Deliberate Control in a Natural Fertility Population: Southern Sweden 1766–1865

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Abstract

This paper analyses fertility control in a rural population characterized by natural fertility, by using survival analysis on a longitudinal dataset at the individual level. Non-parity specific control is measured through the fertility response to short-term economic stress. In the landless group, fertility responded quite strongly to grain prices. The response was neither dependent on number of children previously born, nor on sex composition. The seasonality pattern in the response shows that the fertility effect was strongest within six months after the harvest, which points to the conclusion that the response was deliberate. People foresaw bad times, associated with increasing food prices, already in the late spring and early summer and planned their fertility accordingly. Fertility therefore declined already during the winter, shortly after the harvest season. This evidence shows that fertility was deliberately controlled in years of economic stress, and highlights the importance of deliberate, but non-parity specific, control of the timing of childbirth before the beginning of fertility transition.

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Introduction

One of the most controversial issues in historical demography is whether or not fertility in the West was deliberately controlled also before the fertility transition. This issue is not only of great importance to our understanding of fertility behavior before the decline of fertility in the late nineteenth century, but also a key to understanding the process of demographic transition as such. The way we approach this question may also have methodological bearings upon wider issues in the study of fertility as well as on the opportunities families had to adjust to economic circumstances in the past.

The dominating view in historical demography since the days of the European Fertility Project at Princeton University has been that fertility in pre-transitional Europe was not deliberately controlled but ‘natural’. In fact, fertility was not considered to have been within “the calculus of conscious choice” (Coale 1973, p. 65), and the main explanation behind the fertility transition was the innovation of families starting to adjust fertility within marriage to economic circumstances (e.g. Coale & Watkins 1986). As a consequence, females stopped childbearing after having reached a certain target family size; in other words, the control was parity-specific. Other scholars have, however, questioned these conclusions, emphasizing that families also in pre-transitional Europe might have controlled their fertility deliberately, even though this often was done in a non-parity-specific way (see e.g. Anderton & Bean 1985; Bean, Mineau & Anderton 1990; David & Sanderson 1986; David & Mroz 1989b; Szreter 1993), thus being excluded by the Princeton paradigm. Newly presented evidence has further supported the conclusion that fertility was deliberately controlled also before the fertility transition, often in a non-parity-specific way (Van Bavel 2004).

The aim of this paper is to present a new way of measuring the presence of deliberate control of fertility in a pre-transitional population of southern Sweden. Despite this limited geographical context we believe that the results presented have implications reaching far beyond nineteenth century Sweden. Our approach acknowledges that fertility may have been deliberately controlled by other means than parity specific stopping before the fertility transition. Instead of being solely, or even primarily, preoccupied with ultimate family size families had short-run concerns to tend to. One of the most prominent was to deal with economic stress following price or harvest fluctuations in an agriculturally based economy. Faced with this kind of stress, our results strongly suggest that preindustrial families actively controlled timing of childbirth.

Natural fertility and deliberate fertility control

Ever since the highly influential paper by French demographer Louis Henry (1961) the concept of natural fertility has been in the center of the debate. Henry argued that fertility should be considered natural, i.e. uncontrolled, when a couple did not stop having children after reaching a certain parity. Controlled fertility on the other hand resulted from reaching a target family size, after which childbearing was terminated. In other words, natural fertility was defined as fertility in the absence of parity-specific control. The concept of natural fertility played a very important role in the European Fertility Project in the 1960s and 1970s (e.g. Coale & Watkins 1986), which took as one of its main aims to detect the beginning of this kind of stopping behavior in different parts of Europe. Based on the concept of natural fertility a special set of measures, m and M, was developed by Coale and Trussel (1974, 1978) to detect the presence of stopping and these measures have been widely used, but also criticized and refined (see e.g. Broström 1985, Guinnane, Okun & Trussel 1994; Page 1977; Wilson, Oeppen & Pardoe 1988). Despite this criticism they have retained a rather strong influence probably due to their modest requirement when it comes to data, but also, and perhaps as important, as a result of path dependency, in order make comparisons across populations as well as over time.

One of the main results of the European Fertility Project was that Europe before the decline in fertility was characterized by natural fertility, which was thought to imply that people did not deliberately control fertility before the transition. In fact, the decline was mainly a result of an innovation process whereby the practice of deliberate control became accepted in large parts of Europe, leading to widespread, and rapid, fertility decline, largely independent of social and economic factors (Coale & Watkins 1986; Knodel 1977, 1978; see also Cleland & Wilson 1987). Although several of the conclusions have been seriously questioned (e.g. Crafts 1989; Galloway, Hammel & Lee 1994; Guinnane, Okun & Trussel 1994; Mason 1997; Richards 1977; Schultz 1985; see also Friedlander, Okun & Segal 1999), the "Princeton paradigm" still seems influential in historical demography.

There were, however, different opinions very early on. In a highly influential article, Carlsson (1966), for example, argued that fertility most likely was deliberately controlled long before the decline of fertility in the late nineteenth century, and that accordingly the fertility transition resulted more from changed target family sizes following social, demographic and economic changes (adjustment), rather than changed attitudes towards birth control (innovation). That methods of deliberate birth control, such as abstinence or *coitus* *interruptus*, indeed seems to have been practiced long before the beginning of fertility decline is also supported by other evidence (see Santow 1995), and, at least when it comes to educated middle class women in nineteenth-century United States, the analysis by David and Sanderson (1986) also shows that a range of other traditional contraceptive techniques combined with low coital frequency could be quite effective in limiting the number of births.

