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, 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 over a period of two years. Landless and semi-landless families responded strongly to short-term economic stress stemming from changes in food prices. The response, both to moderately and large changes in food prices, was strongest within six months after the prices changed in the fall which points the conclusion that the response was deliberate. People foresaw bad times and planned their fertility accordingly. The result highlights the importance of deliberate, but non-parity specific, control of the timing of childbirth before the fertility transition, in order to reduce the negative impacts of short-term economic stress.

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 pretransitional Europe was not deliberately controlled but 'natural'. In fact, fertility was not considered to have been within "the calculus of conscious choice" (Coale 1973:65), 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 and 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 pretransitional Europe might have controlled their fertility deliberately, even though this often was done in a non-parity-specific way (see, e.g., Anderton and Bean 1985; Bean, Mineau and Anderton 1990; David and Sanderson 1986; David and Mroz 1989b; Szreter 1996). 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; Van Bavel and Kok 2004).

The aim of this paper is to present a new way of measuring the presence of deliberate control of fertility in a pretransitional 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. This was particularly the case for families without land, or with only small plots of land on which they could not subsist, and these families also had very limited possibilities of storing wealth. Faced with this kind of stress, our results strongly suggest that preindustrial families of lower social strata actively controlled timing of childbirth.

NATURAL FERTILITY AND DELIBERATE CONTROL

Ever since the highly influential paper by French demographer Louis Henry (1961) the concept of natural fertility has been at 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 and 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 and Trussel 1994; Page 1977; Wilson, Oeppen and 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 and Watkins 1986; Knodel 1977, 1978; see also Cleland and Wilson 1987). Although several of the conclusions have been seriously questioned (e.g. Brown and Guinnane 2002, 2003; Crafts 1989; Galloway, Hammel and Lee 1994; Guinnane et al. 1994; Mason 1997; Richards 1977; Schultz 1985; see also Friedlander, Okun and 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; Van de Walle and Muhsam 1995; Van de Walle 2000)[1], 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

[1] It should, however, be noted that since most of the references to methods of birth control in literary writings concerns extra-marital relations, Van de Walle and Muhsam (1995) and Van de Walle (2000) believe that these methods were mainly practiced outside marriage in the pretransitional period.

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 1966:91–92). Such a pattern has also been shown for several communities in preindustrial Europe, including Sweden (Gaunt 1973; Knodel 1978; Winberg 1975:236–238; Wrigley 1966; Wrigley et al. 1997:Table 7:6) or at least in some social groups (Eriksson and Rogers 1978:143).

However, it is questionable if the mere existence of such a pattern can be interpreted as a result of deliberate family limitation because it shares many other characteristics with the pattern found in natural fertility populations (e.g. Knodel 1978). 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 Van Bavel 2003; Åkerman 1977). 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 pretransitional populations often in response to social, economic or demographic factors, such as land scarcity, low income, unfavorable consumer-worker ratios etc. (e.g. Ahlberger and Winberg 1987; Andorka 1979; Gaunt 1976, 1977; Tilly 1984; Åkerman 1986). 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 et al. 1990; Crafts 1989; David and Sanderson 1986; Haines 1989; Morgan 1991; Szreter 1996) 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.[2] 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 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 to data from rural France before the revolution yields several highly interesting results (David and 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 two recent articles a similar but simpler approach is used for the Belgian town Leuven (Van Bavel 2004) and three different samples in The Netherlands (Van Bavel and Kok 2004) in the nineteenth century, examining the hypothesis that families deliberately

[2] The presence of deliberate fertility control before fertility decline has also been observed outside Europe and the United States, for example in China (Lee and Campbell 1997; Lee and Wang 1999; Zhao 1997, 2002; See

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 is modeled using hazard regression mixing all intervals regardless of parity and without controlling for unobserved heterogeneity. The results show that a higher proportion of young children (below nine) in the household is associated with lower fertility, controlling for marriage duration, children ever born and child survival, which is viewed as a strong indication of deliberate spacing due to the negative impact on the household economy of a higher proportion of dependent children.

