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The agricultural revolution and the conditions of the rural poor, southern Sweden, 1750–1860†

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The social consequences of agrarian change have been widely debated. The traditional view of the lower classes becoming increasingly vulnerable due to the loss of access to resources has been met with the revisionist view that this change was counteracted by an increase in the volume and regularity of employment due to investments and new farming practices. This article address this issue by studying the agricultural revolution in southern Sweden using aggregate data at the parish level. New micro-level data on actual harvest outcomes, supplemented by price data, make it possible to differentiate between the development of the local economy and exogenous price shocks. Our results indicate a clear mortality response to harvest fluctuations in general and to harvest failures in particular. The response differed greatly between farming regions, being strongest in the areas most dependent on grain production. The response also diminished during the agricultural revolution, indicating the increasing efficiency of the local economy. This indicates employment effects in line with the revisionist view. At the same time, vulnerability to fluctuations in prices of basic foodstuffs remained high until the second half of the nineteenth century and was also quite similar across farming regions.

The social consequences of the agricultural revolution have long been a subject of dispute, and there are two sharply diverging views on what happened to the rural population when the countryside was reshaped. The traditional view was drawn by Marx in *Capital*, whereby chapter 27 characterized the enclosures in England as the '[e]xpropriation of the Agricultural Population from the Land'.[1] The classical argument in English historiography is that the labouring poor were affected by the privatization of the commons. They were thereby prevented from keeping their own animals, on which they could rely before the enclosures. The Hammonds describe the effect of the enclosures on cottagers as the conversion of a labourer with land to a labourer without land.[2] Thompson stretches the argument to the abandonment of a 'dense cluster of claims and usages' from the commons

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[1] Marx, *Capital*, p. 503.

[2] Hammond and Hammond, *Village labourer*, pp. 97–103.

to the marketplace, which made up the economic and cultural universe of the rural poor that was destroyed.[3] The poor in enclosed villages had no hope of either land or use rights.[4] Women were probably the biggest losers in the proletarianization process, deprived of any alternatives to wage labour.[5]

Arguing from the revisionist view, Chambers and Mingay agreed upon certain effects of losing access to the commons but argued that this was counteracted by an increase in the volume and regularity of employment after enclosure. The commons were not only privatized but also turned into arable land, whereby the demand for labour increased, giving more work opportunities to the landless.[6]

The revisionist view was challenged by Snell. Seasonal unemployment rose and the demand for female farmhands declined during the course of the agrarian transformation, especially after the 1770s. Snell claimed that this was the general pattern in the corn lands in south-west England, while more pastoral areas were less affected. Thus, the parliamentary enclosures not only robbed the rural labourers of access to the commons but amplified the seasonal employment pattern. The result at the county level was a strong association between enclosures and expenditure on poor relief.[7] Allen claimed that agricultural employment fell over the eighteenth and early nineteenth century. Thus the welfare of labourers as a group deteriorated because it was impossible for all of them to find work.[8] Similar questions have been raised in German historiography. After the division of the commons, which in north-west Germany started in the middle of the eighteenth century and gained momentum in the 1820s, the lower-class households lost important sources for their survival strategies. However, the same groups could have gained from a growing market in small plots and from new employment opportunities.[9]

Thus our understanding of the social effects of the agricultural revolution is still ambiguous and some key questions remain to be investigated further. How did the agrarian transformation and the enclosures affect the living conditions of the landless rural population? Did the demand for labour become more unevenly distributed over the year and between the years, or was it the other way around? In the former case, the rural poor would probably be worse off when their income security disappeared. In the latter case, the labourers would benefit directly from the agrarian revolution in terms of more secure incomes.

One way to investigate this is to measure vulnerability to short-term economic fluctuations. Especially in times of crisis and food scarcity in pre-industrial societies, mortality increased and child births were postponed.[10] There is now overwhelming empirical support for this type of demographic response to economic fluctuations in general and to economic crises in particular. The evidence is derived from both aggregate-level studies covering entire countries and micro-level studies of small areas. The latter studies have also been able to demonstrate how the

[3] Thompson, *Making*, p. 239.
[4] Neeson, 'English enclosures', p. 27.
[5] Humphries, 'Enclosures', p. 41.
[6] Chambers and Mingay, *Agricultural revolution*, pp. 96–9.
[7] Snell, *Annals*.
[8] Allen, *Enclosure*, p. 287.
[9] Fertig and Pfister, 'North-west Germany', pp. 247–8.
[10] Allen, Bengtsson, and Dribe, eds., *Living standards*, pp. 15–17.

response differed according to socioeconomic status, or occasionally position in the household hierarchy.[11]

However, there are very few studies on the development of these patterns during a period of social and economic transformation, such as the agricultural revolution. Moreover, nearly all the empirical evidence is from data on wages and prices, reflecting conditions in the wider markets. Most notably, in the case of eighteenth- and nineteenth-century Europe, grain markets were highly integrated,[12] and prices were thus products of supply and demand conditions in quite large geographical areas. This means that the demographic response to short-term fluctuations in grain prices or real wages provides important insights into the response to the cost of food and general standard of living. It is not clear, however, how well the market prices reflect economic conditions at the local level beyond the price of food, given the importance of payments in kind through transfers of grain, for example. Moreover, local output conditions can be expected to have been important determinants of the demand for labour[13] and thus the earnings of landless labourers.

The aim of this article is to study the living conditions of the landless rural population during the agricultural revolution in Sweden. This is accomplished by measuring the mortality response to fluctuations in the grain harvest outcomes and the changes in this process over time. To isolate the effect of changes in labour demand, this is compared with the mortality response to fluctuations in grain prices. We also compare the effects in different farming regions and consider in more detail the mortality response to economic crisis, as measured by low grain output or high grain prices. The analysis is based on data for Scania, the southernmost province of Sweden, in the period 1749–1859, using aggregated parish-level information on mortality, micro-level data on grain production, and regional grain prices. By studying different farming regions with highly diverging economic structures, it is possible to disentangle the effects in terms of the employment opportunities in detail.

We find a substantial mortality response to fluctuations in both harvests and prices before the beginning of the agricultural revolution. However, while the vulnerability to price fluctuations remained more or less unchanged during the transformation, the response to fluctuations in grain output diminished. This indicates a better-functioning local economy and a more uniform demand for rural labour during the agricultural transformation, supporting aspects of the revisionist view. However, the prevalence of the mortality response to high prices indicates that this could not counteract the exposed position of the rural poor.

In addition, the options in terms of employment in the different types of agrarian economy led to diverging living conditions for the labourers. While all the farming regions were similarly affected by grain prices, the plains, with their specialization in grain production, were hardest hit by the bad grain harvests owing to a lack of alternative employment opportunities. People in the forest areas were sensitive to annual harvest fluctuations as well but, due to a diversified economy, harvest failures did not have the same impact in this area.

[11] Bengtsson, Campbell, Lee, et al., *Life under pressure*; Tsuya, Wang, Alter, Lee, et al., *Prudence and pressure*.
[12] Persson, *Grain markets*, pp. 91–130.
[13] Utterström, *Jordbrukets arbetare*, pp. 241–75; Abel, *Agricultural fluctuations*, p. 9.

I

A large number of studies have indicated that in preindustrial societies all around the world, short-term fluctuations in the prices of food or real wages led to demographic responses in the form of lowered fertility and marriage rates and, in the worst cases, increased mortality.[14] Populations exposed to economic hardship tried to protect themselves by postponing childbirth and/or marriage, migrating, or seeking relief through credit markets or aid from major economic actors.[15] Because the local and regional economy was often characterized by a common direction of production (for example, producing grain) and therefore vulnerable to the same shocks, and because institutional arrangements, such as credit markets and state relief organizations, were underdeveloped, these measures in many cases were insufficient, resulting in increased mortality.[16] Mortality was most significant among children over the age of one and among working-age adults, while infants and the elderly seem to have been affected more by factors other than economic fluctuations.[17]

More recently, research at the aggregate level has been supplemented by studies at the micro level.[18] These studies have indicated clear differences in the demographic response in terms of socioeconomic status and gender and household context. It is not surprising, though nonetheless significant, that those with fewer resources were affected more by the economic fluctuations than those who were wealthier; individuals or families without access to land or groups living on the margins of society in other respects were more vulnerable than the landed groups. This was due to the former being dependent on working for others, and thus lacking their own production of food, as well as being exposed to variations in labour demand.

