Fertility Response to Short-term Economic Stress: Deliberate Control or Reduced Fecundability?

Bengtsson, Tommy; Dribe, Martin

2002

Lund Papers in Economic History

No. 78, 2002 *Population Economics*

Fertility Response to Short-term Economic Stress

Deliberate Control or Reduced Fecundability?

Tommy Bengtsson & Martin Dribe

DEPARTMENT OF ECONOMIC HISTORY, LUND UNIVERSITY

Errata. Table 11 missing in text.

Table 11. *Coale-Trussel M and m for the Scanian sample and Sweden as a whole.*

Area	m	M
Scanian sample		
1766-1815	0.15	0.86
1815-1865	0.13	0.89
1766-1865	0.14	0.88
Sweden		
1786-90	0.27	0.96
1846-50	0.14	0.92
1861-65	0.04	0.93
1891-95	0.14	0.91

Note: Calculations based on figures in tables 6 and 7.

Lund Papers in Economic History
ISSN 1101-346X
ISRN LUSADG-SAEH-P--02/78--SE+39

Printed by KFS, Lund, Sweden, 2002

Orders of printed single back issues (no. 1-65)
Department of Economic History, Lund University
Postal address: P.O. Box 7083, S-220 07 Lund, Sweden
Telephone: +46 46 2227475
Telefax: +46 46 131585

Full-text electronic issues (no. 60, 61, 66--)
www.ekh.lu.se

Fertility Response to Short-term Economic Stress

Deliberate Control or Reduced Fecundability?

Tommy Bengtsson & Martin Dribe

Introduction

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 facing people in preindustrial societies (e.g. Galloway 1988; Lee 1981; for an overview see Bengtsson and Reher 1998). Throughout Europe, the fertility response to these changes was much stronger than the response of mortality and nuptiality (Galloway 1988). This was also the case for Sweden (Bengtsson and Ohlsson 1978; Bengtsson 2000: 209-312). In fact, the crude birth rate for Sweden follows real wages for agricultural workers surprisingly closely, with a one-year lag up until the mid-nineteenth century (Bengtsson 2000: Figure 11.5). Not only was major changes in real wages reflected in the crude birth rate, but also minor deviations from the mean. Analysis of sex and age-specific mortality rates shows that the response was similar by sex but varies by age. It was very particularly strong for adults (Bengtsson and Ohlsson 1985: Figure 1). The clear co-variation between changes in real wages and crude birth rates was not dependent upon

---

This paper has been written within the research project *Early Life Conditions, Social Mobility and Health in Later Life*, financed by the U. S. National Institutes of Health/National Institute of Aging (1P01AG18314-02), the Swedish Council for Social Research and the Bank of Sweden Tercentenary Foundation. Martin Dribe gratefully acknowledges financial support from Jan Wallander and Tom Hedelius Foundation, Svenska Handelsbanken. We also wish to thank participants in the Eurasia Project on Population and Family History, and especially George Alter, for most valuable comments and suggestions.
Correspondence to: Tommy Bengtsson, Department of Economic History, Lund University. Tommy.Bengtsson@ekh.lu.se. Martin Dribe, Department of Economic History, Lund University. Martin.Dribe@ekh.lu.se.

fluctuations in marriage (Bengtsson 1993; Carlsson 1970). Instead, it was mainly marital fertility that varied positively with the real wage development (Bengtsson 2000: 310; Bengtsson and Dribe 1997).

The close connection between economic cycles and population changes is by no means a recent finding. This was demonstrated for Sweden by Per Wargentin in his publication from 1776, quoted by Robert Malthus, and in more detail by Johan Hellstenius a hundred years later (Wargentin 1776; Malthus 1803/1992; Hellstenius 1871). Their followers in the twentieth century, Eli Heckscher and Gustaf Utterström, were primarily focusing on mortality and, to some extent, nuptiality, while less attention was given to fertility. While Heckscher embraced Malthus' view, Utterström claimed that the mortality response to short-term economic fluctuations was not uniform, but that infants were less responsive than other age groups (Heckscher 1949: 42-44; Utterström 1957: 207-8). His conclusion regarding infant mortality has later been further corroborated in a study by Bengtsson and Ohlsson (1985). Still, it was apparent not only to scientists of the time but also to laymen, that variations in real wages and food prices determined the well-being of a large part of the population. Despite this awareness, many families were unable to escape hunger and, alas, their mortality, fertility and nuptiality were affected by economic fluctuations. Societal institutions, such as the poor relief system, also failed to help since it was not developed to deal with masses of hungry people but rather the few sick and very poor.[1]

