9 March 2006

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Economic Stress and Timing of Childbirth in Europe and Asia

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Introduction

Short-term changes in food prices had a strong impact on fertility in preindustrial populations (Galloway 1988). This pattern was strikingly similar throughout historical Europe, as it is today in other parts of the world (see the review in Bengtsson and Reher 1998). The fertility response to food prices was rather immediate and lasted for several years (Galloway 1988). Many analyses of this phenomenon are based on large populations – entire countries or large parts thereof – and lack details about social and economic differentiation. These studies therefore fail to explain whether the fertility response was due to malnutrition and poor health, to separation of couples due to temporary migration, or to deliberate planning of births. Thus, they are unable to determine whether the observed relationship between economic fluctuations and birth rates resulted from agency – planned adaptation to economic circumstances – or was a passive response. The aim of this chapter is to examine causality by taking a household perspective in which we combine longitudinal data on individuals with community data on food prices taking the socioeconomic situation of the household into account.

This chapter analyzes the timing of childbirth at the individual level in response to aggregate changes in food prices over time. In so doing, we add a new dimension to the discussions of childbirth in the first part of this volume, which focused on the number of children born and sex composition of surviving children. The main objective is to answer the following question: prior to the fertility transition, did all or some social groups plan their births to smooth household consumption from year to year, as do many couples today, or was the correlation between food prices and births due to temporary infecundity or separation of spouses, possibly due to labor migration? The outcome will give us an understanding of living conditions in the past, the magnitude of social differences, and whether people actively adjusted their childbearing to smooth consumption in times of short-term economic stress. We already know from our previous analyses of mortality that all families were not fully successful in this smoothing process, since food prices affected deaths (Bengtsson, Campbell, and Lee *et al.* 2004). In some of the areas under investigation, there are also indications that labor market opportunities were scarce and migration less of an alternative (Dribe 2003a). Could it be that when economic measures to smooth the effects of short-term economic stress failed, the only measure people could take was to postpone childbirth?

This chapter is divided into five sections. First we give an overview of the new standard of living concept developed in *Life Under Pressure*, which focused on the mortality response to short-term economic stress by sex, age and socioeconomic group (Bengtsson, Campbell, and Lee *et al.* 2004). The second section deals with the development of food prices, which serves as the main indicator of economic stress, in the various local settings. In the third section, we develop the framework for analyzing the effects of short-term economic stress on fertility, followed by a presentation and discussion of the empirical findings.

The Demographic Response to Short-Term Economic Stress

Clear responses of fertility, mortality and nuptiality to short-term changes in harvests, prices or real wages have been found in aggregate studies of several preindustrial countries, indicating the high degree of uncertainty facing people in these societies (e.g. Bengtsson and Ohlsson 1985; Feeney and Kiyoshi 1990; Galloway 1988; Lee 1981; for an overview, see Bengtsson and Reher 1998). The situation for many developing countries of today is similar (Lee 1990). Throughout, the fertility response to these changes was much stronger than the mortality and nuptiality responses (Galloway 1988; Lee 1990). People in poor areas of pre-industrial Europe were more vulnerable than in rich areas, as shown for Denmark and France (Galloway 1986, 1993). Analysis of aggregate sex- and age-specific mortality rates for Sweden shows that the mortality response was also very strong in some age groups, particularly for adults (Bengtsson and Ohlsson 1985). Analyses of micro data within the Eurasian project verify that this holds true for populations in China, Japan, Belgium, and Italy as well (Lee, Campbell, and Bengtsson 2004a). Children were vulnerable to short-term economic stress too, while mortality variations among infants and the elderly were largely determined by other factors (Oris, Derosas, and Breschi 2004; Tsuya and Nystedt 2004).

Some of the variation in birth rates is due to biological constraints related to time since birth of the last child. A sudden peak in births is consequently followed by a drop in the birth rate, because birth intervals shorter than 12-14 months are exceptional. As this process reoccurs, it creates short waves in the birth series. The initial apex could be due either to a positive or negative stimulus that has influence on all couples, or to peaks in marriages. A sharp increase in mortality among unweaned infants is an example of such a negative stimulus that creates short cycles in the birth series. Spikes in marriages, however, have only minor effects on yearly variations in births (Bengtsson 1993b; Carlsson 1970; Lee 1981). Instead, they produce a long wave of births in the following twenty-year period, because of large

variations among women in the interval between marriage and first birth, and in later birth intervals. Historically, some women were pregnant at the time of marriage and gave birth very soon after the wedding, while others had a long waiting time until they conceived. Intervals between births also varied substantially among women. Whilst birth rates often varied from one year to the next by five per thousand or more, marriages varied by less than half that figure. Since twin and triple births are rare – only about 3-4 percent of all births are multiple births – the main part of the yearly variation in births stems not from the timing of marriages and first births, but from the timing of second and higher order births.

While we know from aggregate studies that fertility responded to short-term variations in food prices both in Western Europe and in other parts of the world, we lack the details which would make it possible to identify the principal mechanism behind the response. Whether the response was uniform in all socioeconomic groups or concentrated among the poor is also not clear, nor do we know whether certain stages in the life cycle were particularly vulnerable to economic stress.

The response of fertility to prices offers information about the living conditions and opportunities of people in the past. It is, in other words, an indicator of the standard of living. The idea of using the ability to overcome short-term stress as an indicator of living standards was developed in *Life Under Pressure* (Bengtsson 2004a, 27-59; see also Allen, Bengtsson, and Dribe 2005; Bengtsson 1993b). While the analysis of living standards in studies of demographic behavior is essential, data problems make the actual performance of such analysis cumbersome, especially when working with historical sources of information. Production and consumption data are scarce for preindustrial settings, as is income data, particularly at the household level. Since contemporary standard of living measures are therefore difficult to apply in historical studies, we propose a new concept designed for longitudinal micro-studies and comparative purposes. We argue that the way individuals and

households responded to short-term economic stress resulting from variations in food prices depended on their access to resources. Effects of short-term economic stress on migration, nuptiality, fertility and mortality can therefore be used as an indirect measure of individual living standards. Thus, we analyze the standard of living for men and women of various ages, socioeconomic groups, and household settings through their ability to overcome short-term economic stress. By short-term economic stress we mean variations in income or food prices from one year to the next, or even within shorter time spans, as well as income loss after the death of a wage-earning household head. If you cannot fulfill your long-term plans – to survive, to marry, and to have children – in the face of acute short-term changes in your environment, you have a low standard of living.[1] This new concept has shown consistency with traditional ways of measuring well-being in the past where comparisons are possible (Allen, Bengtsson, and Dribe 2005). The question is then to what degree food prices affected consumption.

Estimates from developing countries show that the elasticity of household consumption with respect to food crop prices varies between -0.37 (Thailand) and -0.66 (Sierra Leone) (see Dasgupta 1993, 223). Thus, an increase of food prices by 30 percent reduced consumption by 12 to 20 percent. In an estimate of the historical standard of living in Copenhagen, the yearly decline in calorie intake per head was 14 per percent in 1763, which was a bad harvest year (Thestrup 1971, 258-259). Since not all residents of the city lowered their consumption that year, some inhabitants saw declines of more than 14 percent. In other words, rather modest price increases during the preindustrial period likely resulted in decreases of around 10 to 20 percent in the annual caloric intake of the poorer parts of the population. Fogel (1992) argues along the same lines in his calculations of the effects of changes in food supply and prices on consumption for various social groups. While the share of consumption varied much more for laborers than for farmers and landlords, their price

elasticity for food grains was high and stable, since they had to buy food regardless of prices (Fogel 1992, 258-259). Hence, in years of harvest failure the effects on consumption are bound to be much more substantial for these groups, while other groups certainly benefited from high prices.

We expect vulnerability to short-term economic stress to be affected by both the consumption needs of individuals and households, and their ability to save. The latter is largely a consequence of access to resources other than labor, particularly land. It is important, therefore, whether the household was a *net producer* or a *net consumer* of food. The extent to which net consumers were affected depended on whether they had access to land or had to buy all their food on the market. The larger the share they bought, the more they should have been affected. We should also expect them to be more affected if they were paid in money than in kind, since wages were more stable than food prices. If they were paid in kind, their response to high food prices would have been dependent on the type and length of contract.

We expect artisans, who produced common goods such as textiles, to have been the group most disadvantaged by a price increase, because many of their customers could not afford their products as food became more expensive. Artisans producing goods for the agricultural sector could, however, experience an increased demand for their products since farmers generally gained from high prices. Given that prices are determined externally, which we believe they were in most of the locations in our study, net producers were positively affected by high food prices (see e.g. Dribe 2000, chapter 7). They benefited more if they paid taxes or rents in money than in kind, labor, or share of harvest, and also if they had long-term rather than short-term contracts. The best-off among the net producers should not have been affected by short-term changes in food prices, since they probably were able to use their savings or at least to borrow. The actual outcome, however, depended to a large extent on

how taxes and rents were paid, and therefore differed according to tenure arrangements, i.e. free-holding, tenancy, sharecropping, etc. It also depended on whether the households were *individually* or *collectively* responsible for paying the tax or rent. The following discussion considers how grain prices might influence each of these groups separately under the assumption that prices are exogenously determined.