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 deliberate spacing: the timing of childbirth in response to short-term economic stress in different socioeconomic groups. Before turning to the actual analysis we give an overview of the data and area under study, with special emphasis on indicators of natural fertility.

AREA AND DATA

The data used is based on family reconstitutions carried out within the Scanian Demographic Database[3] for five parishes in western Scania in southern Sweden: Halmstad, Hög, Kävlinge, Kågeröd and Sireköpinge. In 1766 they had 2,509 inhabitants which increased to 5,026 by 1865; an annual increase of 0.7% during this 99-year period, which is the same rate of growth as for Sweden as a whole (Statistics Sweden 1999, calculations based on Table 1.1).

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also Skinner 1997:66-75.

[3] 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

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 (Bengtsson and Lundh 1991). Since the parish records are updated by the clergyman on a daily or at least weekly basis, we have continuous time information on these events. The parish records are available for the entire period, with only a few years missing. 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. Thus, migrants enter the study upon in-migration and are censored at the time of 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:chap. 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.

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.[4] 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 and Lundh 2003; Gadd 2000:76, 198–

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material is described in Reuterswärd and Olsson (1993) and the quality of data is analyzed in Bengtsson and Lundh (1991).

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 2000:76–78, 86). At least up to the 1860s they paid most of their rent as labor rent, working on the demesne (Olsson 2002).

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 area 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 %) never got married, but, at least for males, this proportion declined during the first half of the nineteenth century (Dribe 2000:68), further indicating an easier access to marriage.[5]

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

Total fertility was slightly above five in the area without much change in the period of concern here (Bengtsson and Dribe Forthcoming). Total marital fertility (15–50) in Scania was between eight and nine in all social groups, while it was around seven for women over 20 (see Table 1). As with total fertility, marital fertility did not change much 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 and Lundström 1976:26–29), and the same holds true for Scania. Without any doubt, the period we are analyzing belonged to the pretransitional regime.

- Table 1 here

Looking at age-specific marital fertility, as displayed in Figure 1, there seems to be only small differences between the different social groups. All groups show a pattern typically found in pretransitional populations. One of the most common ways of measuring the degree of parity-specific control using age-specific marital fertility has been the Coale and Trussell indices: m and M (Coale and Trussell 1974, 1978). Although there have been numerous criticisms against this way to model natural fertility, and several other formulations and estimation techniques presented, it has survived to become widespread, probably because of its simplicity and thus value for comparisons.[6] The values of m and M displayed in Table 1 clearly indicate the absence of parity-specific control in all social groups. The only case where m is statistically significant from zero is for landless, but the value of 0.14 is still below 0.2, which is often considered as a minimum value for a population with parity-specific control.

- Figure 1 here

[6] See for example Page (1977), Broström (1985) and Wilson, Oeppen and Pardoe (1988). Due to the rather small sample size we have used the maximum likelihood approach proposed by Broström (1985).

Figure 2 shows the inter-birth intervals by children ever born for women married in the parishes. Apart from the first interval, from marriage to first birth, which is short because of a strong tradition of prenuptial courtship and bridal pregnancy (Bengtsson and Dribe Forthcoming; Kälvemark 1977; Lundh 2003), birth intervals were between 30 and 35 months on average, quite independent of the number of children ever born. Hence, there are no indications whatsoever that birth intervals became longer at higher parities, which would have been a clear sign of parity-specific control.

- Figure 2 about here

Thus, marital fertility, birth intervals, *M* and *m*, all seem to indicate that parity-specific fertility control was not practiced in the area under study. Overall marital fertility was quite high in the 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 pretransitional populations elsewhere in Europe, including Sweden (e.g. Alm-Stenflo 1989; Coale and Watkins 1986; Knodel 1977, 1988; Wrigley et al. 1997).