The obvious questions emerging from such studies – who suffered from short-term economic stress related to food prices, and which were the causal mechanisms behind the response – are left unanswered in analyses at aggregated level. From micro level analyses of some rural parishes in Scania, we know that both children and adults showed increased mortality after years with high food prices and that the landless groups suffered the most (Bengtsson 2000, forthcoming). Moreover, we also know that the fertility of the landless was strongly affected up until real wages started to increase in the second half of the nineteenth century (Bengtsson and Dribe, forthcoming). The aim of this paper is to discuss the difficult question whether such a fertility response to economic stress resulted from a deliberate planning of births by the family or rather was an effect of reduced fecundability following malnutrition, or spousal separation due to migration. We will study fertility and short-term economic fluctuations from a family perspective,

[1] Only 2.1 percent of the population in Sweden received poor relief in 1829 (Skoglund 1992). For more details on the poor relief system in the area of study, see Bengtsson, Chapter 6, forthcoming and Lee, Bengtsson and Campbell, Chapter 4 forthcoming.

including all social groups, taking different family characteristics into account. In doing so we will not only analyze whether the fertility response to short-term economic stress was deliberate or not but also whether fertility was controlled to limit family size. The analysis is made on four peasant parishes in southern Sweden during the period 1766 to 1865, a period of rapid agrarian change, especially from the beginning of the nineteenth century onwards, but prior to industrialization.

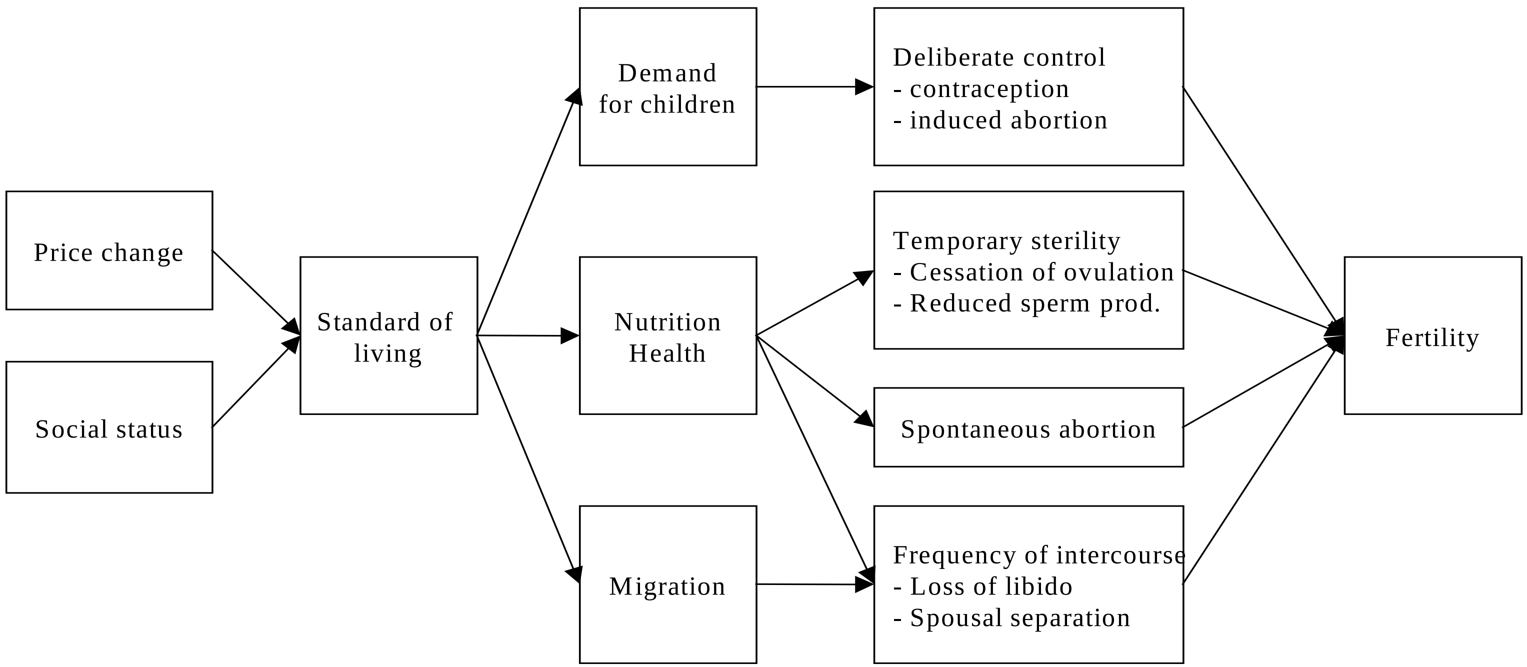
Fertility and Economic Stress – A Conceptual Framework

Human fertility is a complex process with biological/physiological as well as socioeconomic and cultural components. One influential conceptual framework for analyzing this complex phenomenon is the one formulated by Bongaarts (1978), which built upon a previous formulation by Davis and Blake (1956). It views fertility to be determined by a set of immediate factors, or proximate determinants, having to do with the direct control of reproduction, both intentionally and unintentionally. They can be divided into three different sub-groups.