Some scholars have questioned the validity of natural fertility in historic Europe altogether arguing that families actually used their knowledge on birth control to limit family size. One way of indicating this kind of family limitation in preindustrial populations has been to study age-specific fertility by women's age at marriage. The simple idea is that if families had specific targets regarding number of children, women marrying early should have reached their target earlier, and should thus show lower fertility at higher ages, compared to women marrying late (Wrigley 1966, pp. 91-92). Such a pattern has also been shown for several communities in preindustrial Europe, including Sweden (Wrigley 1966; Gaunt 1973; Knodel 1978; Winberg 1975, pp. 236-238; Wrigley *et al*. 1997, Table 7:6) or at least in some social groups (Eriksson & Rogers 1978, p. 143).

However, it is questionable whether the mere existence of such pattern can be interpreted as a result of deliberate family limitation (e.g. Knodel 1978, p. 495). The reason is that such a pattern share many other characteristics with the pattern found in natural fertility populations. The fact that bridal pregnancies were common is part of the explanation, since it will lead to higher fertility among those who marry late compared to those already married. Women who marry early are expected to have a somewhat higher sterility due to a larger number of births, because giving birth is a risk factor for becoming sterile. A negative association between frequency of intercourse and time since marriage adds to the observed fertility difference between women who marry early and late, and so does the negative effect of age of husband (see also Åkerman 1977; Van Bavel 2003). Most often women who marry young tend to marry older men, while the age difference between spouses usually is small for those marrying late. Thus, the negative effect of husband's age on fertility in ages above 30 should be greater for those marrying young.

In much of the literature following the European Fertility Project natural fertility seems to have been equated with absence of deliberate control altogether, and not only with the absence of parity-specific control (see Santow 1995). But, even if most populations before fertility decline show fertility patterns closely resembling natural fertility, this does not imply that families could not have deliberately controlled their childbearing in a non-parity specific way, i.e. through deliberate birth spacing. Several historical studies have tried to demonstrate that such behavior existed in pre-transitional populations often in response to social, economic or demographic factors, such as land scarcity, low income, unfavorable consumer-worker ratios with households etc (e.g. Andorka 1979; Gaunt 1976, 1977; Tilly 1984; Åkerman 1986; Ahlberger & Winberg 1987). However, the argument is often based on simple differences in marital fertility between subgroups, rather than on more elaborate demographic or statistical analyses, which makes it difficult to completely rule out other, non-intentional, factors as explanations of the observed differences and low marital fertility in some groups or geographical areas.

In addition a growing number of studies have also highlighted the role of deliberate spacing (prolonged inter-birth intervals or the interval between marriage and first birth) in the early phases of fertility decline in Britain and the United States (e.g. Anderson 1998; Bean, Mineau & Anderton 1990; Crafts 1989; Haines 1989; Szreter 1993; David & Sanderson 1986; Morgan 1991) thereby questioning the almost complete focus on stopping as the main cause of fertility decline that characterized much previous research following the European Fertility Project. Thus, changing economic, demographic and social circumstances led families to have fewer children and in this process stopping as well as spacing played important roles. This make it possible, and indeed likely, that such deliberate control over timing of childbirth could have had a long history, and thus that the conclusions from previous historical studies might well be correct. It might even be the case, as argued by Morgan (1991), that the long history in Europe of marriage and family formation being closely connected to social and economic circumstances made deliberate spacing an obvious measure when adjusting childbearing to changing circumstances. According to this view the pattern of fertility control exhibits more continuity than discontinuity over time (see also Mason 1997).

Based on previous econometric models David and Mroz (1989a) present a more refined, and more complicated, model to analyze deliberate spacing as a result of family specific life cycle experience, most notably the number of surviving children. The model used acknowledges the possibility of both a target (desired) family size and the timing of births over the life course. Moreover, their econometric model is an early example in historical demography where unobserved heterogeneity between families, as a result of biological differences in fecundity and/or behavioral differences not controlled for by in the estimations, is explicitly taken into account. As will be made clear later on we will use a similar, but not identical, model in this paper. The application of this model on data from rural France before the revolution yields several highly interesting results (David & Mroz 1989b). For our purpose, the most noteworthy is the rather strong support for deliberate control over the timing of births in relation to the number of surviving children and previous experience of infant death. Not only are they able to show that these circumstances affected the pace of childbearing, but also that the effect differed according to both age and sex of the surviving children. According to these results rural families in pre-revolutionary France appear to have had a rather strong preference for sons, which affected not only fertility behavior but also care and survival of infant children.

In a recent article Van Bavel (2004) uses a similar but simpler approach for Leuven in Belgium in the nineteenth century, examining the hypothesis that working class families deliberately adjusted birth intervals in response to the balance between consumers and workers in the household. The time until conception (interval between births minus 40 weeks) for conceptions leading to a birth has been modeled using hazard regression mixing all intervals regardless of parity and without controlling for unobserved heterogeneity. The results show that higher number of young children in the household is associated with lower fertility, controlling for marriage duration, children ever born and child survival. Van Bavel views this as a strong indication of deliberate spacing, since we in the absence of deliberate control, if anything, would expect to find the opposite, i.e. that more children would be associated with higher levels of fecundability or and thus higher, rather than lower, fertility.

As this short review has indicated there appears to be considerable evidence for some kind of deliberate fertility control also before fertility decline. In many cases the control was not primarily directed towards limiting final number of children in the family, but a response to the situation of the family in different phases of the life course. In the remainder of this paper we will present a different way of detecting this kind of deliberate spacing: the timing of childbirth in response to short-term economic stress.