ECONOMIC STRESS AND TIMING OF BIRTHS

There are several ways through which marital fertility could be affected by economic crisis. First, economic stress may influence the *exposure,* since economic crisis may force people to migrate temporarily in search for work, leading to separation of spouses if women stay behind while men go looking for work. In a grain producing economy we expect temporary migrants to leave some time after the harvest, because until after the crops are harvested work is usually available also in bad years, since one could not afford to loose even the slightest part of the output. The effect of economic crisis on fertility should then be delayed with approximately a year as a result of waiting time for conception and pregnancy, and then be retained as long as the absence lasted.

Second, families may *deliberately* postpone childbirth in times of economic hardship either by using contraception or through induced abortion. Induced abortion will indeed give a faster fertility response to short-term economic stress than the use of contraception, perhaps as short as six months. As was pointed out above, different traditional contraceptive methods seem to have been known to people in the past. Even if it was impossible to foresee economic problems, the effect would still been seen well within a year after the price change in the fall. Should it be possible to foresee economic problems by, say the spring, which we believe it was, then the response could come already in the late fall, i.e. only a short time after food prices were set.

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 and Watkins 1981). Since we are dealing solely with short-term effects in this study, 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. Such an effect of malnutrition will influence birth rates after about a year, adding waiting time to conception and gestation together. Malnutrition may also affect birth rates through spontaneous abortions. To the extent that spontaneous abortions is provoked by nutritional stress it mainly takes place during the first trimester of the pregnancy affecting fertility some six months later or more (Wood 1994:Table 6.7). Since malnutrition usually was most severe during the spring, when food became scarce, we would expect the effects to appear about one year or more after the price change. Thus, regardless of the mechanisms, malnutrition will affect fertility much later after the price change than deliberate control.

Finally, short-term economic stress might influence breast-feeding and thereby fertility through *lactational infecundability*. Assuming that people at the time were aware of this mechanism (see, e.g., Ahlberger and 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.

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 and Ohlsson 1985; Galloway 1988; Lee 1981; Weir 1984). The fertility response was much stronger and more consistent than that of mortality (Bengtsson 2000; Galloway 1988), and not dependent upon fluctuations in marriage. Instead, it was mainly marital fertility that was affected by economic fluctuations (Bengtsson 1993; Lee 1981).

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 previously 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 (see Dribe 2000: chap. 8). Peasants, the net producers of food, should be far less vulnerable to price changes because they were better able to store wealth (grain, live-stock, valuable items) and also because they had greater opportunities to borrow money as well as to adjust production costs, than the landless and semi-landless groups, who were net consumers.[7]

In this article 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, 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 annual grain price variations at the community level on the likelihood of giving birth. By estimating the effects of changes in food prices on fertility in subsequent three-

[7] The variation in the yearly calorie intake due to food price changes is likely to have been in the range of 20% for the lower social strata. For a detailed discussion, see Bengtsson (2004a), who also discusses the ability to deal with short-term economic stress among different social groups.

month periods during two years after the price change, we are able to detect the time distribution in the response.

The price data used are annual 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*) in the fall, shortly after the harvest. 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 satisfactory indicators of the true market prices in the region (Jörberg 1972:8–18). The market price scales were also the prices that often were used in different kinds of transactions throughout the year, for example when estate owners sold grain to the tenants and crofters of his estate. 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.[8] The trend in the price series has been removed because we are focusing on effects of short-term economic stress.[9]

The reason for using the annual information about grain prices is that while there is annual data on prices for a set of commodities from all over Sweden from the beginning of the eighteenth century onwards, there is monthly or quarterly data only for shorter periods, and only in certain parts of Sweden. The seasonal components, however, account for only a minor part of the total variation in food prices, which means that changes from year to year totally dominate the price variations.[10]

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[8] A detailed description of the source material and the series themselves are available in Bengtsson and Dribe (1997).

[9] 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 and Jaeger 1993).