There are several groups to consider both in Europe and Asia, each of which had different land tenure arrangements and responded differently to price fluctuations. Freeholders and tenants usually paid a fixed rent in kind or in money. Sharecroppers with short-term contracts paid a share of the harvest in rent, as in Casalguidi where half of the harvest was owed to the landlord. Crofters with small plots, as in Scania and Sart, needed to work as day laborers since they could not survive only on their small farms. Servants were mainly paid in kind. Day laborers were usually paid in money, as were artisans (at least in Europe). Except for servants and day laborers living in the household where they worked, most other groups had access to a small plot of land or at least a garden, where they could grow vegetables and perhaps also keep some poultry. It needs to be emphasized that the size of the landholding was important as well as the type of tenancy. In the beginning of the nineteenth century, for example, the number of freeholders increased in Sweden while the average parcel size declined. As a consequence, some landowners depended on income from wages for their subsistence.

The socioeconomic setting found in Ou in Northeastern Japan is both similar to and different from Europe. It is similar in the sense that there were comparable social groups, e.g. local elite, tenants, artisans, and landless laborers, but different because taxes were paid collectively by the village, not each individual farm (Tsuya and Kurosu 2004b). Farm sizes varied but the proportion of landless was much lower than in the European settings; only about 18 percent, compared to Scania where more than half of the families had no access to

land (figure 9.7; Lee, Bengtsson, and Campbell 2004; see also chapter 2). In the Japanese villages, each farm contributed to the village rent according to the size of the farm but the rent was a collective responsibility. Thus, the socioeconomic situation of households in Ou was to a large extent determined firstly by whether they owned land or not, and only secondly by the size of the farm. Basically, all but the landless were net producers.

Liaodong is similar to the European locations but, then again, also different. The population was employed by the state to produce a certain surplus of food, goods and services. Between 86 and 96 percent of the population in the Liaodong communities were farmers and the rest either belonged to the small local elite or were solders or artisans (chapter 8, table 7.1). These groups had an income from the state as well as their land. The question is whether or not they were compensated for rising food prices, like similar groups in Europe and Japan. Some 15 percent of the farming population was landless in Liaodong, and they suffered from problems similar to landless in the other locations.

Vulnerability to short-term economic stress, manifested in access to food and prices of food, depends on whether a family is a net producer or a net consumer of food products. In the case of net consumers, the degree of vulnerability depends on whether or not compensation for high food prices is possible. For net producers, it depends on the terms of taxes and rents. Basically, tenants with long-term contracts gained from soaring prices, since the owner of the land could not increase the rent even if prices and the incomes of farmers went up (Abel 1966/1980). If the contract was on a short-term basis, the owner might have been able to increase the rent as prices went up, though with a certain time lag. Generally, the best arrangement for tenants in times of rising grain prices was rent paid in money, because high prices meant that less grain needed to be sold to pay the dues. The advantage for sharecroppers was that whatever was left for sale would go at high prices, which meant that they would receive more money for their products. If sharecroppers produced non-staple

goods, however, the demand for these goods may have declined as higher grain prices drove up the cost of living. Thus, this group would have suffered from high prices, if they did not produce food for their own consumption in addition to the marketed crop. For non-agricultural groups, including the local elite and the soldiers, as well as for agricultural laborers, it was a question of whether or not they were compensated or could compensate themselves for high food prices, and if they were able to store food or salable items. While most farmers combined production of plants, mainly grain, with production of meat, some, like the peasants in the Pays de Herve, were specialized in animal production, which means that they probably benefited from low grain prices too.

In conclusion, we expect that various socioeconomic groups responded in different ways to short-term economic stress caused by food price variations. The response tells us much about the conditions under which they lived, i.e. their standard of living. Access to land and ability to store wealth are obvious reasons for differences in response. As we argue below, the response is not only dependent on these factors but also on the stage of the family life cycle, the size and complexity of the household, as well as the larger social context. The most advantaged groups did not respond to prices at all, because they had the capacity to maintain normal consumption during bad years.

Food Prices and the Local Settings

In this section we will focus on aspects of the oft-violent changes in annual food prices in our study areas and on measures taken to prevent them. These measures could be taken by governments, local communities, landlords, employers, or the family itself, either to smooth food prices directly or to reduce the effects of these changes.

Figures 9.1 to 9.6 show the development of food prices in the various locations. The curve for rice prices on the market in Aizu – a town situated about 40 kilometers to the west

of the villages of Niita and Shimomoriya – shown in figure 9.1, is somewhat different from the others because of the dominance of three major famines (Kyoho, Tenmei, and Tempo) and the lack of a long-term trend. There is also a considerable amount of variation from year to year between these famines. Prices of sorghum, a staple crop grown in the area of Liaodong and shown in figure 9.2, reveal a lot of variation both in the short and the medium term but without any long-term trend. The same holds true for the wheat price series shown in figure 9.3 from the city of Parma, which is close to the Italian areas included in this study. The prices for oats in eastern Belgium used for Sart are shown in figure 9.4. Prices of food in Belgium and the rest of Europe were high during the Napoleonic Wars and increased again after a short period of lower prices. The series has a distinctive upward trend until the 1870s, when American grain flooded Europe. In the analysis of the Pays de Herve, the cost of living index constructed by Scholliers (1993) is used (see figure 9.5). Trends in the two Belgian series have been removed using a Hodrick-Prescott procedure, since the focus is on short-term economic stress. The same procedure has been used for the Swedish data, which also contains a trend. Rye prices are used for the analyses of the four parishes in Scania (see figure 9.6).

Food prices in all locations show a considerable amount of variation from one year to the next. The three peaks in the Japanese series are due to above-mentioned famines that presumably affected large parts of the population, and the same applies for Sweden in the 1770s. Most of the variation is not related to extreme situations, like famines, but to more normal variations in the supply of food. Even though prices for our sites in Japan, China and Sweden were either set or monitored by the local governments, they are known to reflect prices on the local markets (Campbell 2004).

- Figures 9.1-9.6 here

For reasons illustrated in previous sections, various social groups were influenced differently by food price fluctuations, and social differentiation was strong in all the geographical settings included in this study. This is evident from figure 9.7, which shows that land was distributed very unequally among households. Inequality was most pronounced in Swedish Scania where about half of the families had no real access to land except for very small plots; least so in the Asian settings where some 15-20 percent of households were landless. The figure also shows that the wealthiest 10 percent of the population in Scania controlled almost half of the land, while the corresponding figure in Ou was only about 20 percent. Indeed, there were local elites in all the societies included in the comparison. In the European setting noblemen, clergymen and priests, functionaries and large landowners stood on the top of the social and economic ladder. Similarly, in the Japanese villages and in Liadong, functionaries and a group of wealthy farmers constituted the highest rank. The lowest groups were the day laborers and the journeymen, people with no land and few skills. In between were households with farms of varying sizes and tenancies, some of whom were net producers while others had to sell their labor to support themselves.

- Figure 9.7 here

In most cases low prices meant good years for net consumers and bad years for farmers, whose expenses for rents, taxes and labor were more stable than their incomes. Measures were taken at various levels to reduce the negative impact of price fluctuations. Governments used granaries and subsidies to stabilize prices and gave or lent grain in years of crisis. When the Swedish government started granaries in order to reduce price fluctuations, the purpose was to limit the negative effects on producers, not to benefit consumers, though it had positive effects for them as well (Åmark 1915). Grain was not given away gratis but on

loan, and at a certain interest rate. The situation in China and Japan seems to have been more generous. Nonetheless, the basic problem in all locations was the high cost of storing grain, both in terms of volumes and nutritional content, which also implied that only quite limited quantities of grain in Europe were stored every year (e.g. Persson 1999, chapter. 3). As a result, the granaries often did not have enough supplies in times of dire need, although institutional arrangements in the two Asian sites were more extensive than in the European ones.

Another way to ease the burden of bad years was to lower taxes and rents or, if it came to the worst, to exempt them entirely. Quite different systems operated in various locations. Taxes in Japan, for example, were paid by the village and not the family, which created community solidarity, even though each family contributed according to their farm size (Tsuya and Kurosu 2004b). Taxes in Sweden as well as Belgium and Italy, on the other hand, were assessed on households or individuals within them. Families could, however, be released from taxes in bad years after applying to a tax appeal board. Tenants, likewise, could be released from rents to landlords. More often, however, rents were only temporarily rescinded, requiring the tenants to pay their accumulated rents afterwards. In Scania, for example, tenants on the Bjersgård estate paid back accumulated rents in 1773 that corresponded to total rents for one year (Olsson 2002, 124).