Economic stress and timing of births

Clear responses of fertility, mortality and nuptiality to short-term changes in food prices or real wages have been found in aggregate studies of several preindustrial countries, indicating the high degree of vulnerability in these societies (e.g. Bengtsson & Ohlsson 1985; Lee 1981; Weir 1984; Galloway 1988). Analysis of sex and age-specific mortality rates for Sweden shows that the response was similar by sex but varied by age; it was particularly strong for adults (Bengtsson & Ohlsson 1985). The fertility response was, however, much stronger and more consistent than that of mortality and nuptiality, a pattern also found elsewhere in Europe (Bengtsson 2000; Galloway 1988). In fact, the crude birth rate for Sweden followed real wages for agricultural workers surprisingly closely; not only was major changes in real wages reflected in the crude birth rate, but also minor deviations from the mean (Bengtsson 2000). While the fertility response to food prices was sudden, birth rates dropped already in the same year as prices went up, still the main effect came in the year after (Bengtsson 2000; Galloway 1988). A closer look at the lag structure, by analyzing monthly data, reveals that the fertility response was significant already a few months after the harvest and then increased and reached a maximum 15–17 months after the harvest (Bengtsson & Ohlsson 1988). A similar rapid response has also been shown for England (Lee 1981). The clear connection between changes in real wages and crude birth rates in the following years was not dependent upon fluctuations in marriage. Instead, it was mainly marital fertility that varied positively with the real wage development (Bengtsson 1993; Lee 1981).

There are several ways through which fertility could be affected by economic crisis (see Bengtsson and Dribe forthcoming-a). First, economic stress may influence the *exposure,* since economic crisis may force people to migrate temporarily in search for work, which leads to separation of spouses if women stayed behind while men went looking for work. The effect of economic crisis on fertility will then, as a result of absence, waiting time for conception and pregnancy, be delayed with a year or more.

Second, families may *deliberately* postpone childbirth in times of economic hardship either by using contraception or through induced abortion. Induced abortion will indeed give an immediate response to economic crises and so would the use of contraception, if it was possible to foresee economic crises. As was pointed out above, different traditional contraceptive methods seem to have been known to people in the past.

Third, fertility may be affected *involuntarily*, by lower fecundability and temporary sterility, and possibly by higher degree of spontaneous abortions, following malnutrition or increased exposure to disease. There seems to be a general agreement that fecundity can be affected by periods of severe, but temporary, malnutrition (i.e. starvation), while there is a disagreement concerning effects also of chronic, but less severe, malnutrition on fecundity (Bongaarts 1980; Frisch 1978; Menken, Trussell & Watkins 1981). Since we are dealing solely with short-term effects in this paper, we can safely conclude that temporary and severe malnutrition may lead to cessation of ovulation, loss of libido and reduced sperm production, which lower fecundity, and thereby fertility. The effect of acute malnutrition will influence the birth rates about a year after the harvest, or even later, since the lack of food did not become severe until the spring the following year. By the end of that year, births rates might be affected through spontaneous abortions as a result of malnutrition early in the gestation period. Effects of loss of libido, or subfecundity as a result of malnutrition will be even further delayed.

Finally, short-term economic stress might influence breast-feeding and thereby fertility through lactational infecundability. If assuming that people at the time were aware of this mechanism (see, e.g., Ahlberger & Winberg 1987), it might have been a deliberate way to avoid pregnancy. They could also have been forced to breast-feed for longer periods as a result of lack of food. On the other hand one could also argue that they had to breast-feed shorter, since they had to work harder during harsh years. Thus, there are several possible links between short-term economic stress and breast-feeding. Bad years may prolong or shorten breast-feeding and breast-feeding could also be deliberately used to control fertility, which makes it difficult to have any *a priori* expectations how economic stress influenced fertility through breast-feeding. Either way, we expect any effects to appear at least a year after the harvest due to waiting time until conception and time between conception and birth.

One problem using aggregated data in analyzing the impact of economic fluctuations on fertility is that it is impossible to distinguish between the different potential mechanisms just mentioned. Another, and related, problem is that it is usually impossible to disaggregate the results by social group. This is very important since peasants can be expected to have responded quite differently from farm laborers to changes in market prices of grain; peasants being producers and benefiting from high prices, while laborers suffered due to their dependence on the market for buying food.

In this paper we use micro-level individual data to overcome these problems, which enables us to study the fertility response to short-term economic stress in much more detail than is possible using aggregated data. We are not only able to distinguish the fertility response between different social groups, and control for different important social, economic and demographic factors, but also to study the timing of the response in great detail. Clearly the timing of the response is crucial in understanding the mechanisms. If fertility is lowered very soon after the economic downturn (e.g. harvest failure) is visible in the sources, say within six months, it would be difficult to conclude anything but deliberate control as a result of families foreseeing the bad times. On the other hand if the response is lagged for a year or more, several factors could be at work, both intentional and non-intentional.

Our approach is to model marital fertility (the time to childbirth) using hazard regression controlling for various social, economic and demographic covariates, estimating the effect of grain price variations at the community level on the likelihood of giving birth. By including seasonal covariates and interacting effects of season and price, we are able to detect the time distribution in the response quarter by quarter following the price changes.

