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Adam Smith and Amartya Sen:
Markets and Famines in Pre-Industrial Europe

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ADAM SMITH AND AMARTYA SEN:

MARKETS AND FAMINES IN PRE-INDUSTRIAL EUROPE

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ABSTRACT

How markets perform during famines has long been a contentious issue. Recent research tends to associate famine with market segmentation and hoarding. The evidence of this paper, based on an analysis of the spatial and temporal patterns of price movements during four famines in pre-industrial Europe, is that markets functioned ‘normally’ in times of crisis.

ADAM SMITH AND AMARTYA SEN:
MARKETS AND FAMINES IN PRE-INDUSTRIAL EUROPE[1]

[1] INTRODUCTION:

How markets influence famines is a contentious issue. One tradition dating back beyond Adam Smith to the French enlightenment holds that free markets minimize the damage done by harvest failure. Another argues that, on the contrary, well functioning markets may exacerbate famines, by removing food from where there is insufficient purchasing power to richer, less affected areas. A third holds that markets may not function well during famines, for a variety of reasons. Grain producers might tend to underestimate their prospects and hold back supplies, resulting in intertemporal misallocation. In that case false hopes of yet higher prices may generate 'bubbles' in markets for staple foodstuffs. Or the problem could be spatial, as when local or regional markets might become balkanized because bad weather disrupts communications, or because 'moral economy' forces -- sanctioned, perhaps, by policy measures -- intervene to prevent food shipments dictated by market forces. Famine conditions producing 'noisy' information about fundamentals could have the same effect. Or, finally, the absence of competitive markets in normal times might lead to profiteering by powerful middlemen such as flour millers and moneylenders during famines (Drèze and Sen 1989: 22; 90-1; 143-4; 155; Persson 1999: 41-2).

In *The Wealth of Nations* Adam Smith made the classic case for free trade in foodstuffs during what he called 'dearths'. All 'dearths' or supply shortfalls in Europe for the previous two centuries or more, he asserted, had been due to poor harvests, and not to collusion between grain merchants, though sometimes such shortages were exacerbated by warfare. Smith also distinguished between 'dearths' and 'famines', claiming that all European 'famines' in the same period had been due to 'the violence of government attempting, by improper means, to remedy the inconveniences of a dearth'. He believed that grain merchants minimized such inconveniences by ensuring both intertemporal and interregional arbitrage (Smith 1976: 526-34). The merchants' optimal selling strategy would be to even out consumption over the harvest year[2]; those who hoarded supplies too long would be forced to sell at a loss. The smooth functioning of markets during famines also minimizes deviations from an equilibrium price vector. Thus by reallocating grain from areas in relative surplus to those in relative deficit, the market mechanism is likely to produce a net reduction in the damage done by any harvest failure (Drèze and Sen 1989: 91).[3]

Smith's preoccupation was with the influence of markets in the event of a harvest shortfall. That influence hinges on the degree of market integration in normal times. But in backward, famine-prone economies facing high transport costs and (perhaps) cumbersome controls on interregional trade, the scope for trade in non-famine years may be limited. This is a reminder of another way in which markets can reduce the probability and gravity of famines: market integration, by ensuring that different regions pursue their comparative advantage, increases steady-state aggregate output and incomes, thereby reducing the damage done by any given proportionate harvest shortfall. This mechanism is emphasised in the work of French enlightenment writers (see Persson 1999), but Smith's concern -- as in the historiography of markets and famines generally -- was with the impact of famines on the normal functioning of markets. Smith's claims were ably re-articulated by Thomas Malthus (1800: 12-14) and by Irish economist Mountifort Longfield (1834: 52-58). However, the ability of merchants and markets to gauge supply correctly in such circumstances has been questioned by others, then and since (Young 1793: vol. 2, 401; Rashid 1980: 497).[4]

The verdict of empirical analyses on market response during famines is mixed. The official inquiry into the Great Bengali Famine of 1942-3 argued that the rise in food prices was 'more than the natural result of the shortage of supply that had occurred'. Sen's research on the same famine pointed the finger at farmers and grain merchants for converting a 'moderate short-fall in *production*... into an exceptional short-fall in *market release*' (emphases in original). The famine was due in large part to 'speculative withdrawal and panic purchase of rice stocks... encouraged by administrative chaos’. Ravallion’s study of the 1974 Bangladesh famine also blamed market failure, concluding that excess mortality was, ’in no small measure, the effect of a speculative crisis’. Rice prices rose dramatically because merchants badly underestimated a harvest which turned out to be normal. Prices then fell back just as fast. Ravallion also found evidence of ’significant impediments’ to trade between the capital city, Dhaka, and its main sources of supply during this famine (Bhatia 1967: 323-4; Sen 1981: 76; Ravallion 1987: 19, 111-3; 1997: 1219-21; Becker and Quddus 2000). Famines in Sudan and Ethiopia in the mid-1980s are also deemed to have been exacerbated by weak spatial integration of markets. Price explosions, price controls, and market disruptions were ’commonplace’, resulting in sharply rising marketing costs and making price trends in sub-regions often dependent on conditions in those same sub-regions alone (von Braun, Teklu, and Webb 1999: ch. 6). However, formal studies of how markets worked during pre-twentieth century famines are scarce.