In most research in this field, grain price variations have been used to measure variations in output, because reliable output series are rare for preindustrial agriculture. The problem, however, is that grain prices, in reality, entail different information from the local harvest outcomes. Grain prices serve as a summary measure of the workings of the preindustrial economy, reflecting not only local harvest conditions but also trade patterns and market integration. Accordingly, they were not locally determined but highly correlated throughout early modern north-western Europe.[19] Hence, the majority of people lived in local agricultural economies that were more or less open to trade and to the influence of markets. The largest part of the budget for families in preindustrial society was directed toward buying food. This meant that the price of food was of utmost importance for survival and, thus, that changes in food prices affected short-term economic

[14] See, for example, Lee, 'Short-term variation'; idem, 'Demographic response'; Weir, 'Life under pressure'; Bengtsson and Ohlsson, 'Age-specific mortality'; Eckstein, Schultz, and Wolpin, 'Short-run fluctuations'; Galloway, 'Annual variation'; idem, 'Basic patterns'; Feeney and Kiyoshi, 'Rice price'; Hammel and Galloway, 'Structural and behavioural changes'; Palloni, Pérez-Brignoli, and Arias, 'Malthus'.

[15] Ó Gràda and O'Rourke, 'Migration'; Bengtsson et al., *Life under pressure*, pp. 27–160; Tsuya et al., *Prudence and pressure*, pp. 97–128; Lundh, Kurosu, et al., *Similarity*, pp. 121–68.

[16] Dribe, 'Dealing with economic stress'; Bengtsson et al., *Life under pressure*, pp. 27–60, 135–72; Dribe, Olsson, and Svensson, 'Manorial system'.

[17] Bengtsson and Ohlsson, 'Age-specific mortality'; Oris, Deroses, and Breschi, 'Infant and child mortality'.

[18] Bengtsson et al., *Life under pressure*; Allen et al., *Living standards*; Tsuya et al., *Prudence and pressure*; Lundh, Kurosu, et al., *Similarity*.

[19] Persson, *Grain markets*, pp. 91–130.

conditions in a significant way. At the same time, in an integrated market, prices did not vary to a great extent with the local harvests; fluctuations in harvests across a broader region existed due to similar climatic shocks, although local conditions also mattered.

If prices to a large extent were determined exogenously, local production data provide valuable additional information on the well-being of people in the local communities. The main reason for this is that local harvest conditions tended to affect the demand for labour and, accordingly, the income of labourers in the community. A bad harvest led to less work during and after harvesting (for example, threshing).[20] While exogenous prices take account of the fact that people spending a higher share of their income on food spend less on products from other sectors, they do not indicate anything about the local demand for agricultural labour.[21]

Taken together, food prices serve as good indicators of economic conditions in the wider markets, but using production as an alternative indicator makes it possible to increase our understanding of the effects of economic hardship on local communities. Through this approach, we can also assess the effect of the altered demand for labour during the agricultural transformation on sensitivity to economic hardship. Furthermore, we will analyse the differences and similarities of the impact of grain prices and local harvests on the well-being of villagers. Important in this respect is whether the responses found, as well as their magnitude, varied between villages with different economies, between villages with a one-sided grain production strategy and villages with a more diversified economy, and between villages with an almost constant surplus production and villages for which the production in normal years was at the subsistence level.

II

The agricultural transformation came late to Sweden compared with England, but it involved a rapid and dramatic change in the countryside, starting in the late eighteenth and early nineteenth century. Until that point, the village community and the open field system were prevalent, except for noble demesne farming in certain areas. The tremendous rise in agrarian output, which is evident from figure 2, broadly coincided with the radical enclosures that led to the consolidation of peasant holdings and the abandonment of the village as an economic organization.[22]

Our study area is the region of Scania (Skåne), the southernmost province of Sweden, which contains a variety of some of the most common types of north European agricultural settings with respect to socioeconomic and topographic conditions, as well as in land management. Two hundred years ago, this region had approximately 250,000 inhabitants, of which less than 10 per cent lived in towns, indicating the small size of the secondary and tertiary sectors in the region. Agriculture was thereby the dominant occupation, and peasant farmers were the backbone of the agriculturalists. The region contained fertile plains as well as forest

[20] Abel, *Agricultural fluctuations*, p. 9; Utterström, *Jordbrukets arbetare*, p. 240. See Dribe, *Leaving home*, ch. 7, for a more detailed discussion.
[21] Jütte, *Poverty*, p. 31.
[22] Svensson, 'Peasants'; Olsson and Svensson, 'Agricultural production', pp. 130–4.

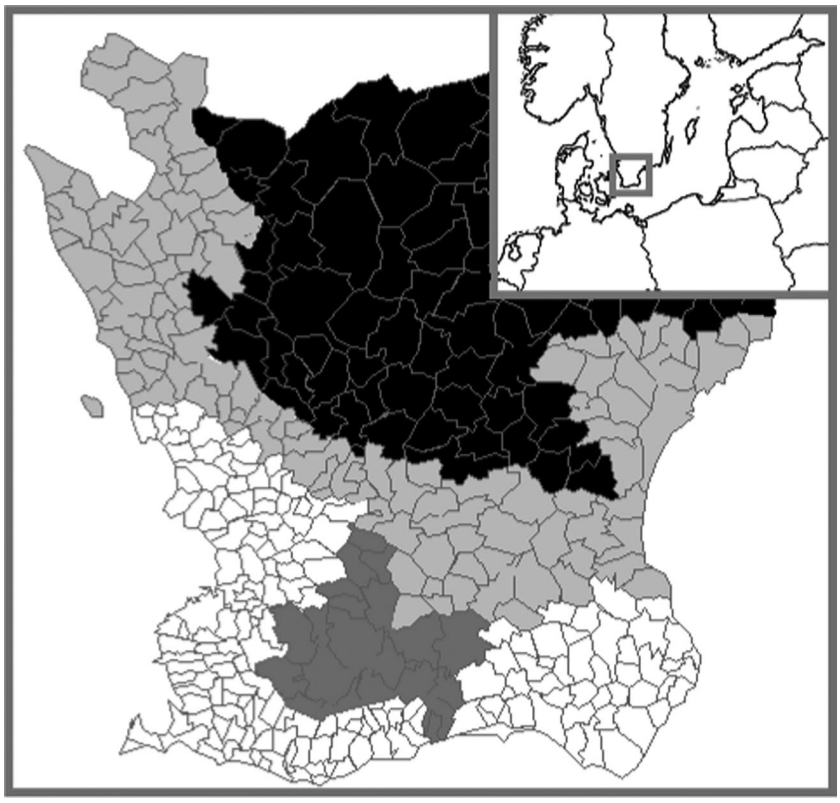

Figure 1. *Farming regions and parish boundaries in Scania*

Notes: Dark = forest areas; uncoloured = plains; grey = brushwood areas. Everything covered by the inset is forest. The darker grey area in the south was ambivalently characterized as forest by Campbell, *Skånska*, relying on certain aspects in the early eighteenth century land survey descriptions. However, already by then its economy was leaning more toward the brushwood nature; Bohman, *Bonden*, p. 60. In our study it is classified as a brushwood region.

areas and intermediate (brushwood) areas (see figure 1). Approximately half of the land was owned by the nobility, and the other half was owned either by the Crown or by owner-occupiers (freeholders). Thus, Scania can be said to have contained different peasant ecotypes with a mix of manorial tenants, freeholders, and Crown tenants on the plains as well as in the more wooded areas.