We limit the analysis to second or higher order births, which implies that we exclude the interval between marriage and first birth from the analysis. The reason for this is that first births are connected as much with the marriage decision itself as with decisions on fertility, and thus needs somewhat different models and deserves a separate analysis. However, since we are analyzing all birth intervals except the first, women included in the sample often experienced several events, and there might be differences in the risk of childbirth between different women due to family specific factors (biological or behavioral) not controlled for in the models. Therefore, we add frailty effects (or random effects) to our survival models in order to control for such family specific variations in the data. More specifically we use a Cox proportional hazards model with frailty (see Therneau & Grambsch 2000, pp. 232-233):

$$h_i(t) = h_0(t)e^{(\beta X_i + \omega Z_i)}$$

where:
$h_i(t)$ is the individual hazard of giving birth to a child at duration (time since last birth) t
$h_0(t)$ is the baseline hazard, i.e. the hazard function for an individual having the value zero on all covariates
β is the vector of parameters for the covariates (X_i) in the model
ω is a vector of the random effects (frailties), assumed to be Gamma distributed
Z_i is a design matrix, which implies that Z_{ij} equals 1 if individual i belongs to family j, and zero otherwise.

Area and data

The dataset is based on family reconstitutions carried out within the Scanian Demographic Database[1] for nine parishes in western Scania in southern Sweden. The sample used in this paper consists of four of these parishes: Hög, Kävlinge, Halmstad and Sireköpinge. The social structure of the parishes varied somewhat. Hög and Kävlinge were dominated by freeholders and tenants on crown land - a group rather similar to the freeholders regarding social

[1] The Scanian Demographic Database is a collaborative project between the Regional Archives in Lund and the Research Group in Population Economics at the Department of Economic History, Lund University. The source material is described in Reuterswärd & Olsson (1993) and the quality of data is analyzed in Bengtsson & Lundh (1991).

characteristics - while Halmstad and Sireköpinge were totally dominated by tenants on noble land. In addition to the peasant group, the parishes also hosted various landless and semi-landless groups, dependent on working for others to cover the subsistence needs of their families.[2] In 1766 the four parishes had 1,310 inhabitants which increased to 3,383 by 1865; an annual increase of 1.0 percent during this 99-year period, which is a somewhat faster rate of growth than for Sweden as a whole, which was 0.7 percent per year (Statistics Sweden 1999, calculations based on Table 1.1).

The family reconstitutions were carried out using parish records on births, marriages and deaths, for the period from the mid seventeenth century up till 1894. The parish records are available for the entire period, with only a few years missing. The reconstitutions were carried out automatically using a computer program. The results have also been checked manually and compared with other sources throughout the period, mainly the poll tax registers and catechetical examination registers. The method used has been described and evaluated in considerable detail in previous work, and need not be reproduced here (see, e.g., Bengtsson & Lundh 1991). The database contains all individuals born in or migrated into the parishes. Instead of sampling a certain stock of individuals, for example a birth cohort, each individual is followed from birth, or time of in-migration, to death or out-migration.

In order to obtain information on where the families lived, and whether they had access to land or not, the poll-tax registers (*mantalslängder*) have been used (see Dribe 2000, Ch. 2). The poll-tax registers were yearly registers, used in collecting taxes and containing information on the size of the landholding, the type of ownership (i.e. manorial, crown, church or freehold) and information on the number of servants and lodgers. In addition to the poll-tax registers, land registers (*jordeböcker*) have been utilized to clarify the ownership of land. Information from these two registers has been linked to the reconstituted families, whereby information has been obtained, not only on the demographic events, but also on the economic realities of these families.

The price data used are local prices of rye, in most years at the *härad* level (an administrative level between the county and the parish), which were used in assessing the market price scales (*markegångstaxan*). The market price scales were administrative prices set, on the basis of market prices, in order to value different payments in kind. They have been used quite extensively in Swedish economic history and are generally considered as

[2] For a more detailed discussion of the sample see Dribe (2000), Bengtsson & Dribe (forthcoming-b).

satisfactory indicators of the true market prices in the region (Jörberg 1972).[3] Since we are using local price information on which the market price scales were based, they should even better reflect actual prices in the area we analyze. The trend in the price series has been removed since we are focusing on effects of short-term economic stress.[4]

The resulting dataset is longitudinal at the individual level, containing information on individual, family, household and community level, and following individuals from birth or in-migration to death or out-migration.

In a previous paper we analyzed the fertility patterns in this area in some detail (Bengtsson & Dribe forthcoming-b), and here we will only mention the more basic pattern. Scania was characterized by a rather typical (Western) European Marriage Pattern (Hajnal 1965; see also Lundh 1997, 1999). Age at marriage was quite high; around 30 years for males and 28 for females. Mean ages at marriage also seem to have declined from the eighteenth to the nineteenth century, which might be connected to an increasing demand for labor making it easier for young people to get married. However, a fairly high proportion of people (10-15 percent) never got married, but, at least for males, this proportion declined during the first half of the nineteenth century (Dribe 2000, p. 68), further indicating an easier access to marriage.[5]

Total fertility was slightly above five in the area without much change in the period of concern here (Bengtsson & Dribe forthcoming-b). Total marital fertility (15–50) in Scania was above nine, while it was around seven for women over 20 (see Table 1). As with total fertility, marital fertility did not change at all during the period under study. In fact, the Swedish fertility transition did not start until the 1880s, leaving marital fertility at a rather stable level for most of the nineteenth century (Carlsson 1966; Hofsten & Lundström 1976, pp. 26-29), and the same holds true for Scania. Without any doubt, the period we are analyzing belonged to the pre-transitional regime.

- Table 1 here

[3] The source material, methods of calculation and the series themselves are available in Bengtsson & Dribe (1997). See also Jörberg (1972, 8-18).