[2] FOUR EUROPEAN FAMINES:

All four famines considered in this paper exacted large death tolls. All were regionally uneven, and the proximate cause in all cases was weather- or fungus-induced crop failure. In all four cases the resultant output loss was considerable, and was reflected in sharp increases in food prices. The first two famines occurred in France toward the end of Louis XIV’s reign. France was then a formidable military power, but its farming system struggled to feed its huge, mainly rural, population of twenty two million. Agricultural output per worker in late seventeenth-century France was less than it had been two centuries earlier, and less than two-thirds of the levels attained in the Low Countries or in England c. 1700 (Allen 2000). Both famines were exacerbated by military campaigns on France’s borders and further afield. In the first, excess mortality mounted in the fall of 1693 and would remain high for much of 1694. The estimated death toll of about 1.3 million people represented six per cent of the population. The ’big winter’ of 1708-9 led to the second famine considered here. It struck at a time of grave economic crisis and ongoing warfare between France and most of its neighbours. Mortality began to mount in mid-1709 and would reach 0.6 million before the end of 1710(Lachiver 1991: 361, 381-2).

The Great Finnish Famine of 1868, Europe’s last major peace-time subsistence crisis, killed over 0.1 million in a total population of 1.8 million. The historical context is severe harvest failure in the wake of several years of hardship in a poor and largely agrarian economy. Heavily forested and dotted with large lakes, and with only about one-twelfth of its land mass under cultivation, Finland was sparsely populated. Internal communications, though improving, were poor, particularly in bad weather. There was an increasing trade in grain between Saint Petersburg, Tallinn, and Riga and coastal Finland, but away from coastal areas the long-distance carriage of grain was on a small scale. On the eve of the famine rye, the staple food of the poor, accounted for well over one-half of grain production. The average yield ratio was only four or five to one. In 1868 mortality was highest in the central provinces of Vaasa and Kuopio and in the remote northern province of Oulu.[5]

Finally, the Great Irish Famine (1846-52) was not just a watershed in Irish history but also a major event in world history, with far-reaching and enduring economic and political consequences. It resulted in the deaths of about one million people (Mokyr 1985). Whereas poor grain crops were the proximate causes of the other famines, in Ireland the culprit was the potato. The potato, in which Ireland had a comparative advantage due to its damp climate, produced twice as much food per acre as grain, but its low yield ratio and its perishability were decided disadvantages (Bourke 1993; Rosen 1999). In 1845, *phytophthera infestans*, a plant disease new to Europe, destroyed about one-third of the potato crop, and in the following year destroyed most of it.[6] After a season's remission it also ruined the harvest of 1848. Excess mortality would persist for two or three years more in some regions. The Irish famine thus lasted longer than the other three and, relatively speaking, was the most devastating.

[3] AN ERROR-CORRECTION APPROACH:

The Law of One Price stipulates that prices will often deviate from their equilibrium values, but properly functioning markets will arbitrage away significant deviations from equilibrium prices. Did markets in France in the 1690s, in Ireland in the 1840s, or in Finland in the 1860s work as posited by LOP? Here I use an error correction model (ECM) approach to test whether the reaction to emerging disequilibria was slower during a crisis than in normal times. I estimate the following simple and familiar representation of the error-correction model:[7]

$$P_{i,t} = a + b\ P_{A,\ t} + cFAM1 + dP_{i,\ t-1} + eP_{A,t-1} + fFAM2 + gFAM3 + u'_{it}$$

where
$$FAM1 = FAMDUM.\ P_{A,\ t}$$
$$FAM2 = FAMDUM.P_{i,\ t-1}$$
$$FAM3 = FAMDUM.P_{A,t-1}$$

Here P is the log of price, A is Region A, and i is any other region. Writing the model in this way offers the intuitive interpretation that agents adjust to $P_{i,t}$ from $P_{i,t-1}$ in response to changes in P_A (with b measuring the short-run effect). Moreover, the model posits the long-run relation $P_i = (e/d)P_A$. Changes in P_i are caused by shocks to P_A, and the extent to which the system is out of equilibrium is represented by the lagged error correction term. Since P_A is expected to adjust upwards if P_i is higher in the previous period, we expect $d<0$. The ratio (e/d) measures the equilibrium ratio between P_i and P_A; in the absence of transport and other transaction costs $d=e$.

The impact of the periods of severest harvest failure and famine -- 1693-4 and July 1708 to June 1710 -- on the adjustment process is captured by the coefficients on the interaction terms *FAM1*, *FAM2*, and *FAM3*. $c>0$ would mean that markets were better synchronized during the crisis, while $f>0$ and $g<0$ would imply slower adjustment than in normal times.

The towns and cities included in the analysis of France are Paris, Toulouse, Angoulême, Grenade-sur-Garonne, Pontoise, Rozay-en-Brie, Albi, and Montbatzon. Four of these places were significant towns at time: Paris (with a population of about 0.5 million), Toulouse (40,000), Angoulême (10,000), and Albi (10,000). There would have been little or no trade in grain between Toulouse and Paris in this period. Similarly for Toulouse and Angoulême, though they were linked by navigable river and coastwise via the major port city of Bordeaux. Three of the other pairs -- Paris-Pontoise, Paris-Rozay, and Toulouse-Grenade -- refer to markets within short distances of each other. Pontoise, a town of a few thousand people, was one of the main grain markets in the Paris basin, while Grenade was only a short distance down-river from Toulouse. Rozay-en-Brie, in the heart of one of France's main grain-producing regions, also supplied the Paris market. Montbatzon was a small market town near Tours. The choice of towns was constrained by the need for monthly wheat price data.[8]

