels nearly always exceeded the critical level of 16 cubits. More generally, Shoshan emphasizes the role of monetary factors behind wheat price trends, and strongly plays down all real factors.<sup>38</sup>

Surprisingly, no systematic test has to my knowledge been made of the effects of inundation upon grain prices. Sufficient data to do it are available. Table 7 reports the results of a regression analysis of wheat prices (residuals from a linear time trend in logs) upon the water level. Since low minimum and maximum water levels should have lowered yields (or harvest expectations) and pushed up prices, the expected sign of both coefficients is negative. A temperature estimate for the northern hemisphere is also included as an explanatory variable. As higher temperatures should increase the risk of drought and higher prices, the sign of this coefficient should be positive.

The results in panel (A) of Table 7 indicate that the water level of the Nile indeed affected grain prices in the short term, just as stated by contemporary observers. The effect of the variation in the minimum level is highly statistically significant with regard to all three types of grain. The maximum level appears to be of somewhat less importance and is significant at the 5 per cent level in the case of wheat and beans but not with respect to barley. Temperature variation had an additional effect in the expected direction on prices of all three types of grain. Real factors did influence prices.

The wheat market should be expected to have been more spatially integrated than the market for lower-priced grains such as barley and beans. Trade should have been taking place over wider distances in the wheat market, since its price could bear higher transport costs. Trade thus would reduce the supply variations for wheat to a larger extent than was the case for low price grains. Climate effects should then be larger on the prices of barley and beans than on wheat prices. Is this assumption supported by the data?

Panels (B) and (C) of Table 7 report the results from an identical set of explanatory variables as in panel (A) but with barley and beans, respectively, as dependent variables. The

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<sup>36</sup> Shoshan 1993: 62; Rabie 1981: 60.

<sup>37</sup> Popper 1951: 215.

<sup>38</sup> Shoshan 1983: 57-59.

key result is that the combined explanatory value of the model is better for the cheap grains than for wheat. Climatic variation had stronger repercussions on prices in the barley and beans market than on wheat. This result is in accordance with expectations and supports the hypothesis that the higher relative cost in transporting the cheaper grains limited the extent of their markets. Variation in the Nile minimum level and temperature had a stronger impact on the price of the cheaper grains than on wheat.

Table 7. Results of regression analysis of Cairo grain prices upon the water level of the Nile and temperature, 1264-1512

(A) Dependent variable: wheat

Parameter	<i>B</i>	<i>t</i> -value	Prob. ( <i>t</i> )
Constant	.188	1.627	.107
Minimum level, meters	-.322	-4.052	.000
Maximum level, meters	-.290	-2.166	.033
Temperature, degrees C	.896	2.533	.013

$R^2 = .234$ ; adjusted  $R^2 = .212$ ; DW = 1.63; N = 108

(B) Dependent variable: barley

Parameter	<i>B</i>	<i>t</i> -value	Prob. ( <i>t</i> )
Constant	.258	1.598	.115
Minimum level, meters	-.370	-4.220	.000
Maximum level, meters	-.268	-1.605	.113
Temperature, degrees C	1.179	2.294	.025

$R^2 = .309$ ; adjusted  $R^2 = .277$ ; DW = 1.75; N = 69

(C) Dependent variable: beans

Parameter	<i>B</i>	<i>t</i> -value	Prob. ( <i>t</i> )
Constant	.218	1.441	.154
Minimum level, meters	-.359	-4.163	.000
Maximum level, meters	-.329	-2.033	.046
Temperature, degrees C	.981	2.022	.047

$R^2 = .303$ ; adjusted  $R^2 = .271$ ; DW = 1.83; N = 69

*Sources:* Prices: see Table 1. Nile minimum and maximum levels: Popper 1951: 212-14, Toussoun 1922: 143-145. The chronology of the Toussoun series differs from the Popper series and has been adjusted to the latter. Temperature: Jones et al 1998.

*Note:* Grain prices are residuals from a linear time trend, in logs. Minimum and maximum levels of the Nile are residuals from a linear time trend, in the arithmetic scale. The temperature series is given as deviations in degrees C in the northern hemisphere versus the 1961-70 mean. All variables are measured at lag zero.