Firstly, exposure factors (nuptiality in most cases) affect the number of women under risk of childbirth. Secondly, there are deliberate actions that could be taken to limit fertility, such as contraception or induced abortion, and thirdly there are a number of more physiological factors influencing fertility, such as post-partum ammenhorrea, sterility and spontaneous abortion. Behind these proximate determinants, however, there are various indirect factors – socioeconomic, cultural or environmental – which are affecting the proximate determinants. This is a very powerful framework that has been used quite extensively in the fertility literature.

We employ an extended version of this framework in our analysis of how marital fertility might have responded to short-term economic stress (see Figure 1). We may think of three main ways through which fertility could be affected by economic crisis. First, families may deliberately postpone childbirth in times of economic hardship by using contraception (modern or traditional) or induced abortion. Second, economic crisis may force people to migrate seasonally to search for work, which could lead to separation of spouses if women stayed behind while men went for work. Third, fertility may be affected by lower fecundability, and possibly higher risk of spontaneous abortions, following malnutrition or increased exposure to disease.

***Figure1**. Model of marital fertility response to economic stress*



There appears to be a strong view in the literature that deliberate family planning was almost unthinkable in pre-transitional Europe (e.g. Coale and Watkins 1986; Knodel 1977), although recent research has emphasized that deliberate spacing of births was important before and during fertility transition (Szreter 1993; see also Santow 1995), which at least points to the possibility of a deliberate postponement of births in times of crisis.

Turning to the link between nutrition and fertility there is an 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 1977; Menken *et al*. 1981). Since we are only dealing with short-term effects on this essay, we can safely conclude that temporary, severe, malnutrition may lead to cessation of ovulation, loss of libido and reduced sperm production, which lower fecundity. Such effects have been documented both in contemporary less developed countries and in modern societies, for example during the Dutch famine during the Second World War (Bongaarts 1980).

Area and Data

The dataset is based on family reconstitutions carried out within the Scanian Demographic Database[2] 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, located about 10 kilometers from the coast as shown on Map 1.[3]

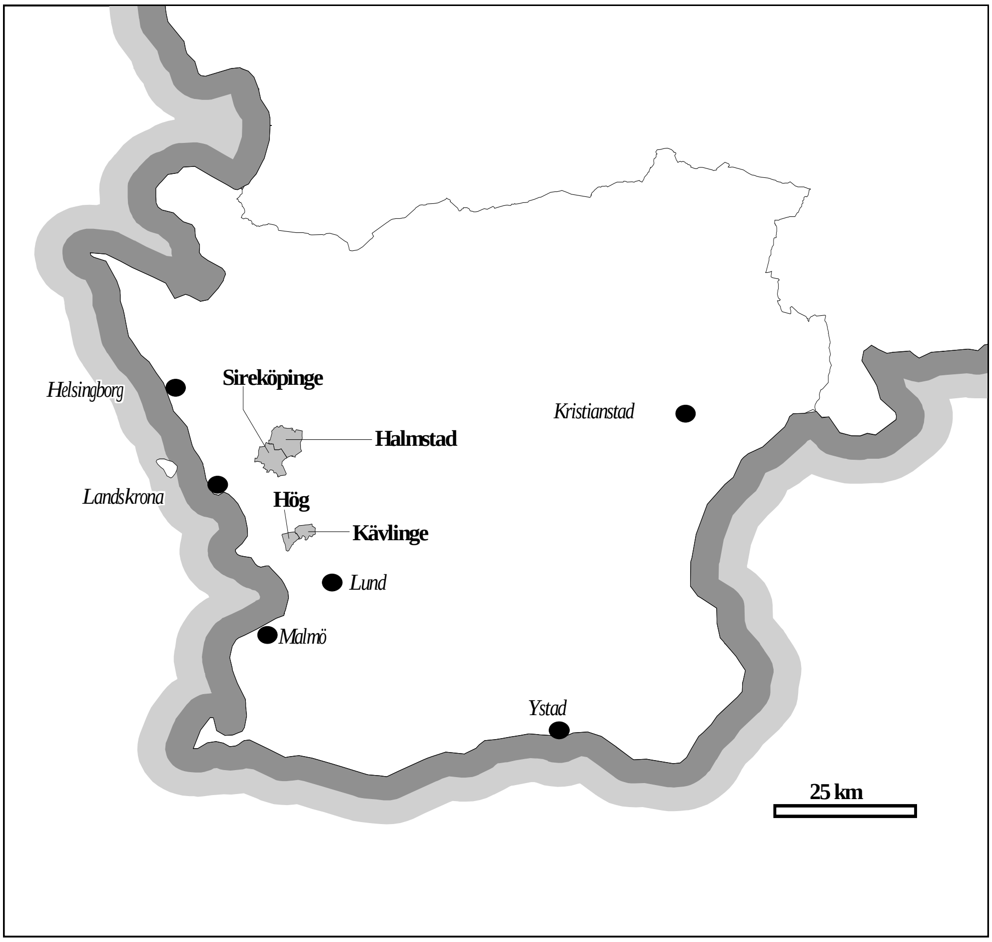
Nearby towns – Lund, Landskrona, and Helsingborg – are all very small and located 10-30 kilometers away. Kävlinge, Hög, Sireköpinge and southern Halmstad were open-country farmland, while northern Halmstad was more wooded. Halmstad and Sireköpinge parishes comprised primarily of noble land (*frälsejord*), while freehold and crown land predominated in Kävlinge and Hög. The parish populations numbered between 200 and 500 inhabitants each in 1800.