Agricultural output tripled per average peasant farm on the plains in Scania, and in Sweden as a whole, agricultural output value doubled in constant prices during the first half of the nineteenth century.[23] Prior to this, agricultural output in Scania developed more or less on a par with population growth, but in the period 1800–50 it increased by 1.8 per cent per year, whereas the rural population increased by 1.1 per cent per year.[24] Simultaneously, social stratification in the rural population intensified in this area; in Sweden, the number of landholding peasants increased by 20 per cent, while the landless increased by 370 per cent

[23] Krantz and Schön, *Swedish historical national accounts*, pp. 35–6; Olsson and Svensson, 'Agricultural production', pp. 128–30.

[24] Olsson and Svensson, 'Agricultural growth', p. 287.

for the period 1750–1850.[25] In Scania, the population of landholding peasants increased more rapidly, by more than 30 per cent, but a large part of this was the growth of small farm units below the subsistence level,[26] which, together with the rapid growth of landless groups, resulted in a similar degree of stratification.

The area of cultivation in western Europe doubled in the period 1700–1870, but in Sweden the increase was much larger, more than 300 per cent.[27] In Scania, land reclamation grew rapidly after the early nineteenth-century enclosures; more acreage was cultivated when meadows and forests, which had been for common use, were privatized and exploited. New farming techniques were introduced in many farmsteads during the first decades of the nineteenth century, often shortly after the enclosure of the village. On the plains, the three-course rotation system had been predominant since the middle ages, but was now abandoned in favour of quite advanced crop rotations, which reduced the fallow and introduced fodder crops on arable fields.[28] This was the core of the agricultural transformation and meant a sharp intensification of land use, raising land productivity substantially.[29]

The prevailing view in Swedish historiography is that land reclamation and more intense farming systems affected the demand for labour as former forests, wetlands, and meadows were cut down, ditched, cleared, and ploughed. Simultaneously, each piece of land was worked more frequently, and the seasons of agriculture were prolonged by the use of new crops such as potatoes and turnips, grass, and other fodder crops. Output per head of the agricultural population can be estimated to have grown by 0.65 per cent per year in Scania during the first half of the nineteenth century.[30] However, was this due to an increase in labour productivity (output per hour of work) or an increase in working time? Because there were few labour-saving innovations before the second half of the nineteenth century, researchers tend to regard the rise in labour productivity as modest during the agricultural revolution.[31] Instead, the demand for labour was met by more work, and the workload became more evenly distributed *within* the year when slack seasons diminished.[32] The same phenomenon—more ground work and diversified crop cultivation—caused labour demand to become more evenly distributed *between* the years.

This development should have lowered vulnerability to output fluctuations, because demand for labour and thus employment opportunities for landless labourers became less connected to short-term harvest fluctuations, thereby lowering the mortality response in the first half of the nineteenth century. However, this was not necessarily the case for grain prices, as they reflected the market price of food.

The rapid agricultural transformation affected all farming regions. A farming region is a territory in which the conditions of soil, topography, and climate have formed farm practices and a rural economy that contrasts with its neighbouring territories.[33] Typical farming regions in England were arable, pastoral, and

[25] Winberg, *Folkökning*, p. 50.
[26] Wohlin, *Den jordbruksidkande*, pp. 196–256; idem, *Emigrationsutredningen*, pp. 100, 117.
[27] Gadd, 'Agricultural revolution', p. 158.
[28] Olsson, *Skatta*, p. 128.
[29] Overton, *Agricultural revolution*, p. 116–21.
[30] Olsson and Svensson, 'Agricultural growth', p. 287.
[31] Gadd, *Järn*, pp. 257–8.
[32] Dribe and van de Putte, 'Marriage seasonality'.
[33] Overton, *Agricultural revolution*, p. 47.

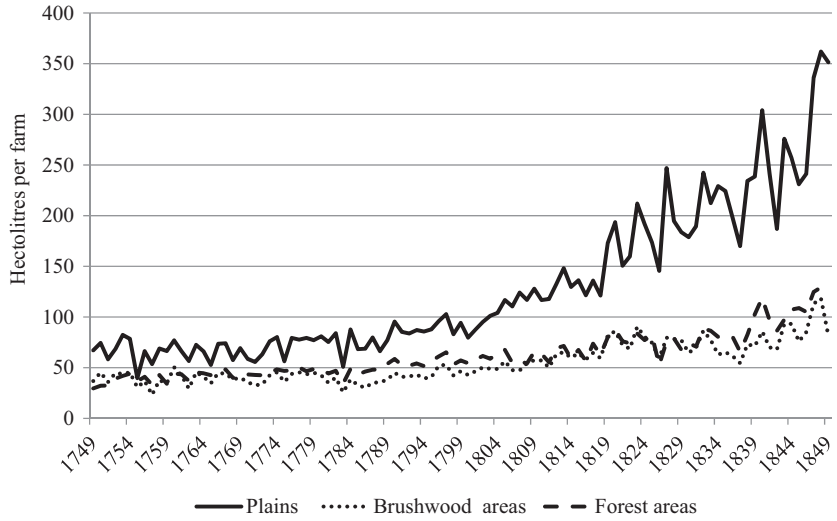

Figure 2. *Grain output in different farming regions (hectolitres per farm)*
Source: Historical Database of Scanian Agriculture, Dept. of Economic History, Lund University.

intermediate types. In Sweden, a similar classification included plains, forest areas, and brushwood or intermediate lands,[34] which reflected the greater amount of forest land in Sweden compared to England, for example. In the plains, the three-course rotation system was predominant (in Sweden until the 1810s); typically, a season of winter rye was followed by barley and then a season of fallow. However, in the Scanian plains barley usually followed directly after fallow, and then winter rye. This was done to prolong grazing on the fallow due to a lack of other grazing areas.[35] The plains in Scania were in this respect and in others, such as the high degree of arable land and the relatively large villages, more similar to the Danish and north-German plains than to other plains in Sweden.[36] In the forest areas, where the fields were smaller and the supply of manure and organic material abundant, there were usually no fallows, so the soil was cropped continuously.[37] Boserup argues that harvest failures were frequent for rain-fed and mono-cropping short-fallow cultivations. The tendency to concentrate on cereals worsened the situation, because if climate conditions in any year were unfavourable, all the crops were likely to fail.[38] While the economy of the plains in preindustrial Sweden was dominated by grain production, the economies of the forest and brushwood areas were more diversified. Households worked in a diverse range of activities rather than specializing in a single profit-maximizing business to abate some of the income risks. This measure reduced average output and thus the level of living standards

[34] Campbell, *Skånska*.
[35] Dahl, *Törna*, p. 111.
[36] Gadd, 'Agricultural revolution', pp. 119, 124, 129.
[37] Dahl, *Törna*, p. 137; Myrdal, 'Farming', pp. 84–5.
[38] Boserup, *Conditions*, pp. 39, 85.

but also the variability of income.[39] How could these patterns have affected the mortality response to economic hardship?

Earlier studies have indicated that rural mortality was affected by economic fluctuations both in the same year and with a lag.[40] The peasants in the forest areas were self-sufficient in a more universal way than those in the plains, and in normal years they did not have to buy grain from outside the local community.[41] The grain markets in the plains and forest areas were highly integrated, the maximum distances were not more than 50 kilometres, and the roads were of sufficient quality.[42] However, the forest areas were certainly closer to the subsistence level in terms of grain supply, which meant that people in these areas were dependent on buying food from other areas in times of bad harvests.