Local poor relief systems during this period were widespread throughout Europe (Solar 1995, 6; Wall 2002). In most cases these systems were designed to assist only the part of the population without means and without relatives to assist them. In most countries and certainly in the ones included in this study this meant the sick, the handicapped, orphans and some elderly. In 1846, a particularly bad year, only five percent of the population in Sart received poor relief.[2] In 1827, only about two percent of the population in Sweden received public poor relief (Skoglund 1992).

Families in the past, in both East and West, to a very large extent had to rely on their own resources to reduce the negative impact of variations in food prices. In the areas under study, people had few opportunities of finding alternative sources of income during bad years. There were no mining, fishing, or industrial activities nearby which they could rely on if farming failed. The only exceptions are Sart and the Pays de Herve, which were located near an industrially developed textile city that offered other opportunities. Put differently, and as we already have shown in our previous volume on mortality responses to prices, various forms of assistance, such as loans from employers and public works initiated to reduce unemployment, did not prevent a large part of the population from suffering heavily from high food prices, (Bengtsson, Campbell, and Lee *et al.* 2004). Though migration was free and frequent in the European locations, migration of married couples in times of economic stress appears to have constituted a realistic alternative only in some of the communities. Hence the question remains as to whether or not people adjusted the timing of births, as a precaution against sudden but, nevertheless, anticipated variations in food prices.

Fertility and Economic Stress - A Conceptual Framework

Human fertility is a complex process with biological/physiological as well as socioeconomic and cultural components. One influential conceptual framework for analyzing this complex phenomenon was devised by Bongaarts (1978), who was inspired by the earlier formulation of Davis and Blake (1956). Briefly, this approach focuses attention on a set of immediate factors, or proximate determinants, that affect reproduction directly, both intentionally and unintentionally. The proximate determinants can be divided into three sub-groups. First, exposure factors (nuptiality in most cases) affect the number of women at risk of childbirth. Second, deliberate actions can be taken to limit fertility, such as contraception or induced abortion. Third, a number of physiological factors influence fertility, such as post-partum

amenorrhea, sterility and spontaneous abortion. These proximate determinants, in turn, are affected by various indirect factors: socioeconomic, cultural or environmental. This powerful framework has been used quite extensively in the fertility literature.

We employ an extended version of this framework in our analysis of how marital fertility might have responded to short-term economic stress (see figure 9.8). We may think of three ways that fertility could be affected by an economic crisis. First, families may deliberately postpone childbirth in times of economic hardship by using contraception (modern or traditional), or induced abortion. Second, economic crisis may force people to migrate seasonally to search for work, which would separate spouses if women stayed behind while men left home. Third, fertility may be affected by lower fecundability, and possibly higher risk of spontaneous abortions, following malnutrition or increased exposure to disease. An influential literature argues that deliberate family planning was almost unthinkable in pretransitional Europe (e.g. Coale and Watkins 1986; Knodel 1977). Recent research emphasizing deliberate spacing of births before and during the fertility transition (e.g. Anderton and Bean 1985; David and Mroz 1989b; David and Sanderson 1986; Szreter 1996; Van Bavel 2004; see also Santow 1995; Van de Walle and Muhsam 1995), however, points to the possibility of deliberate postponement of births in times of crisis.[3]

- Figure 9.8 about here

Turning to the link between nutrition and fertility, there is agreement that fecundity can be affected by periods of severe but temporary malnutrition (i.e. acute starvation), while there is disagreement concerning effect of chronic but less severe malnutrition (Bongaarts 1980; Frisch 1978; Menken, Trussell, and Watkins 1981). Since we are only dealing with short-term effects in this chapter, we can safely conclude that temporary, severe malnutrition

may lead to cessation of ovulation, loss of libido, and reduced sperm production, which lower fecundity. Such effects have been documented both in contemporary less developed countries and in modern societies, for example during the Dutch famine during the Second World War (Bongaarts 1980).

In this chapter, we compare the fertility response to short-term economic stress in the different Eurasian communities. To make these comparisons, we have estimated three different models for each of these communities. The models have also been estimated separately for the interval between marriage and first birth and intervals after first birth, since the causality between marriage and first birth in the European locations is less clear. Sometimes couples had to marry because the woman was pregnant, which was quite often the case, and sometimes they cohabited after having decided to marry but before they were legally wedded. Some couples may even have been together "on trial" to test whether they could conceive before definitely deciding to marry. Since the potential effects of economic stress on the marriage decision might affect the first birth, we separate the analyses of first births from subsequent births into two models. Economic stress is measured by short-term fluctuations in food prices, in most cases grain. The first two models focus on the response to food prices in different social groups, controlling for age, village of residence, time period, and previous migration. One model captures only base effects of these variables, while the other model also includes interaction effects between prices and social status. The aim of these two models is to determine the magnitude of the fertility response to economic stress, whether it occurred in the first or second year after a change in food prices, and to what extent this response was dependent on social status. In most cases, we expect to find differences between social groups because different social groups have different economic margins and also differ in dependence on the market and whether they were net producers or net consumers of grain. While studies on aggregated data suggest that the fertility response to

food price changes could be rather drawn out – up to four years and often with a rebound – micro level analyses show that it was much shorter. Based on this experience, we limit the models to include fertility responses within two years after the change in food prices.

The third model focuses on the effect of prices on fertility with respect to number of children ever born and sex composition of surviving children, controlling for social status, village of residence, time period, and previous migration. This model aims at capturing different responses to prices by children ever born and family composition. If families had clear targets in terms of numbers or sex composition of children, we might expect those who had reached their targets to be more willing to limit childbearing in times of economic stress. This not only depends on having a clear target, but also requires that the perceived cost of missing the target is higher than the cost of having children at a bad time. Otherwise, we cannot expect families who had not reached their targets to be less willing to postpone childbirth in times of stress.

Results

The results of the three different models (overall effects of grain prices, social group-specific effects of grain prices, and response to grain prices by number of children ever born and sex composition of surviving children) are presented in four summary tables (tables 9.1-9.4), giving the estimated effects of prices on fertility (or in some cases reproduction of children at a certain age). While prices changes often could be very large, the estimated coefficients have been transformed to effects of a 10 percent increase in grain prices, to make comparisons as clear as possible.[4] It must, however, be noted that the type of data (continuous, discrete annual, or discrete triennial) and the meaning of prices in different social groups differ among communities, which makes detailed comparisons difficult. Nonetheless, broad comparisons of the direction and order of magnitude of price effects are possible.[5]

Table 9.1 displays the effects of food prices on fertility (risk of giving birth) in the six different communities in the first and second years after the harvest, except for Liaodong for which models with only a one year lag have been estimated.[6] The reason is the problem of identifying and estimating effects distributed over several years with triennial data. In the Asian locations, "fertility" actually means reproduction, because only children surviving to the next registration (annually in the Japanese villages and triennially in Liaodong) are observed (see chapters 7 and 8). This implies that the observed effects on reproduction will reflect a combination of fertility, infant and child mortality, and infanticide or child neglect. Since data on male births in China is known to be of better quality than female births, they are reported separately. The figures given in the table indicate the percentage change in fertility following a ten percent increase in food prices, controlling for age, socioeconomic status, parish of residence, time period and previous migration. The table thus compares the fertility responses to short-term economic stress without taking differences in the response between social groups or family size and composition into consideration. While the absence of an effect of prices could be due to the fact that food prices have opposite effects on producers and consumers, a significant effect in either direction shows that one type of response is dominant.

Table 9.1 clearly shows that the negative effects of prices are predominant. Beginning with second and higher order births, in most locations fertility falls in the year after the price increase. There is a substantial difference in the magnitude of the response. Two locations, Niita and Shimomoriya in Japan, and Sart in Belgium, show no response. In Scania there is an effect also in the second year after the price change. In the Pays de Herve, where there is a very strong negative response in the first year, fertility bounces back in the second year. This means that a drop in births after a year with high food prices is, at least partly, compensated in the second year. In Casalguidi, the response is strong but not statistically

significant. In Liaodong, were we have estimated a model with a one year lag only, we find a price effect for both female and males. Here we should also keep in mind the limitations of using triennial data in studying the response of fertility to economic stress. We can only infer that economic stress had a clear impact on the *reproduction* of approximately three-year-olds. Some of this effect may have been a genuine change in fertility, while some of it was due to infanticide, neglect, and perhaps infant and child mortality (see Lee, Campbell, and Tan 1992; chapter 8). The overall pattern is clear: reproduction decreased in response to short-term economic stress in most locations in both Europe and Asia.