---

[2] 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 and Olsson (1993) and the quality of data is analyzed in Bengtsson and Lundh (1991).

[3] The data are from the Scanian Demographic Database, which is a collaborative project between the Research Group in Population Economics, Department of Economic History, Lund University, and the Provincial Archives, Lund.

Map 1. *The location of the four parishes in Scania, southern Sweden.*



Scania is known as the granary of Sweden.[4] In the eighteenth century agriculture was organized in an open field system where each peasant worked a number of strips in different parts of the village. Pasture and woodlands were used as commons for grazing livestock and sundry other purposes. Rye, barley and oats were the dominant crops and beans, peas and vetches were grown on the fallow (Weibull 1923: 96). Potatoes spread to various parts of Scania by the end of the eighteenth century but were only grown on a small scale (Weibull 1923: 103). After a long period of continuous land reclamation, Sweden experienced a transformation of the agricultural sector during the early nineteenth century. Total production increased rapidly, as did land and labor productivity, owing to the influence of improved tools and equipment, new crops and crop rotations, and enclosure of the land (e.g. Schön 1995; Gadd 1983; Martinius 1982). Agriculture became much more commercialized than before and the surplus was sold on the European market. Scania was a central part of this development.

[4] See Bengtsson and Dribe (1997) and Bengtsson (forthcoming) for more details.

The first steps in Swedish industrialization took place early in the nineteenth century, but the real industrial break-through did not come until the latter part of the century. Its most notable feature, as far as Scania was concerned, was the expansion of the textile industry, which took place mainly after 1865. Thus the period we analyze is a period of expanding agricultural production prior to the industrial revolution.

The social structure of the parishes varies somewhat. Hög and Kävlinge were dominated by freeholders and tenants on crown land – a group rather similar to the freeholders regarding its social characteristics – while Halmstad and Sireköpinge were totally dominated by tenants on noble land (see Bengtsson and Dribe 1997). 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 the family. In 1766 the four parishes had 1310 inhabitants that increased to 3383 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, which was 0.7 percent per year (Statistics Sweden 1999: calculations based on Table 1.1). Mortality in Scania as well as in Sweden as a whole was falling among infants and children. Life expectancy in Sweden increased from about 35 years in 1750 to 45 years in 1850 and 55 years in 1900 (Statistics Sweden 1999: Table 5.5).

The family reconstitutions were carried out using data on births, marriages and deaths, for the period from the late seventeenth century up till 1894. The material is of high quality, with only a few years missing. However, a certain degree of under-recording has been discovered (Bengtsson and Dribe 1997:8). 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. Suffice it to say that the performance of the method seems satisfactory overall (Bengtsson and 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.

Regarding data quality, Bengtsson and Dribe (1997) noticed the rather high proportion males among children. The male to female sex ratio at birth for the period 1766-1865 is 1.09 as shown in Table 1, which indicates the possibility of under-recording of female births.

Table 1*. Sex ratio at birth in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

	All births to women married in the parish	First interval	2+ interval, all married women
Male births	1787	394	2209
Female births	1633	387	2029
Proportion male births	0.52	0.50	0.52
Sex ratio	1.09	1.02	1.09

Source: The Scanian Demographic Database

As shown in Table 6 below, which gives total marital fertility by age and sex of child for two time periods, 1766-1815 and 1815-1865, the potential under-registration of female births only takes place during the second period. While the sex ratio for the first period was 1.0, it was particularly high for mothers aged 15-20 years and aged 35-40 years during the second period. The quality of death records seems very high and four percent of all births are stillbirths, which can be considered normal. If there is a serious problem with under-recording of deaths, it is expected to show up as low mortality before baptism. Baptism in the eighteenth century took place with the first week of life but increased during the nineteenth century up to several weeks (Bengtsson and Lundh 1991: 16-17). The infant mortality rate, stillbirths excluded, is 157 and neonatal mortality 65 per thousand live births, which gives no indication of serious problems. The proportion dying during the first month of life is 41 percent excluding stillbirths.[5] Again, there is no indication of serious problems in the recording of deaths. Thus the only indication of data problems we have is the somewhat high figure of male births in relation to female births during the first half of the nineteenth century, particularly for mothers aged 15-20 and 35-40 years, but this might well be a result of random variation.