The model yields the results described in Table 1. They confirm textbook priors about these markets in normal years. First, the *b*'s are all positive, ranging from 0.204 for Montbatzon-Paris in 1680-1699 to 0.843 for Grenade-Toulouse in 1700-1712, and the *d*'s are all negative, ranging from -0.043 for Angoulême-Toulouse in 1680-1719 to -0.649 for Grenade-Toulouse in 1680-1699. Moreover, the spread of coefficient values is consistent with distance and communications. The closer the markets to each other the stronger the co-movements and the bigger the adjustments to disequilibria. Moreover, the values of *d/e*, representing the equilibrium price ratios between P_A and P_i, are broadly plausible: prices were highest in the receiving areas. Thirdly, the *c*'s are mostly positive and in some cases emphatically so, and none of the negative *c*'s is statistically significant. Evidence of stronger co-movements during the famine months may reflect the power of the famine 'signal' relative to the background noise. Eleven of the fourteen *f*'s in Table 1 are negative, indicating faster adjustment in crisis months. The values are weakly determined for the most part, however (as are the *g*'s), which suggests that responses varied little between normal and crisis years. Finally, dividing the forty-year period into two suggests that the reaction of wheat prices in 1709-10 was stronger than in 1693-4.

Table 2 reports the results of estimating the adjustments to price movements in Paris between 1680 and 1698 as a system of seemingly unrelated regressions (SURE). The standard Breusch-Pagan test emphatically rejects independence ($^{2}(15) = 217.7$), but the outcome is basically as in Table 1 except that the coefficients are nearly always better determined. In sum, these French data imply markets that were better integrated than indicated by the historiography, and fail to support the hypothesis that markets for grain performed 'worse' during the two famines than in normal times.

[TABLES 1-3 ABOUT HERE]

Our Finnish data refer to rye, then by far the most important of Finland's grain crops, from October 1858 to December 1873. In Table 3 describes the in seven of Finland's eight provinces to price movements in the province Viipuri, using both single equation and SURE estimation. Viipuri was chosen as a likely market leader because it was coastal and located next to Russian markets, and therefore most likely to be the channels for outside market influences. Again separate estimation and SURE yield similar outcomes, though the Breusch-Pagan test rejects independence even more emphatically ($^{2}(21) = 613.3$) than in the French case, and estimation is consequently more efficient. As in France nearly two centuries earlier, prices were more synchronized during the famine than in other periods. The case for slower response during the famine is rejected by the generally small and weakly determined values of *f* and *g*.[9]

Finally, though the Irish famine was due to the failure of the potato, the behaviour of grain markets is nevertheless of interest. Indian meal (or maize) and oatmeal were the closest substitutes for the potato. Contemporary critics accused grain merchants of taking undue advantage of the situation and of making enormous profits through over-charging. Data on grain and oatmeal prices in Ireland are plentiful. Estimating a variant of the ECM described above with weekly oats prices between early June 1846 and the end of 1847 suggested strong co-movements and quick adjustment to disequilibria. Comparing the cities of Cork and Dublin, for example, implied that over half the response to a change in the Dublin price occurred within two weeks. Comparing movements in the price of oats in Dublin and Cork with those in London over a longer period also implied the rapid erosion of disequilibrium gaps (Ó Gráda 1999: 141-3).

Considering the evidence of this section as a whole, the outcome is broadly supportive of well-integrated markets both in normal and famine times. Co-movements between pairs of markets continued to be strong in crisis years, and in general the speed of adjustment was as fast.

[4] A SPATIAL PERSPECTIVE:

The Law of One Price states that in a well-integrated market persistent price differences between regions stem largely from transport costs. Let T be a vector of the (constant) costs of shipping grain from a region to the most expensive region, and P_N and P_F be vectors of normal and famine grain prices, respectively. Then the Law of One Price implies that in equilibrium the standard deviation of prices across regions, , will reflect T. Normally P_F will exceed P_N: this was certainly so in all cases considered here. Thus, unless T changes, with well-functioning markets arbitrage will produce (P_F) (P_N). Alternatively, the coefficient of variation in prices (*CV*) should fall during famines (for a simple example see Ó Gráda 1997). Note, however, that the bad weather sometimes associated with famine conditions might increase T, as would the disruption of trade by legislation or 'moral economy' forces.

The contrasting outcomes in the maize markets of Botswana and Kenya in years of crisis in the early 1980s (see Drèze and Sen 1989: 144, 155) are of interest here. In Botswana, where the average price of maize meal rose from 3.53 to 4.74 pula per bag between August 1980 and April 1983, the coefficient of variation across eighteen markets fell from 0.07 to 0.05. In Kenya, however, where the average retail price of maize rose from 2.42 to 4.61 Kenyan shillings per kilo between January and November 1984, the coefficient of variation across eighteen markets trebled from 0.15 to 0.45.

Regional price data are available for all four famines described here. First I use annual data on a broad cross-section of French towns and cities[10] for insight into whether grain markets became more or less segmented during the famines of 1693-4 and 1709-10. Note first that even in normal times the coefficients of variation were very high.[11] A disruption of normal patterns in times of crisis is suggested by the impact on the correlation between wheat prices in the forty towns in year *t* and year *t+1*. Over the period 1671-1750 the average year-to-year correlation was +0.797, with a standard deviation of 0.152. However, the correlation plummeted from +0.770 in 1692-3 to +0.322 in 1693-4 and +0.392 in 1694-5 before recovering to +0.722 in 1695-6. Again it dropped from +0.950 in 1706-7 to +0.271 and +0.233 in the following two years, rising to +0.599 again in 1709-10.