[10] Estimations for Uppsala academy mill show that the seasonal component accounted only for 4–5 % of the total variation in prices for the period 1736 to 1789 (Jörberg 1972:46). A calculation for the 18 southernmost counties in the period 1843–1858 yields similar results (Jörberg 1972: 56, Diagram III:10). Our own calculations based on monthly rye prices for Landskrona, a town close to the parishes in our study, for the period 1802–1813 show that while the average of the variation coefficient within each year is 0.09, the average over the twelve year period is 0.27.

Price changes within a year happened mainly in the spring. For example, if a bad harvest was foreseen, prices increased already in the spring. Thus, the price on the spot market was an early indicator of the economic situation in the fall. For this reason, the County Governors (*Landshövdingarna*) were, from the mid-eighteenth century onwards, obliged to report conditions concerning harvests and production both in the summer and the fall to the central authorities in order for them to take appropriate measures (Utterström 1957:194).[11] As for the local harvest outcome an early indicator was the farmer's inspection of the germination of the fall sowing. This way, he would already in the fall get an indication of what the next harvest would be like, at least if it was going to be miserable. Thus, most likely people very early in the year formed expectations about the economic situation in the fall, both regarding the local conditions and the situation on more distant markets.

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 multiple events, and there might be differences in the risk of childbirth between different women due to different family specific factors (biological or behavioral) not controlled for in the models. The large number of families in the data does not allow us to estimate fixed family effects. Instead, we add frailty effects (or random effects) to our survival models in order to control for such unobserved family specific variations in the data. More specifically we use a Cox proportional hazards model with frailty (see Therneau and Grambsch 2000:232–233):

[11] 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–

$$ln\ h_{ij}(a)=ln\ h_0(a)+\beta X_{ij}+\gamma Z(t)+\omega_j$$

where: $h_{ij}(a)$ is the hazard of giving birth to a child for a woman (j) of observed parity i at duration (time since last birth) a, $h_0(a)$ 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 individual covariates (X_{ij}) in the model, γ is the parameter for the external covariate ($Z(t)$, where t is calendar time), and ω_j is a vector of the random effects (frailties) at family level (all births to the same woman), assumed to be normally distributed (Gaussian).[12]

EMPIRICAL RESULTS

We look first at the basic relationship between social status, prices and fertility controlling for a number of other important determinants of marital fertility (see Table 2).[13] The first thing to note is that the level of marital fertility differed between social groups when controlling for the other determinants of fertility included in the model, with freeholders having the highest and landless the lowest. 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 10% increase in food prices lowered fertility among the landless by 5%, and slightly less than that among the semi-landless, but did not significantly affect the

1867 (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 of the harvest.

12 Models with Gamma distributed frailty were also estimated and yielded practically identical results, which serves to indicate that the results are quite robust against different specifications of the frailty effects. The estimations were made using the 'eha' package in R, developed by Göran Broström at the Department of Statistics, Umeå University, specifically designed to estimate this kind of combined time-series and individual survival model.

13 Tests of the proportionality assumption using the test proposed by Therneau and Grambsch (e.g. 2000:130–140) based on scaled Schoenfeld residuals, indicate non-proportionality in some of the control variables (mainly age and social status), but, more importantly, no indication of non-proportionality in neither the effect of rye prices nor in the interactions between prices and social status or month of year.

landed groups.[14] 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% from the normal level—in 14 years during the period 1766–1865 prices were 120% or more above the trend—the fertility response among the non-landed groups was considerable. A 100% increase in grain prices corresponded to a 32% decline in fertility for the landless 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 (see Bengtsson 2004b).

- Table 2 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. As was pointed before, one way of identifying the causal mechanisms is to study the time pattern in the response. If the lower fertility in response to high grain prices was unintentionally caused by lower fecundability due to malnutrition, 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.

[14] The effects of 10% changes in grain prices were calculated from coefficients on log price deviations from trend (b) using the formula: $100(e^{b \ln(1.1)}-1)$ (see Campbell, Lee and Bengtsson 2004:84).

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 situation in the fall would be like already in the spring. If they were planning their fertility, we should get a response already in the beginning of the year following the price change.