- Table 9.1 about here

Food price effects during the interval between marriage and first birth is, for reasons previously discussed, very difficult to interpret, especially in the European contexts with a high prevalence of premarital pregnancies. In the European locations and in the Japanese communities, there are no statistically significant effects of prices on first births but the sizes of the coefficients are in most cases considerable. Sometimes the coefficient are similar to the effects of higher order births, sometimes they are not. In Liaodong, there are statistically significant price effects for both male and female first births.

In most preindustrial contexts, food prices affect various social groups differently, as previously discussed. In most cases, producers of food benefit from high prices, especially in commercial agriculture where large quantities are produced for the market. In an integrated economy with a well-developed trading network, grain prices are determined on distant markets well beyond the local supply system, which makes the local producers price takers on these larger markets (see e.g. Dribe 2000, chapter 7). This implies, in turn, that the local harvest cannot influence the price of grain. Under these circumstances high grain prices

increase revenues for market producing peasants, while they lower real wages for net consumers (e.g. landless laborers) dependent on the market to buy food. The historical situation was often considerably more complicated, since some consumers received much of their income in kind and thus were not completely dependent on the market for their consumption. At the same time, although the market economy was clearly present in all of our communities, it may not have worked perfectly at all times. Infrastructural as well as institutional deficiencies in some cases had detrimental effects on trade and on the functioning of the market economy. Nonetheless, we can expect that landless, in general, were more negatively affected by grain prices than landed peasants, partly because of their stronger dependence on the market for their consumption and partly because of their lower economic reserves (i.e. accumulated wealth).

Liaodong, especially before 1860, was characterized by subsistence agriculture with limited trade, where high grain prices indicate a low supply of grain and low levels of consumption for producers (chapter 8; Lee and Campbell 2005). In this community, farmers actually had the lowest social status, and it is not possible to differentiate this category further. Hence, high prices were clearly a sign of crisis for the producers of food in this part of northern China. Although this group resembles agricultural laborers more than the market-oriented peasants of, say, nineteenth century Scania (see chapter 8; Lee and Campbell 1997; Lee and Campbell 2005), the fact that farmers constituted about 90 percent of the population in the Liaodong communities highlights the possibility that there might be differences within this social group not captured in our results.

These expected differences between social groups make it necessary to analyze the fertility response to economic stress by social status. Since social structure differs across communities, as do the available sources, it has not been possible to work with identical social categories. We use classifications designed specifically for each community. In the two

Belgian communities and in Liaodong, these categorizations are based on the occupation of the head of the household, while in Scania and the two Japanese villages they are based on access to land. In Casalguidi, social status is based on taxes, distinguishing between high-taxed (rich), low-taxed (medium poor), and untaxed (poor) (see chapter 6). Two additional comments are warranted. First, farmers in Sart and in the Pays de Herve had strongly diverging market orientations. In Sart, they produced grain and other crops needed for subsistence. In the Pays de Herve, 88 percent of the arable land was devoted to pasture, thus the farmers were heavily specialized in dairy products, fruits, and, to a lesser extent, meat. They bought other foodstuffs on nearby markets. Second, the "others/unspecified" group in the Belgian communities is a mixture of people. In the Pays de Herve, about 45 percent in this group had no profession mentioned and about 30 percent were explicitly recorded as having no profession, while the rest were reported as housewives or poor. In Sart, the group of "others/unspecified" belonged mainly to the lower strata of the population.[7]

Table 9.2 shows the effects of prices on fertility by socioeconomic status ranging from high to low. The results in the table are computed from interactions between prices and socioeconomic status covariates in the estimated models, and the table shows the effects of prices for each social group. In Sart, where there was no clear overall fertility response for second and higher order births, as shown in table 9.1, the childbearing of laborers may have been affected by economic stress. The coefficients are not statistically significant but quite substantial in magnitude. When estimating a model with no lag or with one lag only, both are significant. They imply that a ten percent increase in grain prices lowered fertility in each of the two following years by more than four percent. It should be noted, however, that this group only constituted nine percent of the population in Sart, which implies that fertility of the large majority of the population was not affected by economic stress. In the Pays de Herve, people registered under "others/unknown" show the strongest response. A ten percent

increase in cost of living lowered fertility by no less than 24 percent. There are no statistically significant effects for laborers and workers. The fertility of farmers, however, seems to have been negatively affected by high prices, which at first sight seems contrary to our expectations. This effect for farmers in the year immediately following the price change, however, is outweighed by a positive effect of similar magnitude the year after. When interpreting the effects on farmers in the Pays de Herve, we should keep in mind that they were, in effect, not grain producers but cattle-farmers. Most of their food consumption was bought from other areas. The result shows that the immediate response to food prices was negative, indicating that they were unable to compensate for changes in grain prices, which in turn is to be expected since prices of meat and grain often fluctuate in opposite directions in the short run.

- Table 9.2 about here

The price effects on second and higher order births in Casalguidi are negative for the lower social groups but not statistically significant, while the effect on those paying the highest taxes is close to zero. In Scania, there is a clear socioeconomic pattern in the response of fertility to economic stress. The higher order births of the landless and semilandless were clearly affected by fluctuations in grain prices. A ten percent increase in grain prices lowered fertility by three to four percent for these groups, while landed peasants showed no effect. Since the latter did not react positively to prices, they must have been able to rely on a certain amount of wealth to smooth consumption in the short run.

In Liaodong, for second and higher order births, both female and male reproduction is affected by food prices. The results are very consistent for farmers, who constituted some 90 percent of the population. The fact that food prices affected female reproduction stronger

than male reproduction implies that farmers must have practiced infanticide on newborn females. Officials and artisans also seems to have practiced female infanticide, but then after years with low food prices, not after high food prices like the farmers did. Here the results differ between our two Asian locations. While female infanticide was practiced in Japan too, we find no evidence that it was higher during bad harvest years.

Comparing the results of the estimations for first births and higher order births in table 9.2 makes it even clearer than in table 9.1 that they must be analyzed separately. Although the price effects are similar for first and higher order births in some cases, most of the results come out quite differently. Evidently, first births are closely linked to marriages in the European settings. In the Asian settings, on the other hand, the long interval between marriage and first birth allows for other factors to be involved. Thus, it is obvious that one has to analyze first births separately and take the timing of marriage into account when analyzing first births, which is well beyond the scope of this chapter.

When analyzing second and higher order births, we find the expected social differences in the response of fertility to economic fluctuations, even though the pattern is not consistent in all populations. In general, poorer people with less land showed a much stronger response to high prices in the European populations, while officials, farmers, and artisans seem to have been affected in the Chinese communities. As was noted above, farmers constitute about 90 percent of the population in Liaodong, and the sources do not identify poorer farmers, who are expected to be most vulnerable to short-term economic stress.

Other important factors, such as number of children ever born and sex composition of surviving children, could also mediate the fertility response to economic stress. As we explained above, families who were closer to a target family size may have been more willing to deliberately postpone childbearing in times of stress. If couples had targets in mind, we might expect families with more children to have been more willing to postpone childbirth in

times of scarcity. The same reasoning applies to families with a more balanced sex composition or with more sons in areas where these family compositions were valued.

Tables 9.3 and 9.4 explore these issues. Table 9.3 displays the effects of grain prices on fertility by children ever born, while table 9.4 shows effects by sex composition of surviving children. The population at risk is all women with at least two children ever observed. Since the fertility response to price changes was rather strong in all locations except the Japanese villages (although not statistically significant in Casalguidi and Sart), we can use these results to look for evidence that families with certain targets modified their fertility in years of short-term economic stress.[8] Although there are some statistically significant effects, there is no consistent pattern along the reasoning outlined above. Unlike the previous tables, where we found a response in all but a few groups, here we find that the fertility response to economic stress depended neither on number of children ever born nor on the sex composition of surviving children. One possible explanation is that these targets did not exist and, consequently, the fertility response was not structured along these dimensions. The pattern of sex-selective infanticide in Liaodong, however, speaks against such a conclusion for China. Similarly, the results for reproduction both by number of children and by sex composition of surviving children do not support this kind of conclusion. Instead, it seems as if having at least one son was a clear goal of the Liaodong households, and a rather equal balance between boys and girls was preferred once this was achieved (see chapters 8 and 10).

- Table 9.3 and 9.4 about here

Another possibility is that most families were far below their targets, and thus were not willing to limit their family size at all. If this was the case, the observed response must have been non-deliberate and independent of children ever born or sex composition. As will

be discussed in more detail below, however, there are quite strong indications from Scania and China that the fertility response to economic stress was indeed intentional, which does not indicate that families were unwilling to delay fertility in response to economic crisis. Instead, it seems most likely that the perceived cost of missing the target by postponing childbearing in a year of economic stress was low compared to the cost of having a child under dire circumstances. Even families far below their targets did not want to have children at any cost just to keep up the pace of childbearing.