In the plains, specialization in grain production led to large differences in occupation between the summer and winter seasons. This even encouraged a contemporary discussion on stereotypical human traits, in which the indifferent and lazy plain-lander was contrasted with the industrious and lively forest dweller.[43] In the plains, labour demand was especially low during the winter after a bad grain harvest. Late winter and early spring were the most critical period for those who were dependent on income from temporary employment.[44]

Forest villages had a rather different economy. They experienced a type of inverted seasonality of agricultural labour demand with a good deal of winter employment.[45] This meant that labour demand was not only more evenly distributed over the year but was also less sensitive to fluctuations in grain harvests. Thus, while the dependency on the market for buying food was as great as in any other area, the local economy was not as dependent on grain production as was the case in the plains.

The preceding discussion implies that the mortality response to local grain harvests should have been more prevalent in the plains than in the forest areas due to the greater dependency on grain production and the strong impact on labour demand from the harvest outcome in these areas. The more diversified economy in the forest and brushwood areas should have lowered the dependency of labour demand on the harvest outcome, which in turn should have reduced the vulnerability to harvest failures in these areas.

Grain prices, on the other hand, can be expected to have affected people more similarly across the different farming regions, because they reflected the actual costs of buying grain on the market or the amount of grain received as payments in kind, since such payments were calculated on the basis of the same prices.

There is of course a possibility that these hypothesized effects could have been mitigated by institutional arrangements designed to counteract short-term economic shocks. However, as stated above, the majority of European poor relief systems were intended to provide care for a very small group of permanently poor or sick people rather than to benefit larger groups of people affected by temporary

[39] Bardhan and Udry, *Development*, p. 106.
[40] Lee, 'Short-term variation'; Galloway, 'Basic patterns'.
[41] Hanssen, *Österlen*, pp. 150–1, 161, 193.
[42] Bergenfeldt, *Roads*, p. 136.
[43] Utterström, *Jordbrukets arbetare*, pp. 244–9.
[44] Ibid., p. 240.
[45] Ibid., p. 234; Samuel, 'Village labour', p. 7.

crises.[46] This is also true for the region of Scania, where only approximately 1.4 per cent of the population received organized poor relief in 1829.[47] Throughout the period, the main responsibility for the old, sick, and poor rested upon their households, and only those that fell outside these categories, mainly elderly widows, were managed through the poor relief system. One effect of the local responsibility of poor relief was that parishes tried to prevent poor people or people in temporary need from moving into the parish. Individuals were therefore not allowed to move into a parish unless they could demonstrate that they had employment or were going to be provided for by someone with adequate resources.[48] Thus, on the local level, the organization of poor relief was highly similar across parishes.

However, there might have been a difference in capacity between parishes dominated by freeholders and parishes under manorial rule. The latter, in which the noble landlord had a larger pooled surplus in bad times as well, might have had the ability to alleviate the effects of economic crises among the parishioners. Recent research, however, has indicated that this protective effect was limited to the very short term, that is, the year of the crisis. In the year following the crisis, usually the worst year, no effect could be discerned.[49] At the state level, temporary relief through granaries or extra shipments of grain was used to ease the effects of the crises during some of the worst years.[50] However, the effect of these measures was only marginal.[51] Together, this indicates that institutional arrangements in preindustrial Scania could not mitigate the effects of short-term economic crises in a substantial way.

In sum, we expect people in preindustrial rural societies to have been affected not only by fluctuations in the market prices of food, which is a well-established fact, but also by variations in the local output of grain. As a result of the effects on the demand for labour and thus on the earnings of the landless and semi-landless labourers, years of bad harvests led to economic hardship not only for the producers of grain but for most of the local community. Due to the high levels of vulnerability to economic hardship in the rural economy, we expect mortality to have increased in the years following bad harvests and for mortality for ages above one year to have been more severely affected than infant mortality. Moreover, we expect the mortality response to local output conditions to have varied with the economic structure of the community. In the plains, where the dependency on grain production was very high, the effects of bad harvests should have been greater than in areas with a more diversified economy, such as the forest areas, although the latter might have experienced lower average living standards. Finally, we expect the vulnerability to local harvest outcome to have declined over time as a result of the agricultural transformation, which increased the demand for labour and caused this demand to be distributed more evenly over seasons and between years.

[46] Bengtsson, 'Living standards', pp. 50–5.
[47] Skoglund, *Fattigvården*, p. 52.
[48] Ibid., p. 15.
[49] Dribe et al., 'Manorial system'.
[50] Berg, *Volatility*; Gadd, 'Agricultural revolution', p. 162.
[51] Dribe et al., 'Manorial system', p. 297.

Table 1. *Descriptive statistics*

	Infants	*Children*	*Adults*
Mean no. of deaths per year	5.8	4.5	12.1
Mean population size	28.5	306.0	627.5
Observations	25,238	25,265	25,270
Geographical units	274	274	274

Source: Tabular Commission, Mortality tables, and Population tables (Demographic Database, Umeå University), http://www.cedar.umu.se/english/ddb/databases/tabverk.

III

We examine the mortality response at the aggregated parish level for the period 1749–1859 using a panel dataset. In total, we have 25,270 observations for 274 geographical units consisting of a single parish or a pair of parishes (*pastorat*). The data are from the Tabular Commission, a predecessor to Statistics Sweden, which began gathering nationwide data in 1749. Vital events were recorded annually, while the populations at risk were usually recorded every three to five years. We have merged parishes into larger geographical units to construct coherent units over time and to link annual vital events from the mortality tables to the triennial or quinquennial population tables, which contain the population in the parishes divided by age and sex. In this process, over 400 parishes were reduced to 274 geographical units consisting of one or two parishes.

The mortality response is analysed separately for infants, children (1–14 years), and adults (15–84 years). We also disaggregate the analysis of adult mortality into smaller age groups, but as this does not affect the results, adults aged 15 to 84 years are treated as one group in the analysis. In total, we study 564,890 deaths, and this means that there is an average of approximately 6 infant deaths, 4 child deaths, and 12 adult deaths per year across all geographical units (see table 1). The average underlying populations at risk range from approximately 28 for infants to 628 for adults (see table 1).

Economic conditions are measured by two indicators: grain output and rye prices. The grain output series—derived from tithe payments to the local clergy—are included in the Historical Database of Scanian Agriculture (HDSA). The tithes in this region were paid to the Crown, the church, or the local clergy. Following government regulations in the 1680s, the two former were set at a fixed annual amount for each farm, which remained unaltered for over 200 years. In some cases, the tithes of the local clergy were also fixed after agreements with the parishioners but, in many cases, this remained a flexible annual production tax until the 1860s. The clergy kept accounts on each farmer's annual tithe payments, which, in addition to some minor dues and boon days, consisted of every thirtieth sheaf of the harvest and every tenth animal born alive. Measured in production values, animal breeding constituted approximately 15 per cent of the average farm output[52] and will not be further elaborated in this study. Crop output was dominated by barley and rye, and to a lesser extent oats and wheat. Additionally, farmers often grew peas and beans on their fields and occasionally buckwheat in the districts with

[52] Olsson and Svensson, 'Agricultural production', p. 128.

sandy soils. In the early nineteenth century, potatoes that had simply been grown in kitchen gardens became an important arable crop for the majority of districts.