Table 3 shows the price response by three-month period, controlling for the same individual and family level factors as in Table 2 (see also Figure 3). It is interesting to note there is an observable effect of grain prices on fertility up to 18 months after the price change, 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 to December (the first three months after the price change), which is strengthened in January to March and April to June, and then weakened later in the year. Hence, although the response was strongest six to nine months after the price change, fertility dropped already in the months immediately following the price change. Figure 3 also shows that the time pattern in the fertility response to economic stress did not change a great deal within the period under study. Similar time patterns in the fertility response to economic fluctuations have also been reported in studies using aggregated monthly data (see, e.g., Bengtsson and Ohlsson 1988; Lee 1981).

- Table 3 and Figure 3 about here

The strong and fertility response to economic stress in the first six months or so after the price change cannot be expected to have been linked to subfecundity following malnutrition, 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 with about a one year lag, 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. 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 such an effect would not have come until 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 2005). Instead, the evidence points quite strongly at deliberate planning as the main mechanism through which fertility was related to economic fluctuations.

The strong response in fertility to economic stress in January to March in the second year after the price change, however, might well have been an effect of low food supply in late spring following the price change, which through subfecundity or spontaneous abortions led to lower fertility six to nine months later.

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 4.[15] Taking very low prices as the reference, i.e. the most favorable situation for the non-landed groups, the fertility response got stronger at higher prices, but it was not only in years of economic crisis (very high 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 postponement, because an effect of

[15] The categorization of the prices series was done somewhat arbitrarily to get a reasonable distribution of years in each category. As seen in table 4 about 15% of the years are found in each of the extreme categories, and 22–25 % in each of the middle categories.

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

- Table 4 about here

To sum up, the most reasonable interpretation of the rapid 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. Langsten (1980:chap. 3) reached a similar conclusion in an aggregate study of Bangladesh (1966–1976), where the crude birth rate responded to rice price fluctuations with 9 and 14-month lags; the first interpreted as a result of deliberate control and the second as an involuntary response, mainly due to malnutrition.

CONCLUSION

This study deals with the controversial, but important, issue whether or not fertility in Europe was deliberately controlled also before fertility transition, and the results presented 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 birth intervals were quite long, which could have been a result of deliberate spacing, but also of an unintentional effect of breast-feeding or low coital frequency. It is quite difficult to actually show that families made deliberate decisions to control their fertility in response to economic factors, such 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 pretransitional context were capable of this kind of rational decision-making.

In this paper we have tried to go deeper into the 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 timing of the response.

The results clearly show 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 time pattern of the response 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. In addition to this deliberate fertility control in times of economic stress, a delayed response, some 15 months after the price change, might have been an involuntary effect due to subfecundity following malnutrition.

The 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. Fertility indicators by socioeconomic status in the five parishes, 1766-1865.

	All	Freeholders	Noble tenants	Semi-landless	Landless
TMFR	8.7	9.0	9.0	8.6	8.3
TMFR20	6.9	7.0	7.2	7.0	6.5
m	0.01	0.05	-0.04	-0.06	0.14*
M	0.77	0.80	0.77	0.74	0.78
N	8461	893	2364	2796	2408

* p<0.05

Note: M and m were derived by maximum likelihood estimation following the approach in Broström (1985).

Source: The Scanian Demographic Database.

Table 2. Cox proportional hazards estimates of fertility in the five parishes 1766-1865. All women. Second and higher order births.