[4] We have used a Hodrick-Prescott filter with a filtering factor of 100 to estimate the trend, rather than a deterministic trend (e.g. linear or polynomial) or an unweighted moving average, which have been shown to have undesirable effects (e.g. Harvey & Jaeger 1993). For a more detailed discussion of the price series used see Bengtsson (2004).

[5] The trends in mean age at marriage and proportions never marrying go in opposite direction for Sweden, which may be connected to differences in economic development between rural Scania and other parts of Sweden (see Lundh 1999).

Compared to other studies of pre-transitional fertility levels, our figures closely resemble the figures for 26 English parishes 1750–1824 presented by Wrigley *et al*. (1997, p. 355) as well as figures for Dala parish in western Sweden in 1806-30 (Winberg 1975, p. 316). Studies of eastern and middle Sweden generally show lower marital fertility compared to Scania (Gaunt 1973; Eriksson & Rogers 1978, p. 125; Åkerman 1977), which is also in accordance with the general view of regional differences in Swedish demography dating back to Sundbärg (1907). Marital fertility in the 14 German parishes analyzed by Knodel (1978, 1988) is somewhat higher than in Scania, although there appears to be quite large differences between the various parishes (Knodel 1978, Table 3).

From analyses of marital fertility rates, birth intervals, M and m, sex-specific patterns of fertility, and multivariate event-history analysis presented in our previous paper we could safely conclude that parity-specific fertility control did not seem to have been practiced in the area under study. Overall marital fertility was quite high in the four parishes and our study period ends well before the beginning of the fertility transition. The conclusion that there was no parity-specific fertility control before fertility decline is also in line with many other studies of pre-transitional populations elsewhere in Europe, including Sweden (e.g. Alm-Stenflo 1989; Coale & Watkins 1986; Knodel 1977; Wrigley *et al*. 1997).

Empirical results

We will first look at the basic relationship between social status, prices and fertility (see table 2). In this analysis we employ a four-category social structure. The first group consists of freeholders and tenants on crown land that had at least enough land at their disposal so that they could provide for their family and pay land rents or taxes.[6] Freeholders owned their land and paid land taxes, while crown tenants farmed land that belonged to the Crown and paid land rent. Although there were important differences between these groups for example when it came to inheritance and subdivision of land (see, e.g., Dribe & Lundh 2003; Gadd 2000, pp. 76, 198-202), their situations were in many respect highly similar, especially if we compare with other social groups.

The second group is noble tenants with land above subsistence level. They were part of a manorial system and their conditions differed in important respects, both socially and politically, from that of freeholders (e.g. Gadd 2000, p. 76-78, 86). At least up to the 1860s they paid most of their rent as labor rent, working on the demesne (Olsson 2002).

[6] We have used 1/16 mantal as the limit of subsistence (see Dribe 2000, Ch. 2 for a discussion).

The third group—the semi-landless—consists of peasants with land below subsistence level and crofters (*torpare*, *gatehusmän*), who sometimes had landholdings equal to that of smallholding peasants, but other times lacked land altogether. Unfortunately it is impossible from the sources to distinguish between crofters with and without land. This makes the semi-landless group somewhat heterogeneous, containing peasants and crofters with land below subsistence level as well as some crofters lacking land altogether. Finally, the fourth social group—the landless—contains various occupational groups without access to land, i.e. artisans, soldiers, married servants and agricultural workers.

The first thing to note in table 2 is that the level of marital fertility was much lower among the landless and semi-landless than among the landed peasants. It is impossible at this stage to know if these differences resulted from behavioral or biological/physiological factors. The frailty term is strongly significant, indicating that factors at family level not included in the model were important. According to the figures in table 2 a ten-percent increase in food prices lowered fertility among the landless by four percent, and slightly less than that among the semi-landless, but did not affect the landed groups. Most of the response came already within the first year after the harvest. Fertility was, indeed, depressed also during the second year but not as much as during the first year, and this effect is not statistically significant. Since prices normally varied by much more than 10 percent from the normal level—in 14 years during the period 1766–1865 prices were 120 percent or more above the trend—the fertility response among the non-landed groups was considerable. Recalculating the price effects on the landless shows that a 100 percent increase in grain prices corresponded to a 27 percent decline in fertility within a year. The result is much in line with what we would expect, given the low ability for the non-landed groups to store wealth and their mortality response to short-term economic stress (Bengtsson 2004).

- Table 2 about here

The model above includes only socio-economic status and food prices. Other factors, such as age of mother at marriage, age at exposure, age-difference between spouses, location, migration status, and whether previously born child is alive or not, were also important in determining the level of marital fertility. In fact, some of the social differences in the fertility level, shown in Table 2, were due to these factors. The social differences in the fertility response to prices were, however, not modified or canceled out when these factors were taken into account, as is evident from Table 3. The reason is that these variables, though they differed between social groups, were fixed or changed only slowly. Thus, the difference in the fertility response between the landed and the landless/semi-landless groups was not due to differences in mother's age at childbirth or infant mortality. Furthermore, when analyzing the interactions between these factors and food prices, we find no indication that the social gradient in the fertility response to short-term economic stress was canceled out (Bengtsson & Dribe, forthcoming-b). In short, the landless and semi-landless groups suffered from short-term economic stress regardless of observed, or non-observed, differences in other variables between them and the landed groups.