The output series were estimated from these flexible tithe payments in 32 parishes with a total of approximately 2,000 farm units. The sample reflects the existing differences in property rights and the geographical conditions of eighteenth- and nineteenth-century rural Scania. The individual farm production series are of different length, between 20 and 130 years, and on average 450 farms are represented each year. The absolute levels of output differed between the parishes. To create the aggregated series, we first estimated the annual averages for each parish. Then a conversion figure for each parish was created by comparing the mean values of the first five years that it appeared in the database with the current mean values. The individual farm series was smoothed with the respective parish's conversion figure, and finally the annual mean values were calculated.[53] Output was estimated as total production (in hectolitres) per average farm in the sample, using the measurement of farm size in 1770 in the poll-tax registers (*mantal*). The reliability of the output estimates was indicated by their congruence with contemporary qualitative harvest reports, their correlations with each other, and their negative correlations with regional grain prices.[54]

A separate production series for the three farming regions—plains, brushwood, and forest areas—has been constructed, with 8, 16, and 8 parishes respectively. The series are displayed in figure 2 but, due to a lack of sources, it was not possible to construct a series for the plains beyond 1849. For the first five years (1749–53), the annual harvests in the plains, brushwood, and forest areas were 70, 41, and 35 hectolitres per average farm, respectively. A hundred years later, the averages for the same farms were 304, 95, and 120, which provides a clue regarding the strength of the agrarian revolution in Sweden. The absolute levels also indicate that farming in the plains was heavily reliant on grains, while the other two farming regions had a more diversified economy.[55]

The second indicator consists of rye prices. Rye was the dominant bread grain in this period, and the price data are from the Market Price Scales, which were published by Jörberg in his price history of Sweden. The Market Price Scales were the administrative prices used to value the various payments made in kind. The rules governing the manner in which these prices were established varied somewhat over time, but generally speaking they were based on the market prices gathered at the lower levels, such as the towns, judicial districts (*fögderi*), and parishes in the county. The procedure for weighing these prices into the Scales also changed over time (being either the results of the negotiations between various representatives or simple averages).[56] Despite the administrative character of the prices they closely reflected the real market prices, and hence they are an invaluable source for Swedish price history.[57] The price scales were set in the autumn each year after the harvest.

[53] For further information on the methods of constructing the output estimates in the HDSA, see ibid., pp. 120–3, and Olsson and Svensson, 'Agricultural growth', pp. 284–5.

[54] At the village level, the mean correlation coefficient for 293 pairwise estimations is 0.54 and their correlations with regional grain prices are typically –0.5, in both cases after trend elimination through first differences.

[55] After trend elimination, the correlation coefficient plains–brushwood was 0.80, while the forest areas were correlated at 0.73 (plains) and 0.75 (brushwood areas).

[56] Jörberg, *History*, vol. 1, pp. 8–18.

[57] Ibid., vol. 1, ch. 3.

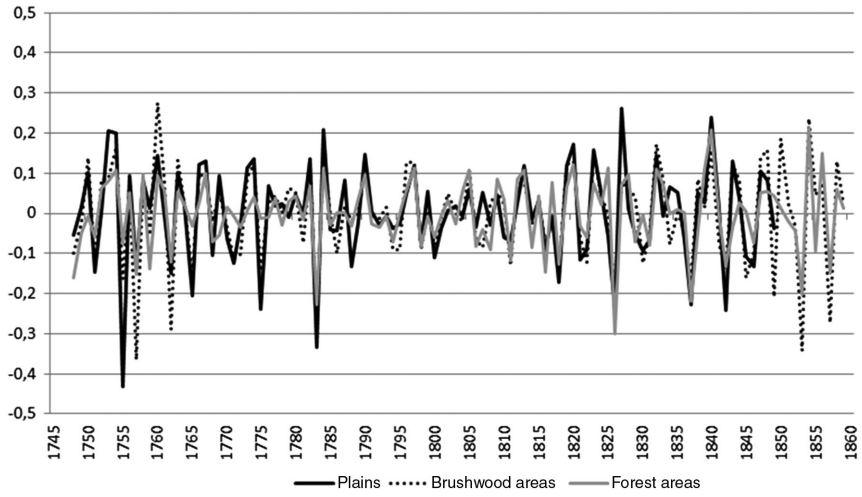

Figure 3. *Grain output in different farming regions, deviations from log HP trend*
Source: See fig. 2.

There was no immediate relationship between the local harvest outcome and the market price, as they reflected the harvests in other parts of the economy as well as the previous year's harvest to the extent that these factors affected the supply of food. Hence, we interpret the grain price as an overall indicator of economic conditions, rather than a simple reflection of the current local harvest. In years of high grain prices, we expect large parts of the population to have suffered economic stress, with a clear impact on mortality. We use rye prices for the two counties in Scania—Malmöhus and Kristianstad—and have recalculated the published figures into a single unit: kronor/hectolitre. The developments of the prices in the two counties were highly similar in terms of both trends and fluctuations.

To measure the short-term fluctuations, we de-trended the logarithms of the output and price series using the Hodrick–Prescott filter (hereafter HP) with a smoothing parameter of 6.25, which is suitable for the annual data.[58] In contrast with first differences, which measure the change between two consecutive years, our de-trended values measure the degree of departure in the series from a smoothed trend. Thus, while a change from low to medium would equal a change from medium to high using first differences, our residuals measure the conditions in the year under consideration in relation to the normal years in the period. The de-trended values used in the analysis are displayed in figures 3 and 4. To observe more closely the impact of economic crises on mortality, we use residuals lower than −0.12 for output (which roughly corresponds to an output that is 13 per cent lower than the trend level) and higher than 0.2 for prices (corresponding to rye prices that are 22 per cent higher than normal) to identify crisis years.[59] In terms of grain production, there were 23 such crisis years, while in terms of rye prices, there were 14 crisis years. The higher number of crisis years in terms of

[58] Hodrick and Prescott, 'Postwar US business cycles'.
[59] These thresholds were set on the basis of visual inspection of the data in figs. 3 and 4 to identify years of high prices and low output.

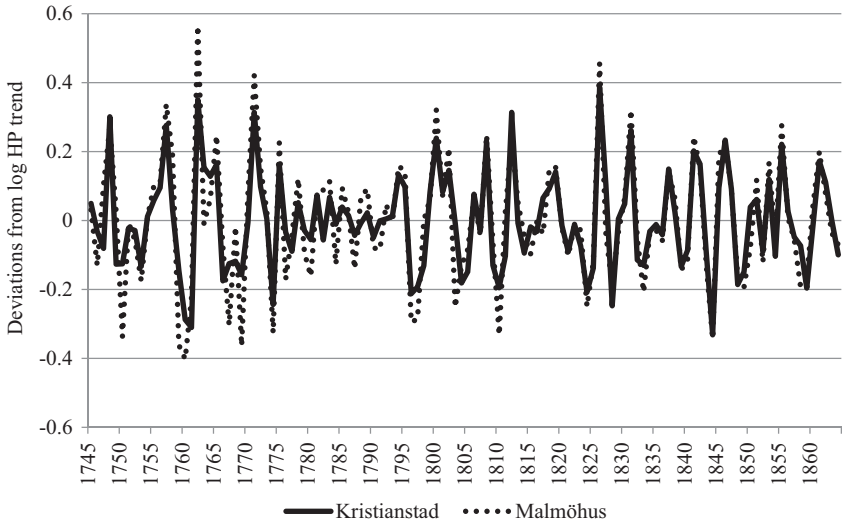

Figure 4. *Rye prices in the Scanian counties, deviations from log HP trend*
Source: Jörberg, *History*, pp. 133–45.

production is due to the lower level of aggregation. Not all bad years were shared between all farming regions, while the short-term price variations were very similar between the two counties because the markets were highly integrated. In fact, aggregating production to the Scania level, there were also 14 crisis years in terms of grain output, although not the same years as for prices. Only four of the 14 crisis years coincided, and in only one year did a high price year come after a low output year. This supports the idea of prices being exogenously determined, thereby reflecting conditions in much wider markets than the province of Scania. The overall correlation between the output and price series was also quite modest. Between the output series for the plains and the price in Malmöhus county, the correlation coefficient was –0.49, and the corresponding figure for the brushwood areas was –0.53 and for the forest areas –0.44. For an aggregated all-Scania series (not used in the estimations), the correlation with the price series was –0.53.