5. Agency or passive response?

Taken together, these results show that short-term economic stress had a clear impact on fertility, although the response differed between communities as well as between social groups. The timing of second and higher order births was strongly determined by short-term economic stress in the Pays de Herve in Belgium, in Scania in southern Sweden and in Liaodong in northern China. The fertility response in Casalguidi in Italy was strong too, but not statistically significant. The response in Sart in Belgium was weaker. In the Japanese villages, however, we have not found any signs of fertility being affected by short-term economic stress, despite the existence of such a response on a more aggregate level (the Fukushima prefecture) (see Feeney and Kiyoshi 1990, table 6) . One factor of potential importance for the absence of a fertility response in the Japanese villages could be the very low levels of fertility (see chapter 7). This indicates that fertility in these communities was already controlled to a very high degree, which may have made families reluctant to postpone childbirth even further in times of stress. The low number of children born also made the total cost of provision for children rather low, and there were probably other, more efficient, means to limit food expenditure in times of stress, such as migration of household members.

As we found in our analysis of mortality, the clear responses to short-term economic stress in both the China and Europe show the vulnerability of families and households in preindustrial societies, (Bengtsson, Campbell, and Lee *et al.* 2004). There are considerable differences within both regions: a response in China, but not in Japan; a stronger impact in the Pays de Herve and Scania than in Sart. The next question is whether this fertility response to short-term economic stress was involuntary or a result of agency (deliberate control).

Overall, the response of fertility to food prices seems to have been negative and rapid, and only occasionally prolonged or positive. A positive response in the second year means that couples compensated quickly for a negative response in the first year. A delayed negative response is consistent with the nutrition hypothesis, which argues that acute malnutrition caused spontaneous abortion, temporary sterility and loss of libido. It is also consistent with the hypothesis that temporary labor migration separated the spouses. We know from our mortality analyses that deaths of adults increased in the year after a price increase, often as early as the following spring. In such a situation, it is very likely that the fecundity of both men and women, as well as the frequency of intercourse, declined. Thus, the later fertility response is indeed consistent with the nutrition hypothesis as well as the results from our mortality analyses. We find the prolonged negative fertility response to food prices only in Sart and Scania, particularly for landless laborers. These communities also show strong effects of food prices on adult mortality in these groups (see Campbell, Lee, and Bengtsson 2004). The malnutrition hypothesis is consistent with the mortality responses, but we have no evidence of temporary migration in these two communities. Hence, malnutrition is likely to have influenced the fecundity among the lower classes in these two communities.

The main response to price increases, which took place within the first year, cannot be interpreted along these lines. This general and quick response, which was both substantial and statistically significant in several communities, occurred too soon to be the result of

malnutrition or temporary migration. In the Pays de Herve, Scania and Liaodong, the communities with the most pronounced responses, most evidence points to deliberate control. This is discussed further in the chapter on Scania (chapter 4), in which we analyze the fertility response by quarters of a year as well as threshold effects. We show that the response was strongest within six months after the harvest, which clearly points to deliberate action by families who foresaw bad times at least several months before the harvest affected prices. This very fast response also rules out the possibility that the fertility was reduced by separation of spouses resulting from temporary labor migration.

These results should also be seen in the light of our previous findings regarding the mortality response to short-term economic stress. The only locations where the fertility and mortality responses were dissimilar are Niita and Shimomoriya, which showed a mortality response only among adult males and children (Tsuya and Kurosu 2004b, table 9.6). In these communities, food prices had no effect on either adult female mortality or reproduction.

It is also interesting to look at the potential role of migration in dealing with economic stress. We expect the fertility response, as well as the mortality response, to be less important in communities where migration was a viable strategy for dealing with economic stress, such as the Pays de Herve and Sart (Oris, Neven, and Alter 2005), and the Japanese villages (Tsuya and Kurosu 2005). In communities with less opportunity for migration to nearby towns or other economic sectors, such as southern Sweden (Dribe 2003a) and northern China (Campbell and Lee 2001), we expect fertility to be more affected by economic stress. In general, the findings are much as expected, with the exception of the Pays de Herve, where both migration and fertility seem to have been sensitive to economic fluctuations.

Our findings highlight the danger of limiting the study of deliberate control of childbearing exclusively to parity-specific behavior. Our results imply that even though there was no parity-dependent fertility control in times of economic stress (as indicated by the

insensitivity of the price effects to the number or sex composition of children), families in pretransitional societies nevertheless deliberately adjusted the timing of their births in accordance with economic fluctuations. It shows that families in both East and West made informed and active decisions about reproduction before the demographic transition.

Notes

[1] This new concept grew out of empirical observations of the relationship between food prices and vital events, but it bears some similarities to Amartya Sen's concepts 'functionings' and 'capabilities', which he uses to define standard of living. Functionings are defined as the "various living conditions we can or cannot achieve" and capabilities as "our ability to achieve them" (Sen 1987, 16). The set of functionings varies from elementary things, such as being adequately nourished and healthy, to more complex ones like happiness and self respect (Sen 1992, 39). Capabilities represent the functionings a person can achieve with his personal characteristics. For a more detailed discussion of the various standard of living concepts, see Bengtsson (2004a).

[2] Belgium, Ministère de l'intérieur, *Statistique de le Belgique, Population, Recensement général, 15 octobre 1846* (Brussels: Th. Lesigne, 1849).

[3] For a more thorough overview, see Bengtsson and Dribe (Forthcoming).

[4] The estimated coefficients *b*, expressing the log relative risk (or log odds ratio) of a one unit change in the log grain price, were transformed to effects of a ten percent change in prices using the formula: $100(e^{b \log(1.1)}-1)$, see Campbell, Lee, and Bengtsson 2004.

[5] The models have been estimated by discrete (logit with cloglog link) or continuous (Cox regressions) event history analysis. These different models yield comparable coefficients.

[6] Studies based on aggregated data often include time lags as long as five years after the change in prices. When individual level data are used, fertility responses are insignificant after two years. (Mortality responses are often insignificant after one year.) We therefore limit the models to include a response up to two years after the price change.

[7] The lack of information about occupation for the Belgian locations that we study is partly due to the fact that this information comes from censuses, which are in 1843, 1846, 1866, 1870, 1800, and 1890, as well as from inheritance acts. Thus people that migrate in and

out between the censuses and do not show up in the inheritance acts have no reported occupation.

[8] In Scania, where the response was most clearly socially structured, only the landless and semilandless groups were included. All social groups are included for the other communities. In locations with less distinct social gradients in the response of fertility to prices than Scania, fertility might well have been adjusted according to family targets independent of the socioeconomic status of the household.

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Table 9.1.
Fertility effects of a 10 % increase in grain prices.

		Marriage to first birth					After first birth				
		First year		Second year		Births	First year		Second year		Births
Country	Site	%	p	%	p		%	p	%	p	
Belgium	Sart	-3.92	0.14	1.05	0.70	394	0.13	0.89	-0.41	0.68	3260
	Pays de Herve	-1.79	0.79	4.11	0.53	503	-8.27	0.00	2.33	0.40	3571
Italy	Casalguidi	-2.34	0.50	-2.70	0.43	541	-2.34	0.14	-1.10	0.49	2428
Sweden	Four Scanian Parishes	-3.03	0.10	-1.54	0.40	788	-2.25	0.01	-2.05	0.01	4251
Japan	Niita and Shimomoriya	-1.63	0.29	0.53	0.73	713	0.31	0.79	-0.30	0.78	1496
China	Liaodong, male births*			-1.73	0.00	3999		0.41	-1.23	0.02	4315
	Liaodong, female births*			-1.53	0.08	1454		0.01	-1.59	0.05	1799

Note: Based on individual multivariate models controlling for age, socioeconomic status, parish of residence, time period and previous migration.
* For Liaodong where data are triennial only one price series was used which is an average of prices one year before and two years after the censal time.

Table 9.2.
Fertility effects of a 10 % increase in grain prices by social status.