The coefficients of variation of wheat prices rose both in 1694 and 1695, and in 1709 and 1710 (and also in the wake of another serious harvest failure in 1740). While some of the rises in 1709 and 1740 might be attributed to the impact of bad weather on shipping costs, those in other years cannot be so readily accounted for. Note that the implied disruption of markets was somewhat greater during the famine of 1709-10 than in 1693-4, and proportionately greatest in 1740.

[FIGURE 1 ABOUT HERE]

I turn next to potato prices in Ireland in the 1840s. Most potatoes grown in Ireland before the famine were for domestic or local consumption. One of the potato's disadvantages is that it was relatively costly to transport; Hoffman and Mokyr (1984) reckon that one-fourth of the potato's value 'evaporated' with every ten miles it travelled. Nevertheless, there was an active local trade in potatoes in Ireland before the famine, and most towns had their potato markets.

[TABLE 4 ABOUT HERE]

Table 4 reports evidence from two sets of regional prices. Panel A summarises data contained in a parliamentary report on potato prices in almost four hundred Irish towns between 1840 and 1846. The numbers are not ideal for our purpose, because they extend only as far as the harvest of 1845, the first to be affected by blight. Moreover because they refer to the highest prices paid, they may well reflect a range of qualities and varieties across the country. In mitigation they refer to the prices paid in a single week in January, so they have the advantage of controlling for seasonal variation. In general, the observed interregional price gaps are smaller than what transport costs would indicate. This suggests that trade in potato substitutes such as grain helped to arbitrage away disequilibrium differences.

Panel B refers to a different, smaller sample of towns. It includes 1848, when the ravages of blight were particularly severe. The standard deviations in the two panels are not strictly comparable. Note, however, that while was higher in 1846 than in any of the preceding years, in 1848 it was lower than in the years immediately following. Though the outcome contains no strong message for how the market (or markets) for potatoes worked during the famine, it seems more consistent with orderly than segmented markets in the wake of the blight.[12]

Two features of the Finnish data in Table 5 are apparent: the very low coefficients of variation throughout, and the rise in the standard deviation in the famine yeras of 1867-8. In Finland both before and after the famine of 1867-8 grain prices were normally highest in the northern provinces of Oulu and Kuopio, with the mean price of rye in Oulu being on average 10-15 per cent higher than that in Vaasa or Häme. However, during the famine years the proportionate price rises were greatest in the southwest, with the result that levels in Uusimaa, Turku and Häme provinces were exceeded only by those in Oulu. The severe harvest shortfalls in the southwest in 1867-8 (Kaukiainen 1984) may account for the increases, and the poverty of Kuopio and Oulu for the failure of prices in those provinces to rise in tandem. Put another way, in Kuopio and Oulu an 'entitlements' failure may have compounded the problem caused by poor harvests. However, the widening gap between prices in the southwest and in Viipuri (Viborg) in 1867-8 leaves unresolved the question why more grain did not flow west from Viipuri during the famine.

[TABLE 5 ABOUT HERE]

The 1870-3 data in Table 5 show the earlier pattern re-establishing itself again in the wake of the famine. This suggests that in normal times small interprovincial movements in grain seem to have been enough to maintain the pattern observed before and after 1867-8. At the height of the crisis, however, we can only speculate that interprovincial trade or imports from outside Finland were insufficient to maintain the kind of equilibrium price vector assumed in our model. Indeed some interprovincial flows may have been reversed. The lack of data on internal trade and the cost of transport preclude firm conclusions on this score.[13]

In sum there is evidence from these famines of rises in the regional variation in prices at the height of the crisis than in immediately preceding or succeeding years. The rises were modest, however: the fivefold rise in the standard deviation of prices across Kenya during 1984 offers some perspective.

[5] SEASONALITY AND STORAGE:

Adam Smith believed that corn merchants were best placed 'to divide the inconveniencies of [a scarcity] as equally as possible through all the different months, and weeks, and days of the year' (Smith, 1976: 533-4). The findings of Sen (1981) and Ravallion (1987) suggest that, on the contrary, speculative hoarding can exacerbate famine situations. Hard historical evidence on storage is scarce: records of the Chartier farm, a large-scale family-run enterprise at Choisy near Paris (Moriceau and Postel-Vinay 1992: 225-226), offer one useful illustration. In normal years such a farm would be expected to combine with grain merchants to produce something akin to consumption smoothing over the season. In the case at hand this meant small off-farm disposals between July and November. Figure 2 compares monthly off-farm corn sales in normal harvest-years and in 1693-4, and shows the Chartiers disposing of *more* of their corn in the early months of the famine harvest-year than in normal seasons. This is hardly consistent with hoarding. Alas, one Chartier swallow does not make a summer, and farm records as rich as theirs are the exception.