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

[5] The corresponding figures for the German villages included in Knodel's study (1978) and for which he does not find any indications of serious recording problems are between 22 and 60, with 41 as the median. See Bengtsson (1999:123-124) for comparisons with other areas in Sweden and elsewhere.

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 satisfactory indicators of the true market prices in the region (Jörberg 1972).[6] Since we are using the local price information the market price scales were based on, they should even better reflect the actual price in the area we analyze. The trend in the rye price series has been removed since we are focusing on effects of short-term economic stress.[7]

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.

Fertility Patterns in Rural Scania

Before turning to the pattern of fertility something needs to be said about the marriage pattern. Scania was characterized by a rather typical (Western) European Marriage Pattern (Hajnal 1965), as is shown in Table 2 and Table 3 (see Lundh 1997, 1999a). Age at marriage was quite high; around 30 years for males and 28 for women. Mean ages at marriage also seems 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 between the two periods, further indicating an easier access to marriage.[8]

---

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

[7] 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).

[8] 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 1999a).

Table 2. *The mean age at first marriage in the seven Scanian parishes, 1751-1860.*

	Age	N
Men		
1751-1810	32.2	372
1811-1860	29.3	687
Women		
1751-1810	27.7	384
1811-1860	26.8	1014

Note: Based on family reconstitution data for Ekeby, Frillestad, Halmstad, Hög, Kävlinge, Sireköpinge, and Stenestad, which are included in the sample of nine parishes in the Scanian Demographic Database.
Source: Lundh 1999a: Table 9.1.

Table 3. *Proportion never married by sex and time period in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1830-1864.*

	Males		**Females**	
Age group	1830/49	1850/64	1830/49	1850/64
0-14	99.4	99.8	99.8	100.0
15-19	99.3	99.7	96.6	96.5
20-24	90.6	90.4	77.2	76.3
25-29	60.3	52.1	44.8	40.9
30-34	32.4	26.0	27.4	20.0
35-39	23.0	13.6	21.4	16.8
40-44	17.0	9.7	18.4	15.1
45-49	14.8	9.1	13.6	14.2
Person years	22753	20442	23614	21281

Source: Dribe 2000:68.

Turning to the fertility pattern, Table 4 displays age-specific and total fertility rates for the four parishes between 1775 and 1855. For comparative reasons only live births are included in the fertility tables. The total fertility rate was slightly above five, with no change between the periods. As shown in Table 5 the levels for Sweden as a whole was lower; slightly above four.

***Table 4**. Age-specific and Total Fertility Rates by period in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	40 - 45	45 - 50	TFR
All births								
1775-1795	0.009	0.129	0.240	0.272	0.278	0.096	0.018	5.21
1800-1825	0.015	0.110	0.261	0.276	0.259	0.137	0.034	5.46
1830-1855	0.013	0.110	0.254	0.268	0.236	0.147	0.019	5.23
Person-years observed								
1775-1795	320	333	317	268	223	219	170	
1800-1825	482	519	402	398	320	292	261	
1830-1855	752	692	635	578	487	416	364	

Note: The calculations were based on quinquennial census data for the four parishes. Person-years observed thus refer to the number of females in the parishes in different ages.
Source: Population registers, The Regional Archives, Lund

***Table 5**. Age-specific and Total Fertility Rates by period in Sweden, 1786-1865.*

	15-20	20-25	25-30	30-35	35-40	40-45	45-50	TFR
1786-90	0.021	0.115	0.200	0.216	0.165	0.092	0.021	4.15
1846-50	0.007	0.094	0.200	0.232	0.197	0.107	0.018	4.28
1861-65	0.009	0.104	0.208	0.240	0.208	0.127	0.020	4.58

Source: Statistics Sweden 1999, Table 3.3.

Total marital fertility in Scania was above nine, while the rates for women over 20 were around seven (Table 6). The level of marital fertility for Sweden as a whole was somewhat higher, although the differences are not very large (Table 7). Thus the higher total fertility rates for Scania compared to Sweden as a whole stems from differences in proportion married. As with total fertility rates, marital fertility rates do 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 (Bengtsson and Ohlsson 1994; Carlsson 1966). The same holds true for Scania. Thus the period we are analyzing belongs to the pre-transitional regime.