			Marriage to first birth				After first birth			
Country	Site	Social group	Grain price year t		Grain price year t-1		Grain price year t		Grain price year t-1	
			%	p	%	p	%	p	%	p
Belgium	Sart	Functionary	-15.15	0.76	-4.98	1.00	-0.71	0.84	1.86	0.69
		Farmers (reference)	-2.39	0.54	-4.83	0.22	0.66	0.60	-0.83	0.51
		Artisans and industrial workers	8.33	0.60	5.64	0.47	0.58	0.98	1.40	0.59
		Laborers	-1.23	0.92	0.91	0.62	-4.89	0.13*	-4.17	0.35*
		Others/unspecified	-6.94	0.40	8.88	0.02	0.66	1.00	1.24	0.37
Belgium	Pays de Herve	Farmers (reference)	-0.80	0.94	3.41	0.75	-7.47	0.07	5.71	0.18
		No activity	-29.27	0.09	44.56	0.08	-23.85	0.08	17.30	0.36
		Day laborers	12.21	0.59	-1.36	0.86	-1.89	0.52	1.80	0.68
		Textile workers	19.54	0.40	18.33	0.52	-5.48	0.82	-2.81	0.34
		Craftsmen	2.34	0.87	-10.30	0.44	-12.47	0.47	-5.72	0.13
		Petty bougeoisie	18.01	0.57	-38.40	0.07	5.00	0.29	7.82	0.87
Italy	Casalguidi	Highest taxed	-6.21	0.45	12.38	0.03	-0.06	0.68	0.25	0.45
		Low-taxed (reference)	3.12	0.68	-16.03	0.03	-2.46	0.55	-4.02	0.31
		Untaxed	-3.29	0.44	-0.63	0.06	-2.74	0.94	-0.76	0.45
Sweden	Four Scanian parishes	Freeholders/crown tenants (ref.)	1.35	0.83	-7.23	0.28	0.75	0.70	-0.13	0.94
		Noble tenants	-4.77	0.42	5.99	0.11	-0.70	0.57	-3.00	0.25
		Semi-landless	-1.75	0.67	1.11	0.27	-2.92	0.12	-2.31	0.35
		Landless	-3.83	0.45	-4.76	0.72	-4.75	0.02	-2.17	0.41

Table 9.2. Cont.

Country	Site	Social group	Marriage to first birth				After first birth			
			Grain price year t		Grain price year t-1		Grain price year t		Grain price year t-1	
			%	p	%	p	%	p	%	p
Japan	Niita and Shimomoriya	Zero koku (reference)	-2.70	0.61	-0.05	1.00	3.17	0.39	-3.20	0.41
		0.09-9.99 koku	-2.81	0.98	-1.39	0.86	0.02	0.48	1.58	0.29
		10-14.99 koku	2.57	0.39	-2.48	0.74	2.16	0.81	-1.18	0.62
		15-19.99 koku	-3.27	0.93	3.54	0.64	-3.06	0.17	1.21	0.34
		20 and more koku	-3.03	0.96	3.41	0.68	-1.54	0.33	-1.22	0.68
		Landholdning unknown	-6.51	0.63	11.42	0.24	0.95	0.68	NA	NA
China, males	Liaodong**	Farmers (reference)			-1.81	0.00			-1.30	0.01
		Soldiers			1.56	0.17			-0.98	0.83
		Artisans			-2.92	0.75			-0.38	0.74
		Officials			-2.85	0.84			2.28	0.42
China, females	Liaodong**	Farmers (reference)			-2.36	0.01			-2.03	0.02
		Soldiers			5.00	0.00			0.08	0.17
		Artisans			-2.75	0.95			-2.43	0.92
		Officials			14.21	0.01			0.89	0.45

Note: Based on individual multivarate models controlling for age, socioeconomic status, parish of residence, time period and previous migration. For each category, the percentage change is the total effect of a price change. Thus, the effects for reference categories are the base effects of prices from the estimated models, while the other effects are the combined base and interaction effects. P-values for reference categories refer to the base effects of prices in the model estimation, while other p-values refer to interaction effects. For number of observations see table 9.1.
* Significant at 5 % level in a model with only one price covariate.
** For Liaodong where data are triennial only one price series was used which is an average of prices one year before and two years after the censal time.

Table 9.3
Fertility effects of 10 percent increase in grain prices by children ever born (only women with 2+ children ever born.

Country	Belgium				Italy		Sweden		Japan		China, male births		China, Female births	
Site	Sart		Pay de Herve		Casalguidi		Four Scanian parishes		Niita and Shimomoria		Liaodong*		Liaodong*	
Social group	All social groups		All social groups		All social groups		Landless, Semi-landless		All social groups		All social groups		All social groups	
	%	p	%	p	%	p	%	p	%	p	%	p	%	p
Grain prices (t)														
Children ever born														
2 (reference)	-1.35	0.62	-14.45	0.04	-4.60	0.31	-2.34	0.50	-3.10	0.26				
3	-0.24	0.49	-11.17	0.68	-2.19	0.63	-0.24	0.62	1.19	0.18				
4	0.41	0.62	-9.02	0.52	2.84	0.18	-8.50	0.16	-1.35	0.60				
5	-2.93	0.69	-0.08	0.13	-3.09	0.80	-3.64	0.80						
6	-2.16	0.87	-1.12	0.20	-9.28	0.49	6.09	0.19						
7	0.43	0.79	7.28	0.08	5.48	0.26	-9.50	0.38						
8	-6.54	0.42	-4.53	0.34	-7.42	0.71	-9.95	0.37						
Grain prices (t-1)														
Children ever born														
2 (reference)	1.60	0.57	13.10	0.10	-3.34	0.46	-1.60	0.64	3.86	0.16	-1.81	0.11	-0.90	0.58
3	2.08	0.88	3.95	0.35	-4.21	0.86	0.07	0.69	-0.94	0.13	-0.20	0.19	0.77	0.36
4	-1.85	0.33	1.25	0.24	-2.21	0.83	0.92	0.58	2.44	0.66	0.82	0.10	-1.15	0.91
5	-0.32	0.64	-3.68	0.11	-1.19	0.72	-1.67	0.99			-1.05	0.72	2.12	0.33
6	1.84	0.96	-12.68	0.02	5.32	0.22	-0.99	0.92			-6.45	0.10	-1.44	0.89
7	9.20	0.25	-16.78	0.02	-9.52	0.46	-2.92	0.87			-0.05	0.76	6.72	0.09
8	2.55	0.89	12.71	0.98	0.96	0.58	10.92	0.16			1.45	0.72	4.84	0.62
N	2572		2969		1972		1171		853		2396		1127	

Note: Based on individual multivariate models controlling for age, socioeconomic status, parish of residence, time period, previous migration, children ever born and sex composition of surviving children. See also table 9.2.
* For Liaodong where data are triennial only one price series was used which is an average of prices one year before and two years after the censal time.

Table 9.4
Fertility effects of 10 percent increase in grain prices by sex composition of surviving children (only women with 2+ children ever born).

Country	Belgium				Italy		Sweden		Japan		China, male births		China, female births	
Site	Sart		Pay de Herve		Casalguidi		Four Scanian parishes		Niita and Shimomoria		Liaodong*		Liaodong*	
Social group	All social groups		All social groups		All social groups		Landless, Semi-landless		All social groups		All social groups		All social groups	
	%	p	%	p	%	p	%	P	%	p	%	p	%	p
Grain prices (t)														
Sex composition of surviving children														
Both sexes (reference)	-1.35	0.62	-14.45	0.04	-4.60	0.31	-2.34	0.50	-3.10	0.26				
Only daughters	-0.42	0.78	-14.27	0.71	-3.01	0.73	-10.36	0.05	2.95	0.09				
Only sons	1.01	0.45	-13.65	0.11	-4.42	0.97	-0.57	0.69	3.42	0.07				
No surviving children	-10.16	0.16	-13.79	0.66	-1.36	0.75	-2.75	0.94	-6.09	0.67				
Grain prices (t-1)														
Sex composition of surviving children														
Both sexes (reference)	1.60	0.57	13.10	0.10	-3.34	0.46	-1.60	0.64	3.86	0.16	-1.81	0.11	-0.90	0.58
Only daughters	-4.77	0.05	15.10	0.85	-0.54	0.55	0.10	0.70	-3.26	0.04	-3.70	0.63	7.49	0.21
Only sons	-1.69	0.28	21.09	0.45	1.61	0.29	-7.09	0.19	1.79	0.56	0.69	0.12	-1.97	0.64
No surviving children	7.26	0.40	-29.79	0.11	-11.01	0.42	-3.71	0.68	-0.46	0.52	-2.39	0.61	-4.62	0.04
N	2572		2969		1972		1171		853		2396		1127	

Note: Based on individual multivariate models controlling for age, socioeconomic status, parish of residence, time period, previous migration, children ever born and sex composition of surviving children. See also table 9.2.
* For Liaodong where data are triennial only one price series was used which is an average of prices one year before and two years after the censal time.