Here I build on an insight associated with McCloskey and Nash (1984) but traceable back to Samuelson (1957) in order to shed further light on the role of hoarding during the famines analysed here. McCloskey and Nash sought to infer storage costs and interest rates in medieval and early modern Europe from the seasonality patterns observed in grain prices. Their argument followed from the simple premise that those merchants and farmers who store grain must in equilibrium be rewarded for the opportunity cost of tied-up funds and losses from wastage during the storage period. A saw-tooth price seasonality pattern is indicated, with low prices in the wake of the harvest giving way gradually to a maximum before the new harvest comes in. The more important are fixed costs such as storage facilities and security, the less sensitive seasonal increases be to the quality of the harvest. Abstracting from other complications, this means that in a well-functioning market seasonality would at most produce the same proportionate increases in prices in bad years as in good. Then lower-than-normal seasonal price rises during the crisis might indicate that producers were holding on to stocks in hopes of much higher prices at the end of the season. If, on the other hand, the seasonal price rise was faster than usual, this could reflect either the desperation of consumers or the fears of producers that their food stocks might deteriorate (see below) or be requisitioned. Hoarding during famines, in other words, implies smaller increases than usual from seasonal trough to peak.

In reality this presumption is complicated by the presence of carry-over stocks of grain from one harvest to the next, and in practice there is considerable variation or

’noise’ in the month-to-month and seasonal movements (see e.g. Persson 1999). In Table 6 I compare the average rises in wheat prices between September in year *t* (at the beginning of the harvest year) and June in year *t+1* (before prices are affected by the next harvest) in eight French towns between the 1680s and the 1710s. The outcome shows only weak traces of the seasonality pattern noted by McCloskey and Nash. On average prices rose a little over the season, but they were subject to huge year-to-year variation. However, in the famine years of 1693-4 and 1708-9 the rises greatly exceeded the average, in 1708-9 soaring two or more standard deviations above it. The particularly sharp seasonal price rises during our two famines do not support the view that farmers or others hoarded early in the season in hopes that price would rise later.

Table 7 compares the average rises in rye and barley prices in Finland between September in year *t* and June in year *t+1* in ’normal’ years (1859-66 and 1869-73) and in the famine year of 1867-8 in rural districts in the provinces of Oulu, Uusimaa, Vaasa, Kuopio, and Mikkeli. The outcome shows the seasonality pattern noted by McCloskey and Nash. In the average ’normal’ year both rye and barley prices were about ten per cent higher in June than in the previous September, but the rise was subject to considerable year-to-year variation. Nevertheless, the rises during the famine year of 1867-8 were exceptional: double to treble the average, and double to four times the standard deviation of price rises in other, non-famine years. These sharp increases do not rule out the possibility that farmers or others hoarded early in the season in hopes that price would rise later, but surely they make it less likely.

Potatoes seem an ideal crop for this kind of simple framework, since there was no carry-over from one year to the next. Indeed, before the Irish Famine the prices of different potato varieties before the crisis were subject to marked seasonality. Moreover, the seasonal rise in prices was *greater* during the crisis than in normal times. While this does not rule out speculation or hoarding on the part of potato suppliers, it certainly argues in that direction. In these data actions speak louder than intentions, but it seems clear that some traders sold quickly for fear that their supplies would not keep (Ó Gráda 1993: 116-21; 2000).[14]

[6] CONCLUSION:

We began our discussion with Adam Smith's assertion that in the two centuries prior to 1776 no famine had arisen '[in] any part of Europe... but for the violence of government attempting, by improper means, to remedy the inconveniences of a dearth' (Smith 1976: 526). The French famines of 1693-4 and 1709-10 represented two more cases where, as in Ireland in the 1840s and Finland in the 1860s, the catastrophic nature of harvest failures overwhelmed functioning markets. If the state was to blame, it was for inadequate entitlement transfers from rich to poor, not for undue meddling with food markets. It is curious how Smith, for all his allegedly wide reading, ignored the major French famines of 1693-4 and 1709-10, though he noted (1976: 526) that he had 'pretty exact accounts' of several dearths and famines. Whether a better understanding of the history of European famines would have caused him to modify his position must remain a moot point.

During these famines, markets worked more smoothly than might have been expected on the basis of a reading of qualitative and fictional accounts. Though a spatial perspective on grain prices produced some evidence of slightly greater segmentation of markets during the famine, an error correction approach to regional price movements showed that in all cases the short-run effect captured by the co-movement of grain prices was more powerful during the famine than in other times. It also yielded evidence in most cases of a quicker-than-normal response to emerging disequilibria. Moreover, the data failed to support the claim that hoarding was more common during the famine than in normal years.

Taken together, our results do not rule out a further role for markets in exacerbating these crises: a fall in purchasing power in the worst-affected regions could have aggravated one or more of them because markets were so well integrated. That is an issue worth exploring further. Nor have we addressed the issue why market responses in pre-industrial

Europe differed so much to those found in southern Asia or in Africa in the twentieth century. Still, it would seem that a backward agriculture, coupled with the lack of an adequate policy response from the authorities, rather than the failure of the markets for staple foodstuffs to work, were mainly responsible for the famines analysed here.