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The above discussion dealt with short term price changes only. In the longer term as well, changes in the inundation seem to have affected prices. At least this is the impression from Figure 3, showing the minimum level of the Nile and the price of wheat. The declining price trend from the first decade of the fifteenth century up to the late 1430s corresponds fairly well to the rising trend in the water level of the Nile.

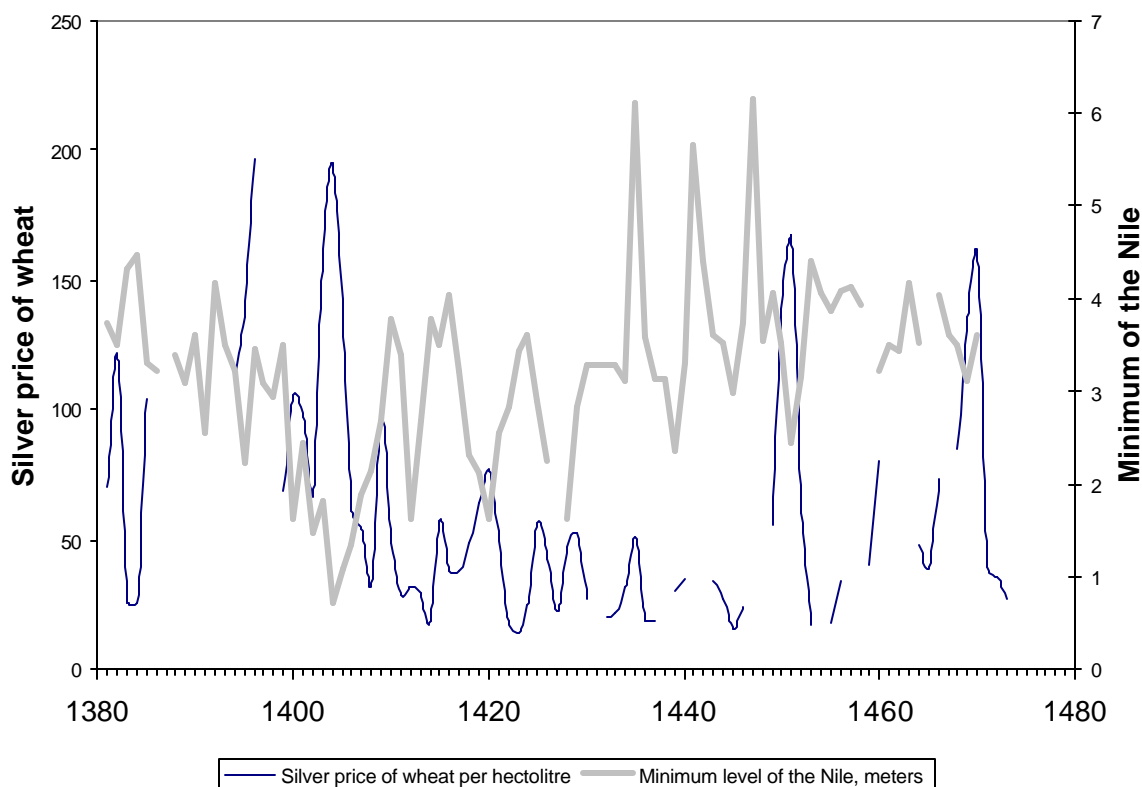


Figure 3. The minimum level of the Nile and the price of wheat at Cairo, 1381-1473  
Sources : Prices: See Table 1. Nile minimum and maximum levels: Popper 1951: 212-14.

To some extent, climatic factors determining the water level of the Nile appear to have had the long-run effect of reducing prices, presumably by influencing yields. With time, the plenitude (level of 16 cubits) of the Nile came earlier, and the river reached higher water levels. Late plenitudes could be harmful. The worst possible situation was the one in which the river did not reach plenitude at all. There were only five years between 1251 and 1522 in which plenitude was not reached. Before the mid-eleventh century, failure of plenitude was much more common (e.g., in 65 years in the period 641-850 and in 36 years between 851 and 1040).<sup>39</sup>

The correlation between calendar year and the date of plenitude (with positive values given to early dates of plenitude) is as strong as .407, and the correlation between time and the maximum level is even stronger (.597). The changing water level and timing in the inundation of the Nile thus appear to have been helpful to agricultural production. A conclusion is that

<sup>39</sup> Popper 1951: 210.

the high volatility of Cairo grain prices should not be attributed to deteriorating climatic conditions.