Table 6. *Age-specific and Total Marital Fertility Rates in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865 (live births).*

		15-20	20-25	25-30	30-35	35-40	40-45	45-50	TMFR	TMFR20	N
1766-1865	All births	0.465	0.417	0.368	0.297	0.236	0.127	0.017	9.6	7.3	3461
	Males	0.264	0.210	0.188	0.153	0.125	0.064	0.007	5.1	3.7	1778
	Females	0.202	0.204	0.176	0.140	0.105	0.063	0.009	4.5	3.5	1633
	Person years	129	1093	2583	3125	2962	2586	2230			
1766-1815	All births	0.404	0.416	0.351	0.287	0.236	0.120	0.021	9.2	7.2	1203
	Males	0.192	0.220	0.165	0.142	0.114	0.057	0.008	4.5	3.5	585
	Females	0.212	0.190	0.181	0.137	0.115	0.062	0.011	4.5	3.5	593
	Person years	52	373	872	1122	1113	979	874			
1815-1865	All births	0.506	0.418	0.377	0.303	0.235	0.131	0.014	9.9	7.4	2258
	Males	0.312	0.206	0.200	0.159	0.131	0.068	0.006	5.4	3.8	1193
	Females	0.195	0.211	0.174	0.141	0.098	0.063	0.007	4.4	3.5	1040
	Person years	77	720	1712	2003	1850	1607	1357			

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

Table 7*. Age-specific and Total Marital Fertility Rates by period in Sweden, 1786-1865.*

	20-25	25-30	30-35	35-40	40-45	45-50	TMFR20
1786-90	0.469	0.367	0.313	0.212	0.118	0.028	7.54
1846-50	0.455	0.366	0.315	0.245	0.135	0.023	7.70
1861-65	0.469	0.386	0.333	0.266	0.163	0.026	8.22

Source: Statistics Sweden 1999, Table 5.6.

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: 355) as well as figures for Dala parish in western Sweden in 1806-30 (Winberg 1975: 316). Studies of eastern and middle Sweden generally show lower marital fertility compared to Scania (Gaunt 1973; Eriksson and Rogers 1978: 125; Martinius 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).

Most of the attention in this study is devoted to marital fertility, which does not imply that all births happened within marriage. Table 8 displays proportions of illegitimate births in the Scanian sample. They increase from c. three percent in 1765-1815 to c. eight percent in 1865-1895. The trend is very similar to Sweden as a whole (Statistics Sweden 1999: Table 3.6). Most of the illegitimate births were first births to younger women, although also higher parity births happened out of wedlock. If it would have been first-born children only, then almost all first born have to be born out of wedlock to make up for the figure at the end of the nineteenth century. To a certain extent this pattern can be explained by a tradition of prenuptial courtship and pregnancies in preindustrial Sweden (see Lundh 1999b), as in other parts of Europe (e.g. Knodel 1988; Wrigley *et al*. 1997).

***Table 8**. Proportions of births out of wedlock by period and mother's age at childbirth in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1765-1895.*

	% out of wedlock	Number of births
Birth order		
1	13.7	453
2	6.0	415
3+	1.0	1273
Unknown	7.2	8527
Mother's age at birth		
under 15	0.0	18
15-20	20.0	110
20-25	15.2	1247
25-30	7.0	2588
30-35	3.7	2673
35-40	2.1	2076
40+	2.1	1211
Unknown	20.3	745
Period		
1765-1815	3.4	2925
1815-1865	7.6	4824
1865-1895	8.4	2919
All	6.7	10668

Source: Birth registers, Scanian Demographic Database.

This is also clear from Table 9, which shows the time between marriage and first birth for women married in the parishes of the Scanian sample. In 35 percent of the marriages a child was born within six months after marriage and 50 percent within nine months. The tradition of prenuptial courtship cannot, however, explain the increase in proportions of children born out of wedlock during the course of the nineteenth century, which is more likely to be changes in social norms as the society becomes more secularized.

Table 10 shows inter-birth intervals by number of children born in the sample. Apart from the first interval between marriage and first birth, which is short for the reasons just explained, birth intervals were between two and three years on average. By definition, birth intervals correspond to fertility rates and the same determinants apply to birth intervals as to marital fertility by parity. Overall birth intervals are somewhat shorter for lower parities for the reasons discussed previously, but the same is true for high parity births (sixth and higher) because of a selection of high fertility women into these parities.

***Table 9**. Number of births by time since marriage in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1765-1865.*

Months since marriage	Number of births	Percent
Before marriage	119	6
0-3	275	15
3-6	257	14
6-9	277	15
9-12	380	21
12-15	155	8
15-18	105	6
18-21	51	3
21-24	38	2
24-27	25	1
27-30	21	1
30-33	21	1
33-36	17	1
36-42	31	2
42-48	19	1
48-54	13	1
54-60	2	0
60+	36	2
Total	1842	100

Note: Based on women married in the parishes. We are grateful to Christer Lundh for providing the calculations.
Source: The Scanian Demographic Database.

***Table 10**. Inter-birth intervals by number of children previously born in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

Number of children born	Mean inter-birth interval (years)	Standard deviation.	N
0	0.92	1.11	817
1	2.39	1.35	700
2	2.57	1.18	565
3	2.83	1.29	455
4	2.82	1.31	358
5	2.74	1.29	257
6+	2.63	1.01	405

Note: Based on women married in the parishes.
Source: The Scanian Demographic Database

Women who give birth to many children are bound to have short birth intervals and quite often their children have higher mortality than average during the first year of life, which tend to shorten the period of lactational ammenhorrea and thereby increase fertility (Lynch and Greenhouse 1994: 130; Knodel 1988: 90). The precise reasons why some women experience much higher infant mortality than others are, however, not known but it does not follow socioeconomic patterns (Knodel 1988: 71-74).