- Table 3 about here

In a previous study we showed that the two non-landed groups had a stronger response in the period of agricultural transformation than they had before (Bengtsson & Dribe, forthcoming-c). Table 4, which displays the social gradient in the fertility response to changes in food prices for two sub periods, 1766–1815 and 1815–1865, as well as the entire period, indicate that it was particularly the landless that followed this pattern.[7] A ten percent increase in prices was followed by a six percent decline in fertility over the next 12 months. The response among the semi-landless was weaker and only significant at a ten percent level for the entire period. For the landed groups, we find no response among tenants on noble land, while the freeholders were vulnerable to grain prices during the first period, albeit significant only at ten percent level. The fertility response for freeholders went in opposite direction to that of the non-landed groups, which could also be expected since high prices meant high income for these market-producing peasants. When prices increased, so did their fertility, which seems to indicate that they were unable to smooth consumption in the period before agricultural transformation in the beginning of the nineteenth century. Hand in hand with agricultural reforms and growing commercialization of the rural sector, their vulnerability to grain prices diminished. The only group that seems to have been unaffected by grain prices throughout the period is tenants on noble land. One explanation behind this is the importance of labor rent on the estates, which made noble tenants much less dependent on the market than either freeholders or landless laborers. Moreover, noble tenants could, at least to some extent,

[7] We analyze each socio-economic group separately by estimating 12 separate models. The main difference from the previous models is that the assumption that all social groups share the same baseline hazard is abandoned.

rely on the landowner in times of scarcity, by borrowing food, or getting postponement of fees (Bengtsson 2004; Olsson 2002, p. 124).[8]

- Table 4 about here

In order to explore the mechanisms behind the observed fertility responses for the landless and semi-landless more in depth, a model was estimated only for these two groups and only for the period 1815–1865, in which we found the strongest response. As was pointed before, one way of identifying the causal mechanisms is to study the seasonal pattern in the response. If the lower fertility in response to high grain prices was unintentionally caused by lower fecundability due to malnourishment, we would expect to find the strongest effect nine months after the time when food supply was at its lowest and prices at highest. To the extent that price increases were caused by lower supply (i.e. a bad harvest) the situation should have been worst in the late spring when supplies had been emptied. In this scenario the strongest effect on fertility would have been more than a year after the harvest (nine months after late spring the year following the harvest), or more precisely in January-March 15 months or so after the harvest.

On the other hand, if the response to grain prices was intentional, as a result of a deliberate postponement of childbirth, the response should have been more immediate, since it is likely that people knew pretty well what the harvest would be like already in the summer before the harvest. If they were planning their fertility, we should get a response already in the beginning of the year following the bad harvest. The same reasoning may apply even if prices were not mainly determined by local harvest conditions, since information on expected harvests, and thereby expected, prices most likely was available. This is illustrated by the fact that the County Governors (*Landshövdingarna*) from the mid-eighteenth century onwards were obliged to report conditions concerning harvests and production both in the summer and the fall (Utterström 1957, p. 194).[9]

Table 5 shows the price response by season, controlling for a number of individual and family level factors. It is interesting to note there is an observable effect of grain prices on

[8] The non-landed groups in Halmstad and Sireköpinge, the two parishes dominated by noble land, was somewhat less sensitive to changes in food prices than the non-landed groups in Hög and Kävlinge, the two freeholder parishes, which also supports this conclusion (not shown here).

[9] Monthly rye price data for Malmö (a town about 30–50 kilometers away from the area under study) in the early nineteenth century also shows that prices often increased already in the spring in years of increasing prices (Malmö Stads månadstaxor, 1799-1867, Malmö Stads månads- och markegångstaxor 1789–1812 and 1813–1867

fertility up to 18 months after the harvest, although the effects in the second year are much weaker than in the first. What is more important, however, is the strong effect already in October-December (the first quarter after the harvest), which is strengthened in January-March, and then weakened later in the year. Hence, although the response was strongest in the third quarter after the harvest, fertility dropped already in the months following the harvest. To say the least, these results give no support for the hypothesis that fertility was influenced by grain prices mainly through subfecundity following malnourishment, since such effects would not have shown up until much later. It is for the same reason highly unlikely that the sudden response was a result of spontaneous abortions. To the extent that spontaneous abortions was provoked by nutritional stress we would expect the effects to appear about one year after the harvest, since the stress was strongest during the spring when food became scarce and because fetal loss mainly takes place during the first trimester of the pregnancy (Woods 1994, Table 6.7). Thus, nutritional effects, be it on fecundity or spontaneous abortions, cannot explain the sudden response to food prices observed here. For similar reasons it is also unlikely that the fertility response to prices was due to temporary migration, since the effect then would have taken place much later. Moreover, although we have very little direct evidence, we have no reason to believe that temporary migration of landless males in response to economic fluctuations in this area took such proportions that it affected fertility to the extent shown here. The almost non-existent response of permanent migration to economic stress for landless in the same area also corroborates this conclusion (Dribe 2003; Dribe and Lundh 2002). Instead, the evidence points quite strongly at deliberate planning as the main mechanism through which fertility was related to economic fluctuations.

- Table 5 about here

The existence of possible threshold effects in the fertility response to economic stress can also inform us about the likely mechanisms. The effects of very low, low, normal, high and very high food prices on fertility are shown in Table 6. Taking very low prices as the reference, i.e. the most favorable situation for the non-landed groups, the fertility response was the same for high and very high food prices. Thus, it was not only in years of economic crisis (very high food prices) that fertility declined, but also when prices went up quite modestly, which supports the conclusion that the fall in fertility was a result of deliberate

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(Malmö Town monthly prices and market scale prices), Malmö Stadsarkiv), which further indicates that people's general knowledge of the price development was not restricted to the time after the harvest.

postponement, because an effect of subfecundity due to malnutrition can be expected mainly to have been present in times of severe crisis, when prices were very high.