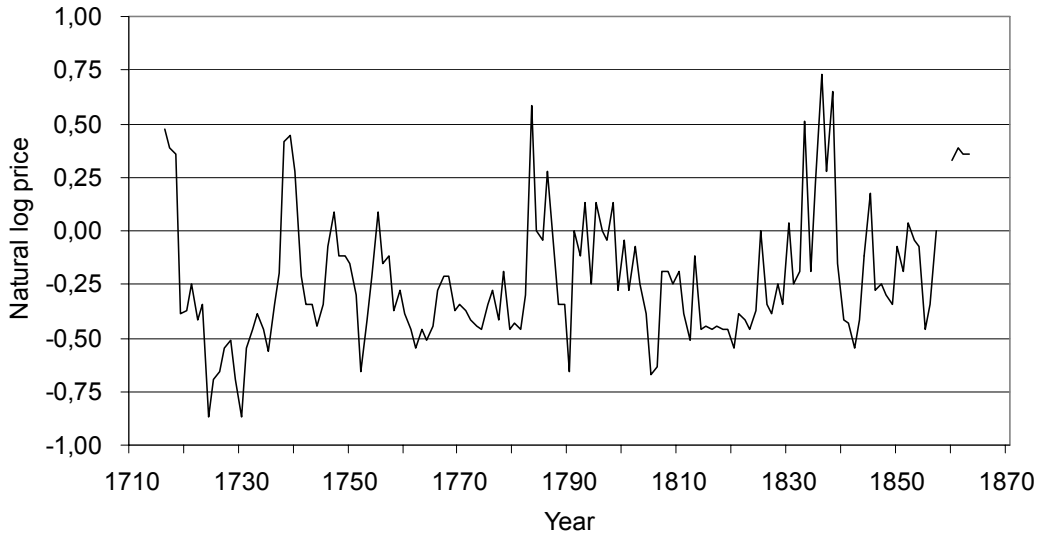

Figure 9.1. Log of rice price in Aizu, 1716-1863.

Source: Iwahashi, Masaru 1981, Kinsei Nippon Bukka-shi no Kenkyu (A Study of the History of Price in Early Modern Japan), Tokyo: Ohara Shinseisha.. From Appendix Table 1: Rice Price in ryo per koku of rice from Various Geographical Areas (pp.460-465). Ryo is based on the value of gold (i.e. a gold-based currency).

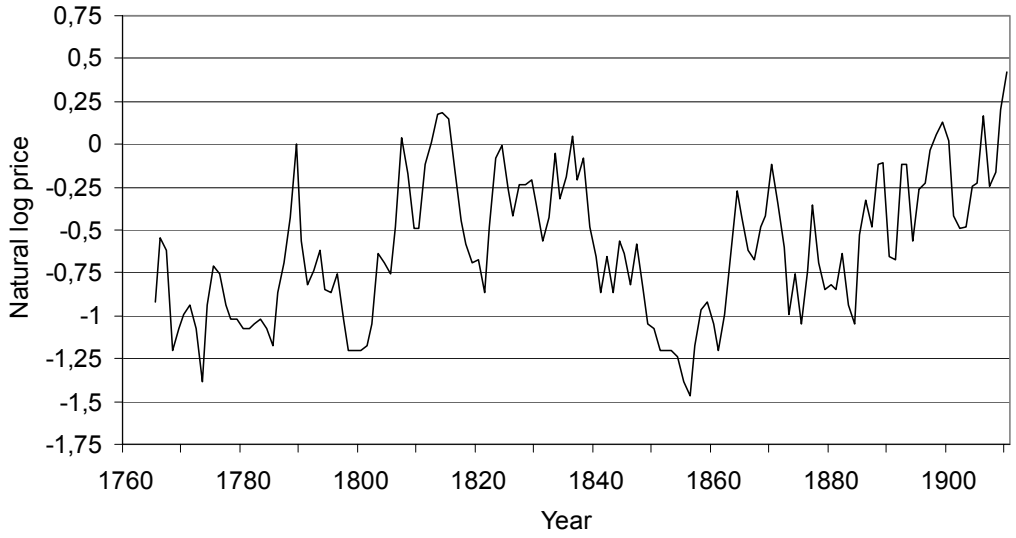

Figure 9.2. Log of sorghum prices in Liaodong, 1765-1910.

Source: Monthly grain price reports from Liaodong, the Palace Museum in Taibei and the First Historical Archive in Beijing, for more details, see Campbell and Lee (1997, 28-34). Price in taels per shi.

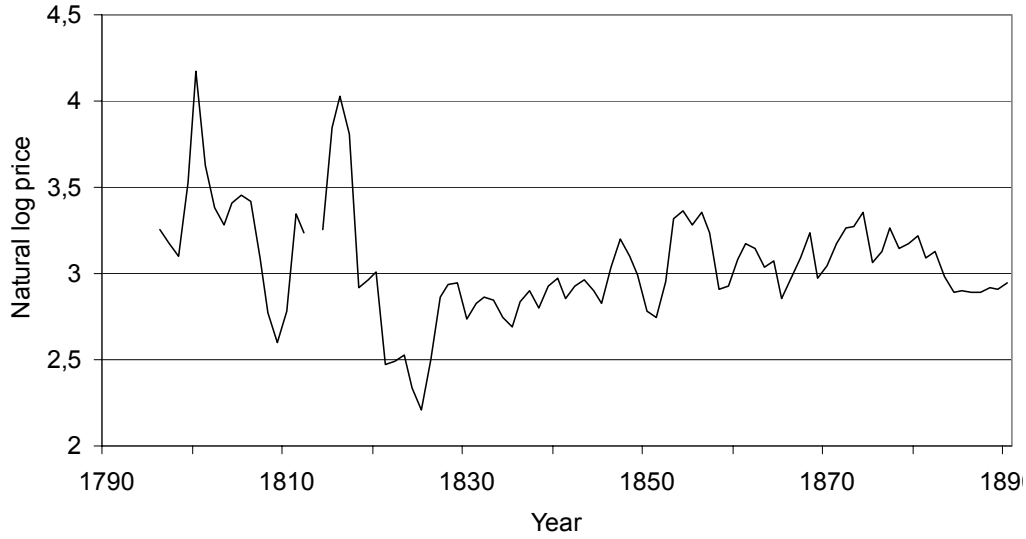

Figure 9.3. Log of wheat prices in Parma, 1796-1890.

Sources: Spaggiari, Pier Luigi. 1959. 'I prezzi di generi alimentari sul mercato di Parma.' Archivio economico dell'unificazione italiana. I-VIII, 3.Turin: ILTE. Spaggiari, Pier Luigi. 1966. L'agricoltura negli stati parmensi dal 1750 al 1859. Milan: Banca Commerciale Italiana. Wheat price in lire per hectolitre.

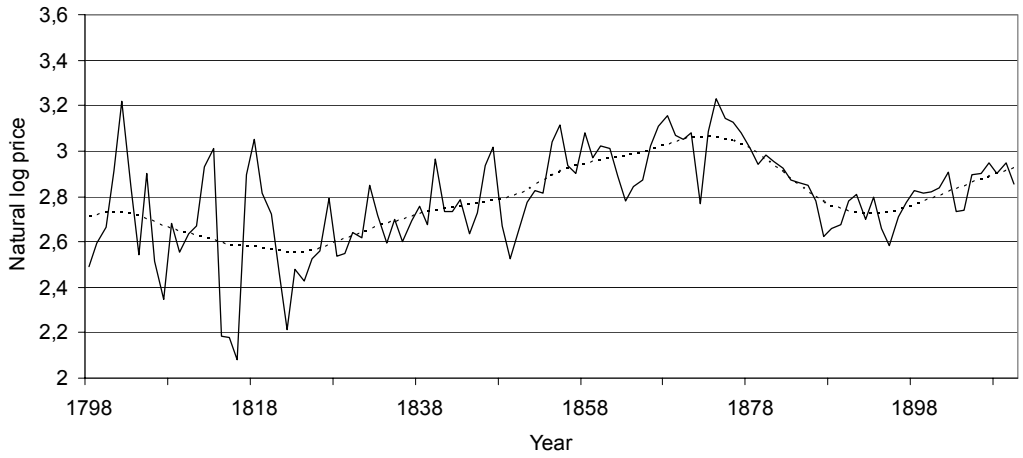

Figure 9.4. Price of oats in east Belgium, 1811-1900.

Sources: Belgium 1831-1900 ; Deprez 1948 ; Verviers. 1852-1892. Belgium. 1831-1900. *Le moniteur belge: journal officiel.* Deprez M. 1948. *Essai sur le mouvement des prix et des revenus en Belgique au début du 19e siècle, 1798-1830*, 2 vol. Unpublished thesis University of Liège. Verviers. 1852-1892. *Exposé de la situation de la ville de Verviers sous le rapport de son administration.* Verviers: Thomas Lesigne.