TABLE 1: PAIRWISE ERROR CORRECTION MODEL ESTIMATES

Coefficients	*Ang-Toul*	*Gren-Toul*	*Batz-Toul*	*Pont-Paris*	*Batz-Paris*
a	0.024	-0.136**	0.017	-0.065	0.004
b	0.281**	0.829**	0.251**	0.545**	0.204**
c	0.031	-0.005	0.282**	0.096	0.288**
d	-0.043**	-0.576**	-0.109**	-0.190**	-0.227**
e	0.028	0.622**	0.094**	0.211**	0.179**
f	-0.141**	-0.227	-0.114	-0.388**	-0.060
g	0.151**	0.232	0.132**	0.386**	0.053
N	396	396	396	226	226
F	13.04	119.36	15.81	26.77	9.26

Coefficients	*Ang-Toul*	*Ang-Toul*	*Gren-Toul*	*Gren-Toul*	*Alb-Toul*
a	-0.001	-0.040	-0.140	-0.201**	0.002
b	0.232**	0.377**	0.839**	0.843**	0.402**
c	-0.420	0.123	-0.110	0.157	-0.082
d	-0.037*	-0.123**	-0.649**	-0.553**	-0.274**
e	0.039	0.130**	0.694**	0.628**	0.283**
f	-0.043**	-0.202**	-0.255	0.224	0.023
g	0.044**	0.212**	0.263	-0.221	-0.008
N	240	156	240	156	197
F	3.56	119.36	74.12	48.06	8.38

Coefficients	*Batz-Toul*	*Batz-Toul*	*Batz-Ang*	*Batz-Ang*
a	0.051	-0.165**	0.129**	-0.062
b	0.232**	0.304**	0.226**	0.405**
c	0.392**	0.124	-0.113	0.066
d	-0.115**	-0.189**	-0.226**	-0.188**
e	0.087**	0.243**	0.141**	0.207**
f	-0.260	-0.086	0.118	-0.339**
g	0.278	0.100	-0.086	0.352**
N	240	156	240	156
F	7.36	11.87	7.33	16.36

Key: Ang=Angoulême; Batz=Montbatzon; Par=Paris; Pont=Pontoise; Gren=Grenade; Toul=Toulouse; Alb=Albi

(**) significant at 1% level; (*) significant at 5% level

N=240 (1680-1699); N=226 (1680-1699); N=356 (1680-1712); N=156(1700-1712); N=197 (1696-1712)

TABLE 2 COMPARING *SURE* AND SEPARATE ESTIMATION RESULTS: FRANCE(1680-1698)

	SURE Estimation (ML)		Separate Estimation (OLS)	
	Coef.	z	Coef.	t
Angoulême				
a	-0.076	-1.65	0.062	-1.32
b	0.129	1.82	0.120	1.65
c	-0.067	-0.61	-0.058	-0.52
d	-0.091	-3.89	-0.072	-2.90
e	0.114	3.34	0.091	2.55
f	0.060	0.84	0.033	0.43
g	-0.061	-1.02	-0.036	-0.57
Grenade				
a	0.017	0.35	-0.006	-0.12
b	0.055	0.68	0.039	0.49
c	0.464	3.68	0.477	3.78
d	-0.134	-5.49	-0.072	-2.74
e	0.099	3.69	0.061	2.21
f	-0.250	-2.33	-0.200	-1.66
g	0.200	2.35	0.158	1.66
Toulouse				
a	0.069	1.37	0.033	0.64
b	0.036	0.44	0.019	0.23
c	0.436	3.35	0.422	3.20
d	-0.130	-5.05	-0.075	-2.71
e	0.078	2.93	0.049	1.81
f	-0.232	-2.06	-0.159	-1.25
g	0.188	2.08	0.127	1.24
Montbatzon				
a	0.004	0.09	0.004	0.08
b	0.203	2.49	0.204	2.47
c	0.306	2.33	0.288	2.15
d	-0.218	-5.56	-0.227	-5.43
e	0.171	4.59	0.179	4.57
f	-0.158	-0.93	-0.060	-0.33
g	0.132	0.96	0.053	0.37
Pontoise				
a	-0.067	-1.57	-0.065	-1.51
b	0.554	7.64	0.546	7.39
c	0.091	0.81	0.096	0.84
d	-0.210	-4.87	-0.190	-4.06
e	0.231	4.93	0.211	4.20
f	-0.342	-2.82	-0.388	-3.00
g	0.341	2.83	0.386	3.01

TABLE 2 continued

Rozay				
a	-0.093	-2.16	-0.122	-2.73
b	0.466	8.06	0.491	8.28
c	-0.503	-0.59	-0.072	-0.83
d	-0.130	-2.75	-0.178	-3.48
e	0.157	2.75	0.211	3.47
f	-0.301	-4.01	-0.263	-3.30
g	0.290	4.05	0.254	3.34

Correlation matrix of residuals in SURE estimation:

	dgren	*dbatz*	*dtoul*	*dpont*	*dang*	*droz*
dgren	1.0000					
dbatz	0.2544	1.0000				
dtoul	0.6939	0.2315	1.0000			
dpont	0.0639	0.1631	0.1038	1.0000		
dang	0.2698	0.1598	0.2761	0.0933	1.0000	
droz	0.0745	0.1571	0.0638	0.3163	0.0198	1.0000

Breusch-Pagan test of independence: chi2(15) = 217.732, Pr = 0.0000

TABLE 3: ECM ESTIMATES FOR FINNISH PROVINCES (1858-1873)