- Table 6 about here

To sum up, the most reasonable interpretation of the fertility response to economic stress seems to be that landless and semi-landless families deliberately postponed births in times of economic stress. Not only did they plan the timing of childbirths deliberately, they did so using knowledge and information on local as well as more distant conditions in agriculture, and in both cases, using this information to predict their economic situation the coming year.

Conclusion

This paper deals with the controversial, but important, issue whether or not fertility in Europe was deliberately controlled also before fertility transition, and the results presented seem to strongly suggest that this was indeed the case. In the community analyzed, we could not find any indications that fertility was limited by parity-specific measures. Nonetheless, fertility was not very high, and in a previous study we showed that birth intervals were quite long (mean values of over three years in some groups), which could have been a result of deliberate spacing, but also of an unintentional effect of breast-feeding or low coital frequency (Bengtsson & Dribe forthcoming-b). Interestingly, birth intervals increased after two children born, but then stayed rather constant, which is difficult to reconcile with strictly biological or cultural interpretations. Instead, this finding might be seen as an indication of families deliberately prolonging birth intervals shortly after having started up family building.

Fertility also differed between social groups, and in our previous study we argued that it is highly unlikely that these differences can be explained solely by unintentional factors having to do with under-nutrition, breast-feeding practices or temporary migration (Bengtsson & Dribe forthcoming-b). On the other hand, it is also virtually impossible to actually show that families made deliberate decisions to control their fertility in response to such economic factors as demand for labor, the role of children as security in old age, women's labor, housing conditions, etc. But given that methods of control were known and available at a reasonable cost, which seems to be supported by considerable evidence, it seems reasonable to expect that people also in a pre-transitional context were capable of this kind of rational decision-making.

In this paper we have tried to go deeper into this issue of deliberate control by presenting an alternative way of measuring, more directly, the degree of deliberate control of fertility before fertility transition. Our approach focuses on the adjustment of childbirth in response to short-term economic fluctuations, and the idea is that by looking at the timing of the response we can draw conclusions about the likely mechanisms. Doing this we take not only demographic and socioeconomic indicators into account, but also calendar time information about food prices and season.

The results clearly showed that especially landless and semi-landless families adjusted their childbearing to economic fluctuations. In years of increasing prices when food became more expensive on the market, landless and semi-landless families reduced their fertility, while no corresponding effect could be found for landed peasants. A more detailed analysis of this response also showed that they reacted in a similar way to moderately high and very high prices, which does not support the hypothesis that severe malnutrition was the causal mechanism behind the response. The seasonal pattern also pointed in the same direction. Marital fertility went down already in the late fall and early spring following the harvest, indicating that families foresaw the bad times and planned their childbearing accordingly. Thus, our results seem to point to the conclusion that landless families deliberately controlled their fertility in a non-parity-specific way in response to short-term economic fluctuations.

Our analysis of this community in southern Sweden clearly shows that a population showing no signs of parity-specific control deliberately controlled fertility also before the fertility transition. This strongly suggests that there is much more to the question of fertility decision-making and fertility control than parity-specific control. Most likely, families made informed decisions concerning many different aspects of their daily life, from economic considerations, such as production, demand and supply of labor, to demographic measures such as migration, household formation and childbearing.

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Table 1. Age-specific and Total Marital Fertility (TMFR) in the four parishes, 1766-1865 (live births).

	15-20	20-25	25-30	30-35	35-40	40-45	45-50	TMFR	TMFR20	N
1766-1865	0.523	0.384	0.344	0.285	0.234	0.123	0.017	9.5	6.9	3027
1766-1815	0.556	0.453	0.366	0.292	0.243	0.118	0.023	10.2	7.5	1132
1815-1865	0.502	0.348	0.332	0.280	0.230	0.127	0.014	9.2	6.7	1895
Person years										
1766-1865	84	875	2313	2937	2845	2525	2201			
1766-1815	32	300	781	1033	1054	969	889			
1815-1865	52	575	1532	1904	1791	1555	1312			

Note: The calculations are based on family reconstitutions in the four parishes and only include women married in the parish.

Table 2. Fertility responses to a 10 percent increase in food prices by socioeconomic status in the four parishes, 1766-1865. All women. Second and higher order births.

	Mean	Relative risk	%	Wald p
Socioeconomic status				
Freeholders/Crown (Ref.)	0.16	1.00		-
Noble tenants	0.21	1.01		0.86
Semi-landless	0.35	0.80		0.00
Landless	0.28	0.76		0.00
Effect of rye price (t) on:				
Freeholders/Crown (Ref.)			0.96	0.61
Noble tenants			-0.58	0.54
Semi-landless			-2.87	0.10
Landless			-4.24	0.04
Effect of rye price (t-1) on:				
Freeholders/Crown (Ref.)			-0.43	0.82
Noble tenants			-1.50	0.66
Semi-landless			-1.73	0.58
Landless			-1.30	0.73
Frailty variance (Family)		0.091		0.00
Number of births				4141
Likelihood ratio test				703
Overall p-value				0.00

Note: P-values for effect of prices on the reference category shows the probability that the effect is zero. P-values for effects of prices on the other categories shows the probability that there is no difference in response between the groups.