### **Concluding discussion**

Five main findings emerge from this paper:

1. Grain prices (in silver) were considerably higher in the Near East than in Europe during the Middle Ages. Over time, price levels were declining in large parts of Europe but not in the Near East (with the exception of Mecca, which may be an artefact of the data). In this sense, European consumers, unlike those of the Near East, gained from the long run price trends. The expansion of the Baltic grain trade could be one factor behind the price decline in north-western Europe.

2. Grain prices also were considerably more volatile in the Near East than in Europe. As a consequence, the population of the Near East must have suffered from violent swings in living standards. High volatility in prices should be seen as a welfare problem, since fluctuations in living conditions led to famine and deterioration of public health. The increased frequency of epidemics in fifteenth-century Cairo is well documented. In this sense, many European cities and towns succeeded better than did Cairo.

Over time, volatility was reduced with regard to the cheap grains (barley and beans) at Cairo. No volatility decline is seen, however, elsewhere in the Near East, and not in Europe. Declining volatility in the Cairo prices of barley and beans could conceivably have been of importance to large segments of the population, given that demand shifted from wheat to cheaper foodstuffs during the later Middle Ages.

The water level of the Nile was rising in the long term, and failure of plenitude became a rare phenomenon. Climatic change leading to a higher water level in the Nile should have contributed towards declining price volatility of barley and beans.

3. Price integration was weaker in the Near East than in Europe. In fact, no price integration at all can be demonstrated between Cairo, Syria, and Mecca. This observation is based on a slender statistical material, though. Also, no price integration can be seen between the European Mediterranean region and the Near East.

The Cairo wheat market, however, appears to have been more spatially integrated than the market for barley and beans which had a lower price. This is in accordance with theory and can presumably be explained by the greater role of trade in the wheat market. It may be noted that the transport cost of wheat on the Nile seems to have been low, and is unlikely to have caused the high volatility in prices at Cairo.

4. In north-western Europe, a cluster of urban centres showing similar price movements had emerged in the fourteenth century, at the latest. The degree of price integration reached then did not abate in the century following the Black Death. On the contrary, the economic network appears to have been extended eastwards (though parts of western England were possibly peripheralized). The Mediterranean area was not integrated into this network.

5. Climatic fluctuations (in temperature as well as in the water level of the Nile) did affect Cairo grain prices. High temperatures and low water levels led to rising grain prices. Between 23 per cent (wheat) and 31 per cent (barley) of the variance in prices could be eliminated by reference to climatic and Nile inundation variance. These are not insubstantial figures.

In Europe, on the other hand, temperature variation in the short term did not have an appreciable impact on prices. It seems that western European price integration cannot be explained by the existence of a common climatic factor.

The more prominent role of climatic factors in Egypt compared to Europe should not be surprising. It lends support to the general view that early European economic development was facilitated by abundant natural resources and a robust environment that was not easily

ruined by human activity.<sup>40</sup> In this sense, Europe held a favoured position versus Egypt and other parts of the Near East.

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Ashtor based his view that the Near East started to lag behind Europe during the later Middle Ages primarily on his assessment of technological and industrial development. Those aspects have not been studied here.

It appears, however, that the study of prices carried out here could be well in line with a more general hypothesis that Europe advanced in two respects relative to the Near East during the Middle Ages. Firstly, Europe gained in regional economic integration; secondly, European consumers enjoyed declining wheat prices.

However, the overall picture is not entirely gloomy for the Near East. With time, prices of cheap grains at Cairo become more stable. As welfare for broad layers of the population of Cairo was at a low and probably declining level, things would have been even worse without this reduction in volatility. This is a point where Europe was less successful: price stability did not improve, despite market integration and improvements in transports. Further research is needed to clarify this issue.

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<sup>40</sup> Diamond 1999.