	SURE Estimation (ML) Coef.	z	Separate Estimation (OLS) Coef.	t
Oulu				
a	-0.394	-3.07	0.302	-2.20
b	0.423	4.07	0.409	3.86
c	0.667	2.93	0.654	2.83
d	-0.005	-3.78	-0.004	-2.62
e	0.168	3.51	0.130	2.49
f	-0.004	-2.40	-0.004	-1.67
g	0.043	2.37	0.034	1.64
Vaasa				
a	0.019	0.26	0.014	-0.19
b	0.318	4.35	0.315	4.27
c	0.420	2.55	0.345	2.05
d	-0.106	-5.11	-0.070	-2.74
e	0.101	3.26	0.075	2.15
f	0.089	1.22	0.207	2.24
g	-0.092	-1.23	-0.214	2.26
Mikkeli				
a	-0.804	-4.46	-0.886	-4.52
b	0.447	4.21	0.455	4.19
c	0.630	2.65	0.619	2.54
d	-0.009	-5.08	-0.010	-5.05
e	0.325	4.75	0.359	4.78
f	-0.000	-0.19	-0.000	-0.13
g	0.004	0.18	0.002	0.12
Uusimaa				
a	-0.016	-0.23	0.018	0.25
b	0.435	5.81	0.377	4.89
c	0.463	2.88	0.502	3.07
d	-0.234	-6.11	-0.124	-2.50
e	0.239	5.07	0.118	2.02
f	-0.287	-2.29	-0.350	-2.17
g	0.302	2.35	0.364	2.20
Kuopio				
a	0.002	0.02	0.007	0.09
b	0.406	4.92	0.397	4.71
c	1.067	5.93	1.072	5.84
d	-0.208	-5.21	-0.184	-3.93
e	0.210	4.64	0.185	3.60
f	0.009	0.10	0.035	0.34
g	-0.013	-0.14	-0.039	-0.37

TABLE 3 CONTINUED

Turku				
a	0.117	1.47	0.104	1.30
b	0.336	4.04	0.329	3.91
c	0.377	1.92	0.204	0.98
d	-0.179	-6.07	-0.142	-3.55
e	0.142	3.67	0.109	2.30
f	0.121	1.79	0.239	2.60
g	-0.118	-1.69	-0.242	-2.56
Häme				
a	-0.096	-0.68	0.000	0.00
b	0.602	4.08	0.524	3.47
c	0.851	2.62	0.792	2.38
d	-0.303	-7.44	-0.209	-3.88
e	0.331	5.00	0.208	2.62
f	-0.188	-1.39	-0.077	-0.44
g	0.195	1.42	0.082	0.46

Correlation matrix of residuals from SURE estimation:

	doul	*dvaas*	*dmik*	*duus*	*dkuop*	*dturk*	*dhame*
doul	1.0000						
dvaas	0.4338	1.0000					
dmik	0.1987	0.3399	1.0000				
duus	0.3556	0.4321	0.3545	1.0000			
dkuop	0.4109	0.3876	0.2929	0.3183	1.0000		
dturk	0.2724	0.5565	0.2863	0.5512	0.4061	1.0000	
dhame	0.2122	0.4370	0.2530	0.5977	0.2448	0.6556	1.0000

Breusch-Pagan test of independence: chi2(21) = 613.320, Pr = 0.0000

TABLE 4: MEAN MONTHLY PRICE OF RYE BY PROVINCE (FINNISH MARKS)

Province	*1859-64*	*1867-68*	*1870-73*
Uusimaa	24.64	32.52	22.31
Turku	24.46	33.84	23.33
Häme	24.00	32.49	22.25
Mikkeli	24.34	30.52	25.17
Viipuri	24.97	29.02	23.42
Kuopio	26.74	30.76	25.03
Vaasa	24.30	30.73	22.10
Oulu	27.64	33.42	25.98
Mean	25.14	31.66	23.70
	1.236	1.548	1.408
CV	0.049	0.049	0.059

Source: Ó Gráda (2001)

FIGURE 1: THE COEFFICIENT OF VARIATION IN GRAIN PRICES IN FRANCE 1690-9, 1705-14, AND 1735-44

Year	*CV*	*Year*	*CV*	*Year*	*CV*
1690	0.291	1705	0.336	1735	0.280
1691	0.309	1706	0.401	1736	0.288
1692	0.335	1707	0.370	1737	0.258
1693	0.345	1708	0.397	1738	0.181
1694	*0.424*	*1709*	*0.469*	1739	0.168
1695	*0.485*	*1710*	*0.470*	*1740*	*0.401*
1696	0.278	1711	0.279	1741	0.292
1697	0.317	1712	0.238	1742	0.312
1688	0.261	1713	0.186	1743	0.354
1699	0.231	1714	0.282	1744	0.371

Table 5: THE REGIONAL VARIATION OF POTATO PRICES IN THE 1840s

A. MARKET TOWN DATA 1840-1846:

	1840	1841	1842	1843	1844	1845	1846
Mean price per st. (pence)	2.83	2.70	2.78	2.38	2.49	2.65	3.94
	0.97	0.82	0.89	0.84	0.79	0.76	1.16
CV	0.34	0.31	0.32	0.35	0.32	0.28	0.29

B. TOWN PRICE DATA, 1848-1851:

	1848	*1849*	*1850*	*1851*
Mean price per cwt. (pence)	58.06	49.55	42.37	43.38
	7.04	9.12	8.40	7.09
CV	0.12	0.18	0.20	0.16

Note: sources for these data are given in Ó Gráda, 1999

TABLE 6: THE SEASONAL RISE IN WHEAT PRICES 1680-1719: MONTHLY DATA

	Paris(*)	*Angoulême*	*Rozay*	*Toulouse*	*M'batzon(#)*	*Pontoise*	*Grenade*
Mean Increase (%)	0.9	10.8	2.4	7.3	13.7	7.6	12.2
Standard deviation	28.1	35.9	49.0	28.8	49.2	47.4	31.1
Increase in 1692-3 (%)	80.4	27.0	44.7	37.0	22.5	84.6	39.1
Increase in 1693-4 (%)	21.5	29.8	40.4	53.1	50.0	40.0	61.8
Increase 1708-9 (%)	--	171.8	256.5	108.9	248.1	242.7	112.5