Table 3. Fertility responses to a 10 percent increase in food prices by socioeconomic status in the four parishes after controlling for age, parish of residence, parish of origin, age difference between spouses, mother's age at first birth, and life status of previously born child, 1766-1865. All women. Second and higher order births.

	Mean	Relative risk	%	Wald p
Age				
15-25	0.04	1.67		0.00
25-30 (Ref.)	0.14	1.00		
30-35	0.21	0.68		0.00
35-40	0.22	0.46		0.00
40-45	0.20	0.18		0.00
45-50	0.18	0.03		0.00
Socioeconomic status				
Freeholders/Crown (Ref.)	0.16	1.00		
Noble tenants	0.21	0.91		0.29
Semi-landless	0.35	0.79		0.00
Landless	0.27	0.68		0.00
Parish				
Hög (Ref.)	0.19	1.00		
Kävlinge	0.22	1.10		0.22
Halmstad	0.29	1.24		0.01
Sireköpinge	0.30	1.17		0.05
Parish of origin				
Parish of residence (Ref.)	0.36	1.00		
Other parish	0.64	1.10		0.08
Age diff. between spouses				
Wife older (Ref.)	0.24	1.00		
Husband older < 6 years	0.40	0.79		0.00
Husband older > 6 years	0.36	0.71		0.00
Mother's age at first birth				
-20	0.05	0.75		0.00
20-25 (Ref.)	0.31	1.00		
25+	0.64	1.06		0.33
Life status of previous child				
Alive (Ref.)	0.82	1.00		
Dead < 2 years since previous birth	0.07	6.83		0.00
Dead > 2years since previous birth	0.11	1.18		0.01
Effect of rye price (t) on:				
Freeholders/Crown (Ref.)			-0.46	0.81
Noble tenants			-0.44	0.99
Semi-landless			-4.46	0.10
Landless			-4.99	0.08
Effect of rye price (t-1) on:				
Freeholders/Crown (Ref.)			-0.28	0.88
Noble tenants			-4.34	0.11
Semi-landless			-2.96	0.29
Landless			-1.67	0.59

Table 3 (cont'.)

	Mean	Relative risk	%	Wald p
Frailty variance (Family)		0.041		0.00
Number of births				4063
Likelihood ratio test				4217
Overall p-value				0.00

Note: A small number of women (1.9 percent of the total number of births) for whom age difference between spouses or women's age at first birth is unknown have been excluded in all estimations in this table. For interpretation of p-values, see note in Table 2.

Table 4. Fertility response to a 10 percent increase in food prices and lagged food prices stratified by socioeconomic status in the four parishes, 1766-1865, 1766-1815, and 1815-1865. All women. Second and higher order births.

	Freeholders/Crown		Noble tenants		Semi-landless		Landless	
	%	Wald p	%	Wald p	%	Wald p	%	Wald p
1766-1865								
Rye price (t)	1.04	0.58	-0.42	0.79	-2.72	0.06	-4.43	0.01
Rye price (t-1)	-0.75	0.69	-1.49	0.36	-1.92	0.17	-1.31	0.44
Frailty (Family)	0.130a	0.01	0.102a	0.02	0.085a	0.07	0.002a	0.36
Number of births		769		1006		1390		976
1766-1815								
Rye price (t)	5.32	0.10	-0.11	0.96	-3.21	0.19	3.17	0.41
Rye price (t-1)	-2.18	0.64	-0.61	0.77	-2.43	0.32	-1.52	0.69
Frailty (Family)	0.109a	0.10	0.092a	0.07	0.133a	0.06	0.000a	0.91
Number of births		275		577		447		187
1815-1865								
Rye price (t)	-1.07	0.65	-0.50	0.84	-2.42	0.16	-6.05	0.00
Rye price (t-1)	-0.14	0.95	-3.16	0.22	-1.60	0.35	-2.12	0.26
Frailty variance (Family)	0.164	0.02	0.161	0.03	0.005	0.35	0.004	0.37
Births		494		429		943		789

Note: The table shows the results of 12 model estimations, three for each social group. Total number of births 4141.

Table 5. Fertility response to a 10 percent increase in food prices by a quarter of a year among the non-landed groups in the four parishes, 1815-1865. All women. Second and higher order births.

	%	Wald p
Harvest year 1		
1st quarter (Oct-Dec)	-2.94	0.53
2nd quarter (Jan-Mar) (Ref.)	-5.16	0.03
3rd quarter (Apr-Jun)	-6.81	0.62
4th quarter (Jul-Sep)	-5.23	0.98
Harvest year 2		
1st quarter (Oct-Dec)	-1.65	0.16
2nd quarter (Jan-Mar) (Ref.)	-2.85	0.01
3rd quarter (Apr-Jun)	0.52	0.28
4th quarter (Jul-Sep)	1.10	0.04
Frailty variance (Family)	0.437	0.00
Number of births		1730
Likelihood ratio test		1969
Overall p-value		0.00

Note: The model also includes age, parish, married in parish, age difference between spouses, and life status of previous child. For interpretation of p-values, see note in Table 2.

Table 6. Thresholds in the fertility response among the non-landed in the four parishes, 1815-1865. All women. Second and higher order births.

	Mean	Relative risk	Wald p
Rye prices			
Very low (Ref.)	0.14	1.00	-
Low	0.25	0.92	0.28
Normal	0.22	0.95	0.48
High	0.23	0.81	0.01
Very high	0.16	0.82	0.02
Frailty variance (Family)		0.006	0.35
Number of births			1730
Likelihood ratio test			34.6
Overall p-value			0.00

Note: For interpretation of p-values, see note in Table 2.