The degree of variability in grain harvests has been attributed some importance with respect to its impact on mortality, in that the decreased volatility damped down the price variations and reduced the risk of famines. In the case of England, the variability of the medieval yields was reduced until modern times. Due to the lack of data, the precise date is uncertain, but the process seems to have started no later than 1750.[60] In our case, it is not possible to follow the annual harvest fluctuations during the middle ages but, during the period of investigation, the volatility increased somewhat after 1840. Prior to this, the coefficients of variation for each 20-year period ranged between 0.12 and 0.16, but at this time it increased to 0.20. This pattern has been interpreted as a consequence of a switch from peasant risk-aversion behaviour to market orientation, in keeping with a sharp

[60] Campbell and Ó Gràda, 'Harvest shortfalls', pp. 873–4.

production increase.[61] The decrease in grain price volatility during this period has instead been attributed to continuous market integration.[62]

We analyse the mortality response to fluctuations in output and prices by estimating a series of geographical unit fixed-effects regression models for which the dependent variables are the age-specific mortality rates for the three age groups (0, 1–14, and 15–84). Mortality rates are calculated as the number of events divided by the population at risk. The fixed effects capture all unobserved factors at the geographical unit level (parishes or parish-pairs), such as differences in social structure, property rights (manorial–freehold), production structure, and geographical conditions. Results are reported as elasticities, which indicate the percentage change in the demographic rate for a change of 1 per cent in the grain output. We control for the period by including a set of 10-year period categorical variables. We use output data specific to three farming regions: plains, brushwood, and forest areas. Each geographic unit has been defined as belonging to one of the three farming regions, and the output data for each region are used in the estimates. These estimates give a picture of the mortality response to the local output situation. We also observe separate models for each farming region to determine whether their patterns differ. In the models analysing the response to price fluctuations, we use prices at the county level.

IV

The results are reported in tables 2 to 5. First, we examine the linear mortality responses to short-term variations in grain output and grain prices, and then we turn to crisis responses as measured by low output and high grain prices.

Table 2 displays the estimates for an assumed linear mortality response to variations in grain output measured by the deviations from a logged HP trend. With regard to the entire period 1749–1859, there appears to have been a clear mortality response to output fluctuations in all age groups. For infants, a 10 per cent decline in output increased mortality by 1.1 per cent in the same year and by 1.8 per cent in the year after. For child mortality and adult mortality, the effect was approximately 4 per cent in the year following the output change, but there was no significant immediate response. Thus, the mortality response was stronger for children and adults, and stronger the year after the output change than in the same year.

When divided into two periods (1749–99 and 1800–59), the relationship between harvest fluctuations and mortality exhibits quite dramatic changes. During the eighteenth century, the lagged mortality response was much stronger than during the nineteenth century. It is interesting to note that an immediate response developed in the nineteenth century at the same time as the lagged response diminished. For children and adults in the eighteenth century, a 10 per cent lower output meant an 8 per cent increase in mortality, which is a sizeable magnitude.

[61] See Olsson and Svensson, 'Agricultural production', p. 125, for an in-depth discussion of this.

[62] Jörberg, *History*, vol. 2; Persson, *Grain markets*, p. 91. Berg, *Volatility*, p. 47, underlines the importance of observing the level of aggregation when studying changes in harvest volatility, and also concludes that increased geographical market integration was decisive for the decrease in price fluctuation in eighteenth- and nineteenth-century Sweden.

Table 2. *Elasticities of the mortality response to short-term fluctuations in grain output (deviations from log HP-trend), fixed-effects estimates*

	All regions						*1749–1859*					
	1749–1859		*1749–99*		*1800–59*		*Plains*		*Brushwood areas*		*Forest areas*	
	Elasticity	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*
Infant mortality												
Grain output (t)	−0.111	0.008	−0.063	0.380	−0.194	0.000	−0.150	0.023	−0.059	0.337	−0.263	0.002
Grain output (t−1)	−0.178	0.000	−0.284	0.000	−0.037	0.517	−0.353	0.000	−0.039	0.554	−0.248	0.029
Observations	24,277		10,081		14,196		8,775		11,599		3,903	
Geographical units	274		239		273		102		126		46	
F	75.8	0.000	16.9	0.000	45.1	0.000	40.1	0.000	42.0	0.000	17.8	0.000
Child mortality												
Grain output (t)	−0.049	0.376	−0.028	0.777	−0.134	0.018	−0.086	0.385	0.042	0.569	−0.413	0.002
Grain output (t−1)	−0.392	0.000	−0.798	0.000	−0.009	0.872	−0.648	0.000	−0.221	0.008	−0.282	0.072
Observations	24,304		10,099		14,205		8,778		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	44.0	0.000	42.0	0.000	20.3	0.000	21.0	0.000	19.4	0.000	15.0	0.000
Adult mortality												
Grain output (t)	−0.050	0.390	−0.043	0.683	−0.117	0.046	−0.105	0.295	0.054	0.493	−0.392	0.004
Grain output (t−1)	−0.411	0.000	−0.817	0.000	−0.046	0.434	−0.706	0.000	−0.197	0.020	−0.362	0.027
Observations	24,309		10,099		14,210		8,783		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	39.4	0.000	43.5	0.000	20.8	0.000	15.2	0.000	24.2	0.000	13.3	0.000

Notes: P-values based on robust standard errors. Models control for 10-year periods. Elasticities give the % response in mortality of a 1% change in output.
Sources: See tab. 1.

In the nineteenth century, the immediate response to a change of 10 per cent was only approximately 1 per cent. The pattern for infant mortality was very similar. The fact that the mortality response weakened in the nineteenth century appears consistent with the changes taking place in the rural economy, with increasing levels of production and productivity[63] as well as ongoing market integration.[64] It also appears to be in line with indications of a general intensification of labour in this period, reducing the length of the slack season.[65] The higher and seasonally more uniform demand for labour meant that employment opportunities became less dependent on the harvest outcome, which in turn also affected demographic vulnerability to the local harvest outcome.

The pattern was quite different in the various farming regions, as indicated in table 2. The strongest response was in the plains region. Here, a 10 per cent lower output was associated with an increase in infant mortality of approximately 3.5 per cent in the year following the decline, and the corresponding effects for child mortality and adult mortality were 6.5 per cent and 7.0 per cent, respectively. The immediate response was lower and often not statistically significant. As a comparison, the response to a similar output change in the brushwood areas was approximately 2 per cent for child mortality and adult mortality, while there was no response for infants in this area. Similar to the plains, there was no response in the same year as the output change, only in the following year. In the forest areas, the mortality response was more similar for the current year and the previous year than was the case in the plains, approximately 3–4 per cent for children and adults and slightly less (approximately 2 per cent) for infants. This indicates an immediate sensitivity to fluctuations in output in the farming region where the production of grain was closest to the subsistence level.

Table 3 displays the estimation results using rye prices as a measure of economic fluctuations. The main difference with the output estimates is that prices reflect conditions in larger areas, while the production data reflect local output conditions. First, it is clear that mortality was highly responsive to fluctuations in grain prices, which is concurrent with previous research using prices. The response was stronger for children and adults than for infants, and the lagged response was also stronger than the immediate response for children and adults, though not for infants. Thus, there was a clear difference between the mortality responses to local output conditions and to market prices in that the immediate response was only visible for prices.[66]

Turning to the pattern by period, the lagged mortality response became slightly stronger over time for both children and adults, while the immediate response diminished. For infants, both the immediate and the lagged response became weaker over time, leaving only a very weak immediate response. This is in line with our hypothesis and with previous research using micro-level data, indicating a stronger mortality response to grain prices among landless labourers during the

[63] Utterström, *Jordbrukets arbetare*, pp. 694–717; Martinius, *Jordbrukets omvandling*, pp. 13–14; Gadd, *Järn*; Schön, *En modern*, pp. 69–73; Svensson, 'Peasants'; Olsson and Svensson, 'Agricultural growth'.

[64] Persson, *Grain markets*, pp. 91–130.

[65] Dribe and van de Putte, 'Marriage seasonality'.

[66] Models including both output and price at the same time indicate highly similar results, which supports the idea of exogenously determined prices and independent effects of price and output (results not displayed).