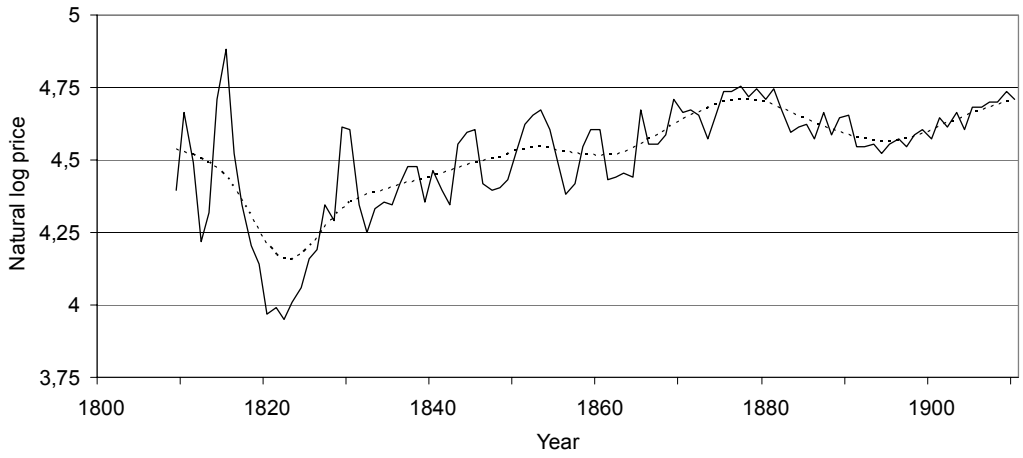

Figure 9.5. Log of cost of living index in the Pays de Herve, 1811-1900.

Sources: 1811 - 1850: Oris, M. 1998, "A brief discussion on the economic series in 19th century Belgium", EurAsian Project on Population and Family History, Working Paper series, n. 19. 1850 - 1910: Scholliers, P., 1993, "The cost of living in nineteenth-century Belgium", in Studia Oeconomica. Liber Amicorum Herman van der Wee, Leuven, Universitaire Pers, pp. 221-238. Trend estimated by using a HP-filter, with a smoothing parameter of 100.

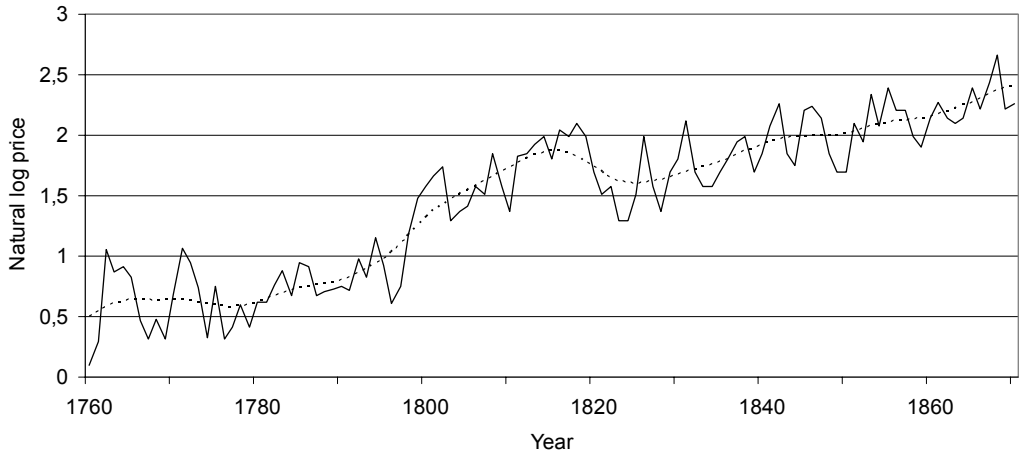

Figure 9.6. Log of rye prices in the four parishes in Scania, 1760-1865.

Sources: The local rye prices for 1760-1779: Hög (=Landskrona), 1780-1802 and 1812-1864: Harjager's härad, 1803-1811: Hög (=Malmöhus county) from church tithe records (*Kyrkotiondelängder*), The Regional Archives, Lund. Kronor per hectoliter. Trend estimated by using a HP-filter, with a smoothing parameter of 100. Kronor per hectoliter. See Bengtsson and Dribe (1997).

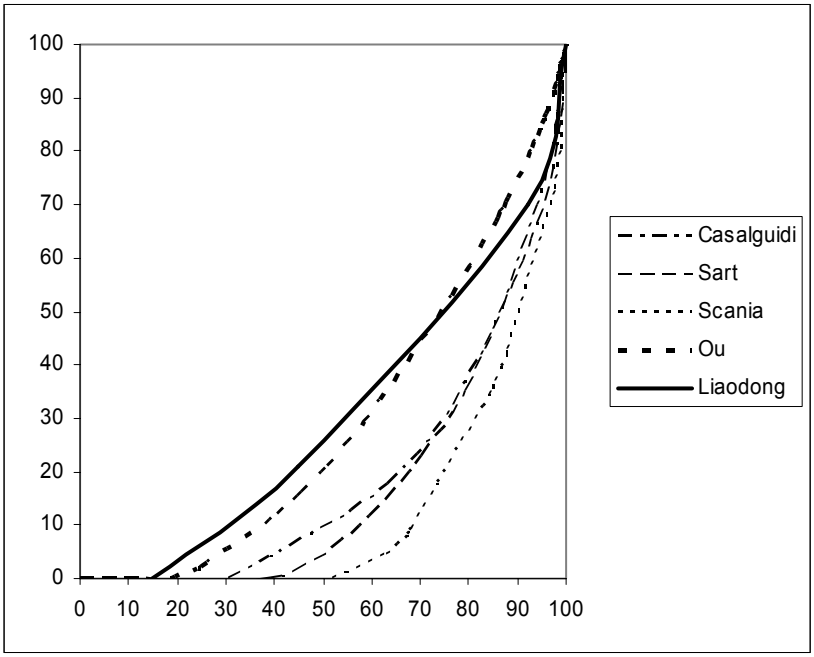

Figure 9.7. Inequality in five Eurasia populations: Wealth reflected from tax records.

Sources: Casalguidi: Archivio di Stato di Pistoia, Comunità di Serravalle Pistoiese, Tasse di famiglia, 1830-1837. Niita and Shimomoriya: Mizuyama Family Documents, Koriyama-shi Historical Records Archive in Fukushima Prefecture (Shimomoriya), 1716-1869; Endo Family Private Documents (Niita), 1720-1870. Liaodong: Private communication from the Liaoning Land Bureau. Figures from 1948 Provincial Land Reform. Sart: 1822: Archives de l'Etat à Liège, "Rôles de repartition des taxes communales pour l'année 1822," Fonds hollandais, number 2423. Scania: Mantalslängder (Taxation Records), Malmöhus läns landskontors arkiv, Vol. E III: 52, Lunds landsarkiv (The Regional Archives in Lund).

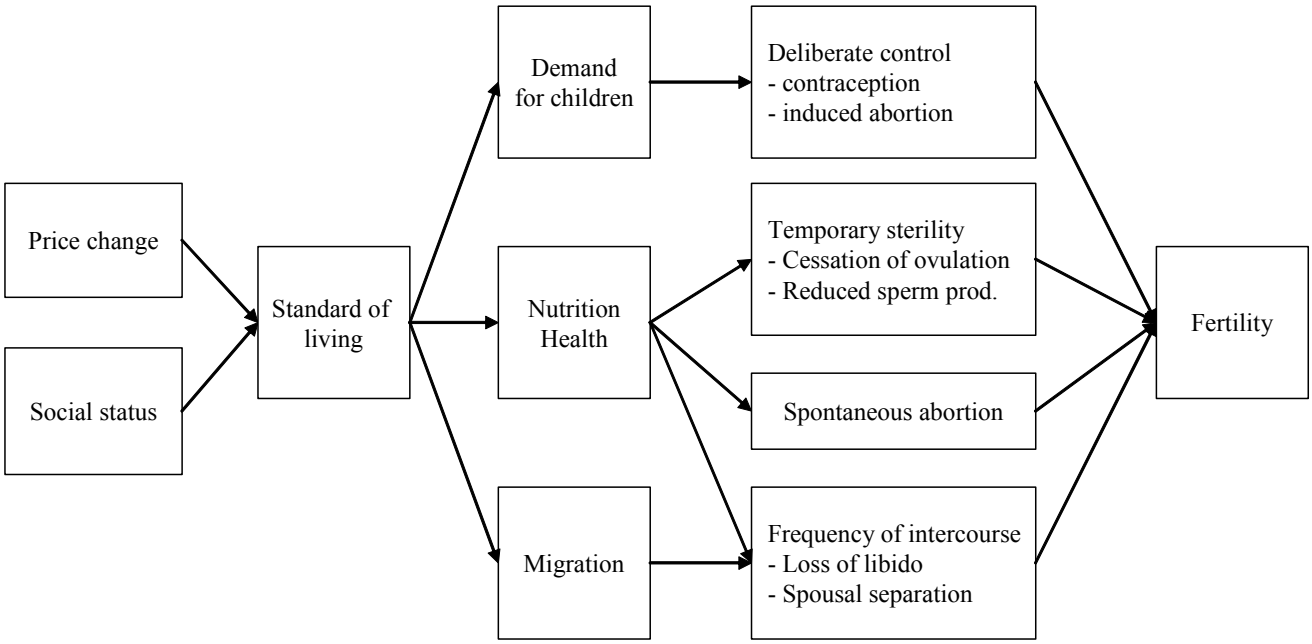

Figure 9.8. Model of marital fertility response to economic stress.