From this description of the basic fertility patterns in the area we turn to the question of whether there are any signs of fertility control in the area. Ever since Henry's introduction of the concept of natural fertility (Henry 1961), there has been a strong tendency in the literature to equate deliberate fertility control with parity-specific control (e.g. Coale and Watkins 1986). Table 10 made it clear that there was no change in birth intervals with greater number of children born, which indicates that there was no observable parity-specific control being practiced in the area. Similarly, calculations of Coale-Trussel M and m (Coale and Trussel 1974: 1978) points to a similar conclusion (see Table 11). The m:s for Scania, as well as Sweden as a whole, are very close to zero, which servers to indicate that the age-specific schedules are closely resembling natural fertility schedules. The level parameter M also indicates rather high levels of fertility in the area.

One way of indicating 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; Henry 1967: 89). Such a pattern has also been shown for several communities in preindustrial Europe (Wrigley 1966; Gaunt 1973; Knodel 1978; Winberg 1975: 236-238; Wrigley *et al*. 1997: Table 7:6) or at least in some social groups (Eriksson and Rogers 1978: 143).

Figure 2 and Table 12 show the age-specific and total fertility rates by mother's age at marriage in the four parishes. The differences in lower ages are naturally substantial, but the main issue here is the differences in later ages. In the age group 35-40 there are clear differences in fertility according to age at marriage. Women marrying after 25 have ten percent higher fertility compared to women marrying between 20 and 25, and almost 15 percent higher fertility than women marrying before age 20, which seems to corroborate the previous findings just mentioned. In the next interval (40-45), however, women marrying later have lower fertility, while in the last interval, again, there seems to be some positive differences. Thus, the pattern observed in the four parishes are by no means clear, and it is very difficult to use this data to draw some conclusions regarding the practice on family limitation in this community.

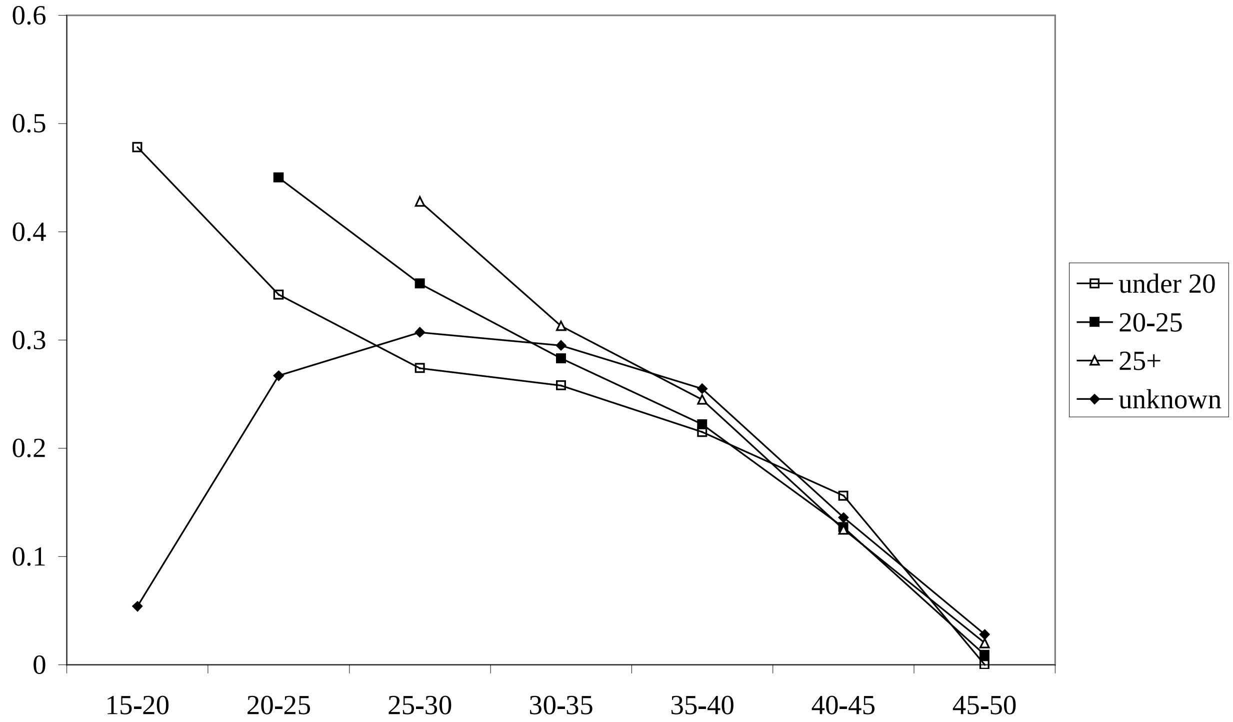


***Figure 2**. Age-specific marital fertility rates by woman's age at marriage in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865 (based on the figures in Table 12).*