(*) 1680-98; (#) 1680-1715, 1698/9 missing

TABLE 7: THE SEPT.-JUNE RISE IN RYE AND BARLEY PRICES IN FINLAND

[1] Rye:	*Oulu*	*Uusimaa*	*Vaasa*	*Kuopio*	*Mikkeli*
Mean Increase (%) [*]	9.6	8.1	11.3	12.2	13.8
Standard deviation *[*]*	13.0	9.2	8.3	11.9	13.1
Increase in 1867-8 (%)	22.9	31.5	29.0	38.1	43.7
[2] Barley					
Mean Increase (%) [*]	14.6	7.2	15.1	12.2	13.0
Standard deviation [*]	14.4	7.0	10.9	10.0	7.3
Increase in 1867-8 (%)	40.9	30.4	56.4	38.1	39.9

[*] Excluding 1867-8

FIGURE 2: SALES OF WHEAT AT CHOISY-AUX-BOEUFS IN THE 1690s

Monthly Sales (percent)	*VIII*	*IX*	*X*	*XI*	*XII*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*
Normal Years	1.8	1.9	1.4	6.4	8.4	8.8	11.6	11.1	8.7	11.9	17.4	10.6
1693-4	11.4	12.3	8.0	8.8	6.0	12.6	8.5	8.8	7.3	7.1	9.2	0.0

Source: Moriceau and Postel-Vinay, 1992: 226

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ENDNOTES:

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2. Well, not quite, since the cost of storage implies a gradual reduction in consumption over the harvest-year.

3. See too François Quesnay's remark in his article on corn in the *Encyclopédie*: 'le prétexte de rémédier aux famines dans un royaume, en interceptant le commerce des grains entre les provinces, donne encore lieu à des abus qui augmentent la misère, qui détruisent l'agriculture, et qui anéantissent les revenus du royaume' (in Quesnay, 1958: 494n.)

4. Young did not blame grain merchants, however. In *Travels in France* he stressed their part in minimizing the danger of famine, and denounced the anti-speculator sentiment of the *cahiers de doléance*. In *The Question of Scarcity Plainly Stated*, prompted by the near-famine of 1800, he argued that the harvest shortfall was 'great and real [and] a very high price a necessary consequence', against critics who blamed artificial manipulation by hoarders and speculators. But Young did not fully trust merchants' judgement of the size of the harvest, and as secretary of the Board of Agriculture urged the necessity of a national agricultural census (Young, 1793: ch. 18; Rashid, 1980: 499; Gazley, 1973: 416-7).

5. For background see Kaukiainen 1984; Kiiskinen 1961; Lefgren 1973.

6. Fogel (1992) has characterized famines in early modern Europe as due to anticipated rather than true harvest

failures. The famines analysed here do not fit such a pattern. In Finland 'the harvest of 1867 failed seriously: what was left amounted to about half the normal crop' (Kaukiainen, 1984: 241), while the admittedly limited quantitative data available on France in 1693 and 1708 suggests that the harvests of those years were also severely affected (Lachiver, 1991: 118, 308-9).

7. Alogoskoufis and Smith (1995) is a good introduction to ECM. Before estimating an ECM the individual price series had to be tested for stationarity. The series used here are differences in the logs of prices in the markets mentioned above, and the gaps between the logs of price pairs. In all cases the hypothesis that the individual series had a unit root could be firmly rejected.

8. The data (for which I am grateful to David Weir and Jean-Michel Chevet) refer to market or *mercuriale* prices. Gaps were very few and these were plugged by simple interpolation.

9. Elsewhere (Ó Gráda 2001) I examine the outcome of treating Vaasa as market leader and the reaction of prices in the remote northern province of Oulu to movements in the other seven provinces. The outcome corroborates the results reported in Table 3.

10. The underlying data base, which was kindly supplied by David Weir of the University of Michigan, refers to forty towns and cities. For details see Ó Gráda, 2001b.

11. Across the eight statistical provinces that would constitute the Kingdom of Prussia in 1871 coefficient of variation of wheat prices averaged 0.074 over the 1841-70 period and that of rye prices 0.117 (estimated from *Zeitschrift*, 1871).

12. Far greater segmentation between regional markets for potatoes in bad years is suggested by early nineteenth century

German data. Across Prussia's eight statistical regions the coefficient of variation of potato prices during the famine years of 1816-17 was double the 1818-27 average (estimated from *Zeitschrift*, 1871).

13. An alternative scenario is also plausible (compare Ejrnaes and Persson, 2000). The inter-provincial differences in grain prices before 1867 seem to have been much smaller than those suggested by transport costs. Perhaps this was because in normal years other goods and labour were less expensive to move than grain, and substituted for grain shipments between the provinces. If so, a crisis-induced increase in grain shipments between regions might well have have *increased* the spatial variation in prices.

14. Cork city, newspaper reports refer to the quantities of potatoes traded on six city markets between 1842 and 1848. On the eve of the famine, the outcome reveals a market which spread sales well over a harvest season beginning in early autumn. Comparing the pattern in 1845-6 with that in 1842-43, 1843-44, and 1844-45 indicates that the proportion of sales early in the season was higher than before. In 1846-7 again sales were proportionately higher early in the season. This outcome is consistent with that indicated by the seasonal pattern in prices (Ó Gráda, 1999: 147-9).