	Mean	Relative risk	%	p
Age				
15-25	0.04	1.39		<0.01
25-30	0.14	1.00		ref.cat.
30-35	0.20	0.68		<0.01
35-40	0.22	0.47		<0.01
40-45	0.21	0.19		<0.01
45-50	0.19	0.03		<0.01
Socioeconomic status				
Freeholders	0.10	1.00		ref.cat.
Noble tenants	0.27	0.88		0.09
Semi-landless	0.36	0.79		<0.01
Landless	0.28	0.67		<0.01
Parish				
Hög	0.11	1.00		ref.cat.
Kävlinge	0.12	1.16		0.07
Halmstad	0.18	1.28		<0.01
Sireköpinge	0.18	1.28		<0.01
Kågeröd	0.42	1.23		<0.01
Place of birth of spouses				
Both in parish of residence	0.23	1.00		ref.cat.
One in parish of residence	0.40	1.12		0.03
None in parish of residence	0.37	1.22		<0.01
Place of marriage				
Other parish	0.35	1.00		ref.cat.
Parish of residence	0.65	1.04		0.37
Age diff. between spouses				
Wife older	0.24	1.00		ref.cat.
Husband older < 6 years	0.38	0.85		<0.01
Husband older > 6 years	0.38	0.69		<0.01
Life status of previous child				
Alive	0.81	1.00		ref.cat.
Dead < 2 years since previous birth	0.08	7.51		<0.01
Dead > 2years since previous birth	0.11	1.13		<0.01
Effect of 10% change in rye price (t):				
Freeholders (Ref.)			0.12	0.95
Noble tenants			-0.27	0.86
Semi-landless			-4.16	0.05
Landless			-4.95	0.02

Table 2 (cont'.)

	Mean	Relative risk	%	p
Effect of 10% change in rye price (t-1):				
Freeholders (Ref.)			-0.28	0.88
Noble tenants			-2.42	0.32
Semi-landless			-1.20	0.67
Landless			-2.79	0.26
Frailty variance		0.418		<0.01
Number of births				7166
Likelihood ratio test				7705
Overall p-value				<0.01

Source: See Table 1.

Note: P-values for effect of prices on the reference category refer to base effect of prices, while p-values for the other groups refer to interaction effects.

Table 3. Fertility response to a 10% change in food prices by quarter of a year among the non-landed groups in the five parishes, 1766-1865. All women. Second and higher order births.

	Oct-Dec		Jan-Mar		Apr-Jun		Jul-Sep	
	%	p*	%	p	%	p*	%	p*
Rye price (t)	-2.66	0.18	-5.52	<0.01	-6.15	0.77	-3.12	0.27
Rye price (t-1)	-0.33	0.04	-4.77	<0.01	-1.57	0.13	-0.86	0.07

Frailty variance (p-value)	0.384 (<0.01)
Number of births	4274
Likelihood ratio test	4622
Overall p-value	<0.01

Source: See Table 1.
Note: The model also includes age, parish, place of birth, place of marriage, age difference between spouses, life status of previous child and season.
*P-values for interaction effects.

Table 4. Fertility response to categorized grain prices among the non-landed in the five parishes, 1766-1865. All women. Second and higher order births.

	Mean	Relative risk	Wald p
Rye prices			
Very low (Ref.)	0.14	1.00	ref.cat.
Low	0.25	0.91	0.06
Normal	0.22	0.87	0.01
High	0.23	0.81	<0.01
Very high	0.16	0.74	<0.01
Frailty variance (Family)		0.380	<0.01
Number of births			4274
Likelihood ratio test			4557
Overall p-value			<0.01

Source: See Table 1.
Note: The model also includes age, parish, place of birth, place of marriage, age difference between spouses, and life status of previous child.

Figure 1. Age-specific marital fertility rates (live births) in the five parishes 1766-1865 by socioeconomic status.