## References

### Internet sources

Robert C. Allen–Richard W. Unger Database: European Commodity Prices 1260-1914,  
[www.history.ubc.ca/unger/htm\\_files/new\\_grain.htm](http://www.history.ubc.ca/unger/htm_files/new_grain.htm)

International Institute of Social History: Prices and Wages  
Tuscany: [www.iisg.nl/hpw/malanima.xls](http://www.iisg.nl/hpw/malanima.xls), author: Paolo Malanima  
Brugge: Prices of the Sint-Donatianskapittel in Brugge, 1348-1800,  
<http://www.iisg.nl/hpw/donat.xls>, author: A.E. Verhulst

### Published references

- Ashtor, E. (1969), *Histoire des prix et des salaires dans l'Orient médiéval*, Paris: S.E.V.P.E.N.
- Ashtor, E. (1971), *Les métaux précieux et la balance des paiements du Proche-Orient à la basse époque*, Paris: S.E.V.P.E.N.
- Ashtor, E. (1977), "Quelques problèmes que soulève l'histoire des prix dans l'Orient médiéval", Myriam Rosen-Ayalon (ed.), *Studies in Memory of Gaston Wiet*, Jerusalem: Institute of Asian and African Studies, The Hebrew University of Israel, pp. 203-234
- Allouche, Adel (1994), *Mamluk Economics: A Study and Translation of al-Maqrizi's Ighathah*, Salt Lake City: University of Utah Press
- Ashtor, E. (1983), *Levant Trade in the Later Middle Ages*, Princeton, N.J.: Princeton University Press
- Bacharach, Jere L. (1973), "The Dinar versus the Ducat", *International Journal of Middle East Studies*, vol. 4, No. 1 (Jan.), pp. 77-96
- Bacharach, Jere L. (1983), "Monetary Movements in Medieval Egypt", J.F. Richards (ed.), *Precious Metals in the Later Medieval and Early Modern Worlds*, Durham, NC: Carolina Academic Press, pp. 159-181
- Braudel, Fernand, and Spooner, Frank (1967), "Prices in Europe from 1450 to 1750", *Cambridge Economic History of Europe, vol. IV: The Economy of Expanding Europe in the Sixteenth and Seventeenth Centuries*, Cambridge: Cambridge University Press, pp. 374-486
- Campbell, Bruce M.S. (1997), "Matching Supply to Demand: Crop Production and Disposal by English Demesnes in the Century of the Black Death", *Journal of Economic History*, vol. 57, No. 4 (Dec.), pp. 827-858
- Chaudhuri, K.N. (1990), *Asia before Europe: Economy and Civilisation of the Indian Ocean from the Rise of Islam to 1750*, Cambridge: Cambridge University Press
- Clark, Gregory (1999), "Markets and Economic Growth: The Grain Market of Medieval England", Department of Economic, University of California, Davis
- Darrag, Ahmad (1961), *L'Égypte sous le règne de Barsbay 825-841/1422-1438*, Damascus
- Diamond, Jared (1999), *Guns, Germs and Steel: The Fates of Human Societies*, New York: Norton
- Epstein, Stephan R. (2000), "Market Structures", William J. Connell & Andrea Zorzi (eds.), *Florentine Tuscany: Structures and Practices of Power*, Cambridge: Cambridge University Press
- Epstein, Stephan R. (2001), *Freedom and Growth: The Rise of States and Markets in Europe, 1300-1750*, London and New York: Routledge
- Farmer, David L. (1988), "Prices and Wages", Joan Thirsk (ed.), *The Agrarian History of England and Wales II. 1042-1350*, Cambridge: Cambridge University Press
- Galloway, James A. (2000), "One Market or Many? London and the Grain Trade of England", James A. Galloway (ed.), *Trade, Urban Hinterlands and Market Integration c. 1300-1600*, Centre for Metropolitan History, Working Paper Series No. 3, London
- Hammel-Kiesow, Rolf (2002), "Lübeck and the Baltic Trade in Bulk Goods for the North Sea Region 1150-1400", Lars Berggren et al (eds.), *Cogs, Cargoes, and Commerce: Maritime Bulk Trade in Northern Europe 1150-1400*, Toronto: Pontifical Institute of Medieval Studies
- Harrison, D.F. (1992), "Bridges and Economic Development, 1300-1800", *Economic History Review*, New Series, vol. 45, No. 2 (May), pp. 240-261
- Hinz, Walther (1955), "Lebensmittelpreise in mittelalterlichen Vorderen Orient", *Die Welt des Orients*, vol. 2, pp. 52-70