Table 3. *Elasticities of the mortality response to short-term fluctuations in grain prices (deviations from log HP-trend), fixed-effects estimates*

	All regions						*1749–1859*					
	1749–1859		*1749–99*		*1800–59*		*Plains*		*Brushwood areas*		*Forest areas*	
	Elasticity	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*
Infant mortality												
Rye price (t)	0.117	0.000	0.135	0.003	0.087	0.033	0.072	0.185	0.098	0.036	0.321	0.000
Rye price (t–1)	0.025	0.371	0.035	0.403	0.008	0.798	0.093	0.038	0.002	0.952	–0.090	0.259
Observations	25,238		10,081		15,157		9,736		11,599		3,903	
Geographical units	274		239		273		102		126		46	
F	89.7	0.000	16.3	0.000	56.2	0.000	49.2	0.000	41.6	0.000	12.9	0.000
Child mortality												
Rye price (t)	0.114	0.000	0.175	0.003	0.057	0.171	0.088	0.073	0.086	0.083	0.276	0.000
Rye price (t–1)	0.276	0.000	0.218	0.000	0.328	0.000	0.339	0.000	0.223	0.000	0.267	0.009
Observations	25,265		10,099		15,166		9,739		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	48.9	0.000	33.3	0.000	32.7	0.000	26.5	0.000	19.4	0.000	13.9	0.000
Adult mortality												
Rye price (t)	0.114	0.001	0.184	0.003	0.052	0.217	0.103	0.044	0.079	0.124	0.254	0.001
Rye price (t–1)	0.278	0.000	0.203	0.001	0.345	0.000	0.348	0.000	0.217	0.000	0.267	0.003
Observations	25,270		10,099		15,171		9,744		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	46.3	0.000	36.7	0.000	32.6	0.000	19.7	0.000	25.1	0.000	12.9	0.000

Notes: See tab. 2.
Sources: See tab. 1.

agricultural transformation.[67] Next, observing the results for different farming regions separately, it is interesting to note that the responses were highly similar across all regions, which is in sharp contrast to the pattern of responses to local harvest variations. While we found substantial differences in responses to local output conditions, the price response was very similar in different farming regions. Again, this supports the connection between the local output situation and the demand for labour. Although vulnerability to food prices was similar in all contexts, the relationship between the harvest outcome and employment opportunities was strongest in areas dominated by grain production, and it was also in these areas that mortality was most sensitive to the local harvest outcome.

Separate regressions for the change over time by farming region (the results are not displayed) reveal that vulnerability to output changes before the agricultural transformation was greatest in the plains, for both children and adults. After 1800, there were no significant responses to grain output in any of the three farming regions. This is in sharp contrast to the price response, which was similarly strong in the plains before and after 1800. In addition, in comparison, it increased between the two periods in the forest and brushwood areas. The latter can be interpreted as the result of the increasing vulnerability of the landless in these remote parishes, as a consequence of being pulled into the market economy in the nineteenth century.

Thus far, we have considered mortality responses to economic variations assuming a linear response. In reality, however, we expect mortality to have been affected mainly by larger negative deviations in output or positive deviations in prices; in other words, an economic crisis. Table 4 displays estimates of mortality responses to low output, defined as an output level approximately 13 per cent below normal (a deviation of more than 0.12 below the trend in log output). The estimates in the table indicate the percentage effect of a change of 1 per cent in the output variable. A one-unit change in a dummy variable amounts to 100 per cent, which implies that the estimates in the table should be multiplied by 100 to obtain the percentage response of low output compared with the normal/high output levels.

For the whole period, there was an increase of 13–14 per cent in the year following the crisis for both child and adult mortality. The infant mortality response was much lower, approximately 5 per cent. In the eighteenth century, a crisis year implied an increase in child and adult mortality of approximately 30 per cent in the year following the crisis. For infants, the lagged response was 9 per cent. This clearly indicates the high degree of vulnerability of rural people to local grain production in the period preceding the agricultural revolution. It affected children and adults most severely, but infants were clearly also harmed by adverse economic conditions. In the nineteenth century, the crisis response had completely disappeared. As previously mentioned, this indicates a seasonally more uniform demand for labour, which became less dependent on the most recent harvest and more dependent on long-term investments in land and buildings. These results also imply that the immediate response that developed in the nineteenth century, according to the linear estimates in table 2, cannot be explained as an immediate

[67] Bengtsson and Dribe, 'New evidence'.

Table 4. *Elasticities of the mortality response to low grain output, fixed-effects estimates*

	All regions						*1749–1859*					
	1749–1859		*1749–99*		*1800–59*		*Plains*		*Brushwood areas*		*Forest areas*	
	Elasticity	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*
Infant mortality												
Low output (t)	0.001	0.915	−0.005	0.835	0.011	0.475	0.016	0.501	−0.007	0.721	−0.006	0.869
Low output (t−1)	0.051	0.001	0.092	0.000	0.009	0.572	0.076	0.004	0.035	0.109	0.052	0.223
Observations	24,277		10,081		14,196		8,775		11,599		3,903	
Geographical units	274		239		273		102		126		46	
F	74.9	0.000	16.3	0.000	42.7	0.000	41.2	0.000	40.9	0.000	12.5	0.000
Child mortality												
Low output (t)	−0.005	0.758	0.019	0.535	−0.027	0.130	−0.006	0.826	−0.008	0.752	−0.015	0.745
Low output (t−1)	0.133	0.000	0.296	0.000	−0.004	0.811	0.256	0.000	0.062	0.017	0.069	0.211
Observations	24,304		10,099		14,205		8,778		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	46.3	0.000	47.9	0.000	18.8	0.000	25.1	0.000	19.8	0.000	15.0	0.000
Adult mortality												
Low output (t)	−0.007	0.684	0.025	0.441	−0.033	0.076	0.005	0.860	−0.017	0.500	−0.030	0.523
Low output (t−1)	0.137	0.000	0.307	0.000	0.002	0.921	0.273	0.000	0.057	0.030	0.069	0.229
Observations	24,309		10,099		14,210		8,783		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	40.4	0.000	47.4	0.000	19.6	0.000	18.7	0.000	24.5	0.000	13.3	0.000

Notes: See tab. 2. Low output compared with normal/high output. Low output is defined as about 13% below normal (log output deviations below −0.12).
Sources: See tab. 1.

crisis response, but was instead caused by lower mortality in comparatively good years in the forest areas (these results are not displayed).

Turning to the pattern by farming region, the marked differences are displayed in table 4. There was no response whatsoever in the year of the crisis in any of the regions, indicating that there were reserves available to cover the needs of the population in times of crisis. However, in the year following an output crisis, when we expect the supply of food to have been at its lowest in the spring and unemployment to have made it difficult for landless labourers to buy sufficient food on the market, mortality for children and adults increased by approximately 25 per cent in the plains and for infants by 8 per cent. In the brushwood and forest areas, the response was much lower and sometimes not even statistically significant. A year of output crisis meant an increase in adult and child mortality of only approximately 6 per cent in the following year. The low mortality response in the more marginal areas (forest and brushwood) indicates a lower dependency on grain due to a more diversified economy. In the plains, on the other hand, where the average standard of living was higher, the dependency on grain and thus the level of vulnerability were also higher.[68] To a large extent, this effect was probably related to a lower demand for labour and thus the lower earnings of large segments of the population following unemployment in the areas with the greatest dominance of grain production.