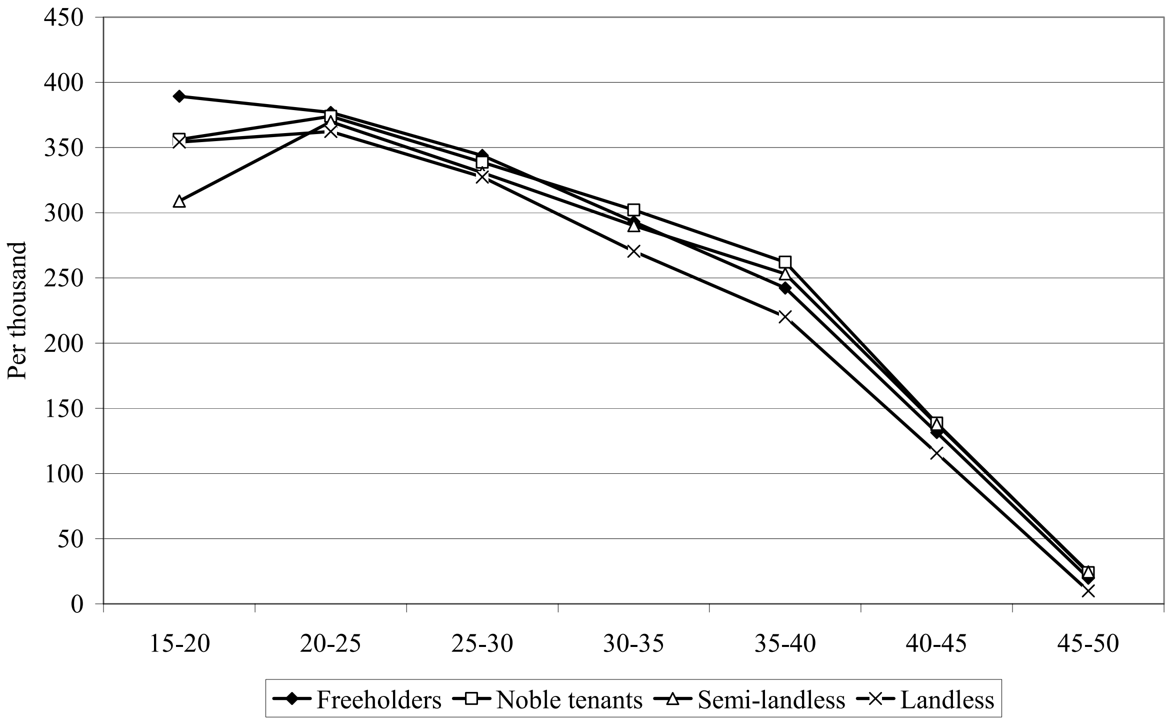
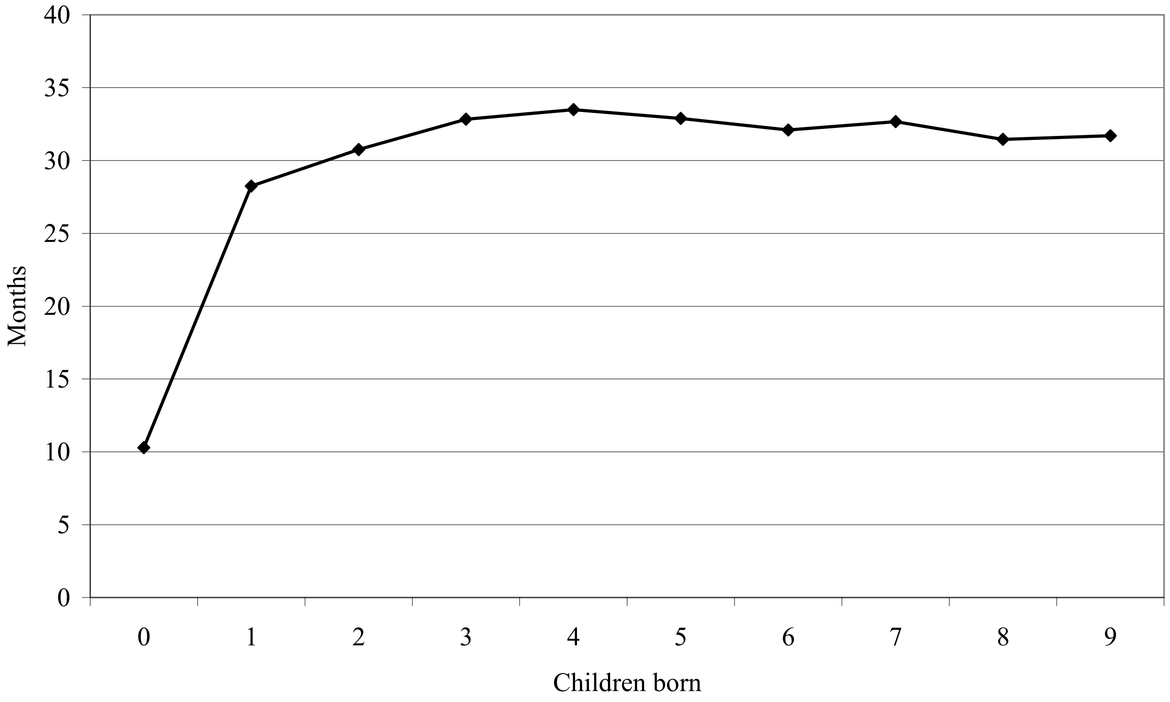
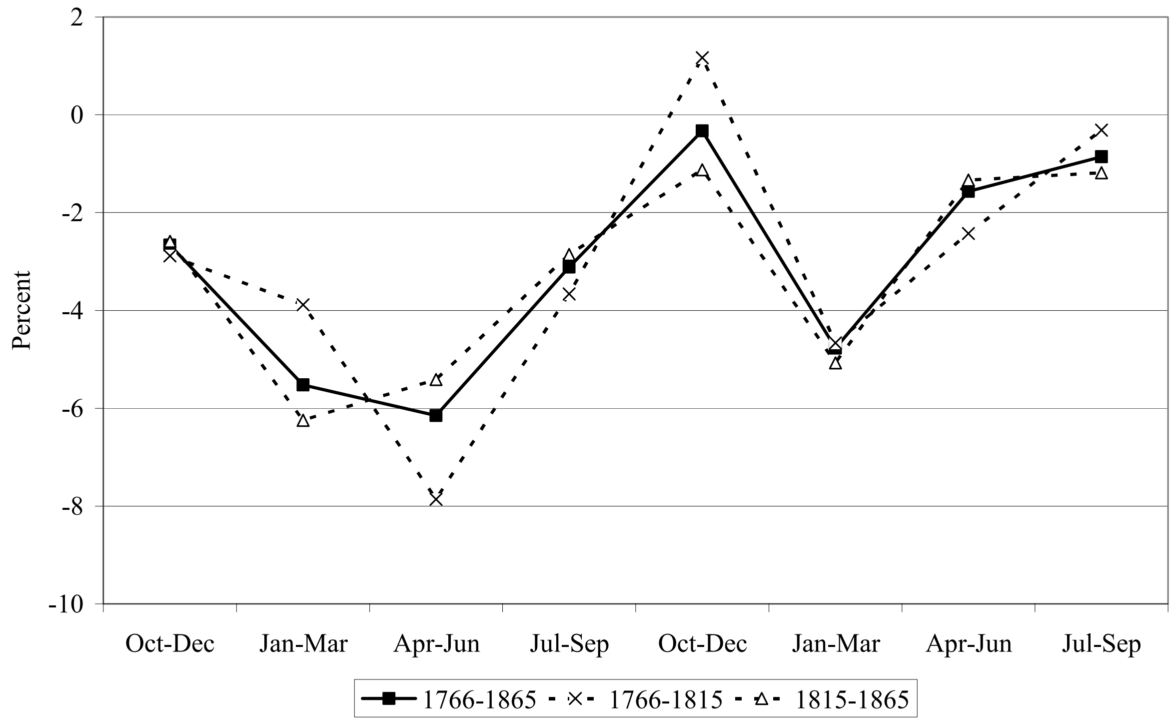


Figure 2. Inter-birth intervals by previous children born in the five parishes, 1766-1865.



Note: All socioeconomic groups. Only includes women married in the parishes. First interval is from marriage to first birth.

Figure 3. Fertility response to 10% change in rye prices over the next two years by three-month periods in the five parishes.



Note: Based on model estimations using the same model as in table 3.