- Hybel, Nils (2002), "The Foreign Grain Trade in England, 1250-1350", Lars Berggren et al (eds.), *Cogs, Cargoes, and Commerce: Maritime Bulk Trade in Northern Europe 1150-1400*, Toronto: Pontifical Institute of Medieval Studies
- Jones, P.D., K.R. Briffa, T.P. Barnett, and S.B. Tett (1998), "High-resolution Palaeoclimatic Records for the last Millennium: Interpretation, Integration and Comparison with General Circulation Model Control-run Temperatures", *The Holocene* 8, pp. 455-471. Data source: P.D. Jones, K.R. Briffa, T.P. Barnett, and S.F.B Tett, 1998, Millennial Temperature Reconstructions. IGBP PAGES/World Data Center-A for Paleoclimatology, Data Contribution Series #1998-039, NOAA/NGDC Paleoclimatology Program, Boulder CO, USA. Downloadable data: [ftp://ftp.ngdc.noaa.gov/paleo/contributions\\_by\\_author/jones1998](ftp://ftp.ngdc.noaa.gov/paleo/contributions_by_author/jones1998)
- Lopez, Robert, Miskimin, Harry, Udovitch, Abraham (1970), "England to Egypt, 1350-1500: Long-term Trends and Long-distance Trade", *Studies in the Economic History of the Middle East from the Rise of Islam to the Present Day*, ed. M.A. Cook, London: Oxford University Press
- Masschaele, James (1993), "Transport Costs in Medieval England", *Economic History Review*, New Series, vol. 46, No. 2 (May), pp. 266-279
- Mortel, Richard T. (1989), "Prices in Mecca during the Mamluk Period", *Journal of the Economic and Social History of the Orient*, vol. 32, pp. 279-334.
- Persson, Karl Gunnar (1999), *Grain Markets in Europe, 1500-1900*, Cambridge: Cambridge University Press
- Popper, William (1951), *The Cairo Nilometer: Studies in Ibn Taghrî Birdî's Chronicles of Egypt, I*, Berkeley and Los Angeles: University of California Press
- Popper, William (1957), *Egypt and Syria under the Circassian sultans 1382-1468 A.D.: systematic notes to Ibn Taghrî Birdî's Chronicles of Egypt*. P. [2], Berkeley and Los Angeles: University of California Press 1957
- Rabie, Hassanein (1981), "Some Technical Aspects of Agriculture in Medieval Egypt", A.L. Udovitch (ed.), *The Islamic Middle East, 700-1900: Studies in Economic and Social History*, Princeton, NJ: Darwin Press
- Sabra, Adam (2000), *Poverty and Charity in Medieval Islam: Mamluk Egypt, 1250-1517*, Cambridge: Cambridge University Press
- Shoshan, Boaz (1980), "Grain Riots and the "Moral Economy": Cairo, 1350-1517", *Journal of Interdisciplinary History*, vol. 10, No. 3 (Winter), pp. 459-478
- Shoshan, Boaz (1983), "Money Supply and Grain Prices in Fifteenth-century Egypt", *Economic History Review* 2nd ser., vol. 36, No. 1 (Feb.), pp. 47-67
- Shoshan, Boaz (1986), "Exchange-rate Policies in Fifteenth-century Egypt", *Journal of the Economic and Social History of the Orient*, vol. 29, pp. 28-51
- Shoshan, Boaz (1993), *Popular Culture in Medieval Cairo*, Cambridge: Cambridge University Press
- Spufford, Peter (1986), *Handbook of Medieval Exchange*, London: Office of the Royal Historical Society
- Spufford, Peter (2002), *Power and Profit: The Merchant in Medieval Europe*, London: Thames & Hudson
- Toussoun, Omar (1922), "Aboul Mahasin (année 874 Hégire = 1470 ère chrétienne)", *Mémoires présentés à l'Institut d'Égypte*, vol. 4, pp. 135-145