Finally, observing the mortality response to high prices, the pattern across farming regions was again much more similar than for output (table 5). A year of high grain prices led to an increase in mortality in the following year of 11–19 per cent for children and adults across the different farming regions. For infants, the response was approximately 10 per cent in the plains and brushwood areas but insignificant in the forest areas. The only notable distinction between the areas is a significant immediate response in the forest areas of approximately 10 per cent for all age groups. Observing all regions together, it can be seen that the pattern over time did not change greatly, as was the case when we analysed the continuous response in table 3. Thus, when determining the mortality response to price fluctuations, the degree of vulnerability does not seem to have changed greatly during the agricultural revolution, while the response to the output crisis virtually disappeared in the nineteenth century. That is to say, while employment opportunities became less dependent on the harvest outcome over time, most notably in the grain-dependent plains, mortality also became

[68] Living standards in the forest areas and the plains has not been systematically studied, but as shown by Söderberg (*Agrar fattigdom*, p. 18) for Sweden (based on Lundsjö, *Fattigdomen*), and in Söderberg's characterization of his two studied parishes in Scania, the average living standard on the plains was higher than in the forest areas. We have estimated the wealth for two different types of settings using probate inventories, which shows around 60–70% higher wealth in the plains, both for peasant farmers and the landless. The table shows wealth in probate inventories (in kronor) for peasant-farmers and the landless in Kinnevalds härad (forest area) and Bara härad (plains), 1750–1900 (N in parentheses).

	Forest areas	*Plains*
Peasant farmers	1,631 (50)	2,593 (56)
Landless	320 (43)	545 (41)

Table 5. *Elasticities of the mortality response to high grain prices, fixed-effects estimates*

	All regions						*1749–1859*					
	1749–1859		*1749–99*		*1800–59*		*Plains*		*Brushwood areas*		*Forest areas*	
	Elasticity	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*	*Elasticity*	*p-value*
Infant mortality												
High price (t)	0.048	0.001	−0.005	0.880	0.081	0.000	0.029	0.284	0.041	0.041	0.120	0.003
High price (t−1)	0.089	0.000	0.089	0.007	0.092	0.000	0.094	0.000	0.100	0.000	0.034	0.317
Observations	25,238		10,081		15,157		9,736		11,599		3,903	
Geographical units	274		239		273		102		126		46	
F	92.1	0.000	15.7	0.000	54.7	0.000	49.2	0.000	43.6	0.000	13.3	0.000
Child mortality												
High price (t)	0.036	0.029	−0.050	0.224	0.077	0.000	0.005	0.831	0.039	0.128	0.106	0.015
High price (t−1)	0.137	0.000	0.140	0.003	0.139	0.000	0.143	0.000	0.114	0.000	0.187	0.003
Observations	25,265		10,099		15,166		9,739		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	49.5	0.000	31.8	0.000	29.9	0.000	24.6	0.000	19.9	0.000	18.5	0.000
Adult mortality												
High price (t)	0.036	0.040	−0.045	0.318	0.073	0.000	0.010	0.710	0.039	0.144	0.093	0.061
High price (t−1)	0.141	0.000	0.125	0.005	0.152	0.000	0.155	0.000	0.118	0.000	0.167	0.001
Observations	25,270		10,099		15,171		9,744		11,611		3,915	
Geographical units	274		239		273		102		126		46	
F	49.1	0.000	35.0	0.000	33.3	0.000	19.3	0.000	26.5	0.000	18.8	0.000

Notes: See tab. 2. High prices compared with normal/low prices. High prices are defined as 22% above normal (log price deviations above 0.2).

Table 6. *Cox regression (hazard ratios, HR) of child mortality (1–14 years)*

	PRICE				*OUTPUT*			
	Farmers		Landless		Farmers		Landless	
	HR	p-value	HR	p-value	HR	p-value	HR	p-value
1766–1814								
t	0.87	0.695	1.73	0.086	1.63	0.560	0.44	0.283
t–1	2.46	0.008	2.20	0.010	0.29	0.102	0.30	0.099
1815–64								
t	0.78	0.554	2.95	0.000	0.63	0.404	0.20	0.000
t–1	1.27	0.560	1.20	0.480	1.05	0.929	1.05	0.898

Notes: Models control for parish. Price and output refer to harvest year (Oct. to Sept.) and are linked to the individual data; see Bengtsson and Dribe, 'New evidence', for a more detailed analysis of the price response and the construction of the dataset.

less sensitive to local harvest fluctuations in general and to harvest failures in particular. Despite the greater robustness of the economy, people were as vulnerable to food price variations as before, and it was not until later in the nineteenth century that demographic vulnerability to these kinds of economic fluctuations vanished.[69]

In the data used, we cannot distinguish the demographic responses by socioeconomic status. The only way to do that is to look at much smaller geographical areas for which longitudinal micro-level data are available. Using such data for five parishes in western Scania we were able to examine the mortality of farmers and the landless separately. These results showed that it was only the landless that were vulnerable to fluctuations in price and output during the agricultural transformation, while the responses were more similar between the groups before the transition (see table 6).[70]

V

The aim of this article has been to deepen our knowledge of the effects of the agrarian transformation on the vulnerability of the rural labouring poor. This has been achieved by using a unique dataset that made it possible to observe in more detail the effect on the population of local harvest fluctuations and grain prices. Our findings indicate a clear mortality response to fluctuations in local grain output, which means that not only prices, as a measure of the market price of food, but also local economic conditions affected mortality before the agrarian change. Mortality in all ages responded, but it was strongest among children aged one year and over and among adults. This response diminished during the agricultural revolution in the nineteenth century. The response to market prices, on the other hand, remained largely unchanged over time, which seems to suggest that while the overall level of vulnerability did not change, the functioning of the labour market and the local

[69] See Bengtsson and Dribe, 'New evidence'.

[70] The same data have been used in a number of detailed analyses of the demographic responses to price fluctuations, corroborating these findings of a much stronger and more consistent response among the landless groups. See, for example, Bengtsson, 'Living standards'; Bengtsson and Dribe, 'New evidence'; Bengtsson and Dribe, 'Agency'; Bengtsson and Dribe, 'Quantifying'.

economy improved considerably. This made it possible to withstand local output crises without the detrimental effects of mortality. When conditions were severe in larger areas, as indicated by the high grain prices in wider markets, it was still very difficult to deal with economic stress, as indicated by the strong mortality response to grain price variations. In fact, this response to grain prices became slightly stronger over time, which indicates increased vulnerability to market fluctuations.

The degree of vulnerability to output fluctuations before the agricultural transformation was also much greater in the plains than in the brushwood and forest areas. This is explained by the greater dependency on grain in the plains; those in the forest and brushwood areas had more diverse sources of income. Part of the response in the brushwood and forest areas came as a result of lower mortality in good times; in other words, when production was high. On the other hand, the local harvest had a much weaker impact on the demand for labour than in the plains. The landless could find jobs the next winter, in spite of a bad harvest in the autumn, which is probably the reason for the weak or non-existent impact of the harvest crises. This is in contrast with the plains, where there was a deep and profound crisis response after the harvest failures, indicating that landless people simply ran out of job opportunities in the one-sided grain economy.

As a result of the changes in and the character of the agricultural transformation of the early nineteenth century, in northern Europe commonly associated with new land brought into cultivation, demand for labour increased following these massive investments in land, including enclosures, land reclamation, drainage, introduction of new crops, and crop rotations. This contributed to a seasonally more uniform demand for labour, which in turn reduced dependency on the previous harvest for employment opportunities in the rural communities dominated by grain production. This subsequently reduced vulnerability, as measured by the mortality response, to local harvests, thereby providing some support for the revisionist view of the effects of the agricultural revolution on employment.[71]

The mortality response to price fluctuations was, on the other hand, similar across the different areas. This indicates that while a more diversified production structure insulated people in the forest and brushwood areas from much of the uncertainty of grain production, they were as dependent on market prices as people on the plains. Similarly, vulnerability to price variations remained unchanged in the first half of the nineteenth century, which indicates that the more efficient and more productive economy emerging through the agricultural transformation was still unable to insulate the population from these kinds of uncertainties; the revisionist employment effect was at hand, but at the same time the poor lacked resources to prevent them from being hit by exogenous price shocks. Not until the second half of the nineteenth century, when these structural changes were completed, did the strong connection between the price of basic foodstuffs and mortality diminish. Only then was one of the most decisive characteristics of preindustrial, or Malthusian, society eradicated.

[71] Chambers and Mingay, *Agricultural revolution*, pp. 98–9.

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