Table 12. *Age-specific and Total Marital Fertility Rates (live births) for all births by mother's age at marriage in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1765-1865.*

Mother's age at marriage	15-20	20-25	25-30	30-35	35-40	40-45	45-50	TMFR	TMFR20+	N
under 20	0.478	0.342	0.274	0.258	0.215	0.156	0.000	8.6	6.2	368
20-25	NA	0.450	0.352	0.283	0.222	0.127	0.009	7.2	7.2	1469
25+	NA	NA	0.428	0.313	0.245	0.125	0.020	5.7	5.7	1611
N.A.	0.054	0.267	0.307	0.295	0.255	0.136	0.028	6.7	6.4	2271
Person-years observed										
under 20	111	322	278	248	196	147	111			
20-25	NA	761	1434	1167	898	695	543			
25+	NA	NA	862	1710	1869	1744	1577			
N.A.	241	975	1793	2215	2030	1742	1411			

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

Moreover, even when such a pattern exists it has been questioned if it can be interpreted as a result of deliberate family limitation (e.g. Knodel 1978: 495). The reason is that such a pattern share many other characteristics with ‘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 Martinius 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. Overall, the fertility of women marrying early is gradually declining by age in the way we associate with natural fertility, as shown in Figure 2.

Finally, to investigate potential sex-specific patterns in fertility control, Table 13 displays sex ratios at birth by number of male and female births. The absence of a clear systematic pattern implies that there does not seem to have been any sex-selective patterns in fertility control of the kind that can be found in Asian populations (e.g. Tsuya and Kurosu 1999; Wang, Campbell and Lee 1999), and this further substantiates the conclusion that there are little evidence of any parity-specific, or sex-specific, control in this area.

Table 13. *Sex ratio at birth by number and sex of children under 15 living in the household (live births) in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

Number of surviving daughters	Number of Surviving sons				
	None	One	Two or more	All	N
None	1.06	1.09	1.03	1.06	1681
One	1.23	0.99	0.98	1.07	929
Two or more	1.06	1.18	1.28	1.19	810
All	1.09	1.08	1.11	1.09	
N	1656	934	830		3420

Note: Only births to women married in the parishes.
Source: The Scanian Demographic Database.

To conclude, the analyses of marital fertility rates, birth intervals, M and m, and sex-specific patterns of fertility all point to the conclusion that parity-specific family limitation, in general, does 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 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 in Europe and elsewhere (e.g. Coale and Watkins 1986; Knodel 1977; Wrigley *et al*. 1997).

However, quite different conclusions have been drawn for some other parts of Sweden in the same period as studied here, where previous analyses of parishes in western, eastern and middle Sweden found indications of fertility control either in broader segments of the population or in certain social groups (Eriksson and Rogers 1978; Gaunt 1973; Winberg 1975). The overall fertility was very low in the parish Alskog in Gotland studied by Gaunt. Among the freeholders of Gotland, brides who marry young often stayed with their parents and the interval between marriage and first birth was as long as 33 months in the middle of the eighteenth century (Gaunt 1973: 52) and no less than 43 percent of the intervals were longer than 48 months indicting sterility or deliberate control. Long birth intervals were also frequent in Dala parish in western Sweden, but in this case age at last birth was rather high (Winberg 1975: 239-240). In general, however, the age pattern of fertility in Dala was similar to the Scanian, and closely resembling the pattern typical of populations not practicing parity-specific control. In the Åsunda district in east-central Sweden, birth intervals were also very long and the average age of mother at birth of last child was low among peasants, giving a low total marital fertility (Eriksson and Rogers 1978: 137). There were also large differences in age-specific fertility between peasant women marrying before age 25 and those marrying later (Eriksson and Rogers 1978: 142). The number of peasant women marrying after age 25 was, however, very small, as pointed out by the authors. Summarizing the evidence, Eriksson and Rogers conclude, “that peasant were limiting the size of their families, at least during the latter part of the nineteenth century” (Eriksson and Rogers 1978: 244).

Taken together, the existence of extraordinary long birth intervals, long intervals between marriage and first birth, or low age at birth of last child, and thus low overall fertility in certain areas of central Sweden and the island of Gotland suggests that families intentionally limited births before the fertility transition started in the 1880s (Gaunt 1973; Winberg 1975; Eriksson and Rogers 1978). This is also consistent with the evidence that people had knowledge of contraceptive methods in this period (e.g. Santow 1995). In the four parishes studied here, we find no indications of deliberate family limitation in the period 1765 to 1865. This does not, however, exclude the possibility that families were controlling the timing of births for other reasons.

Multivariate analysis

In the multivariate analysis we deal exclusively with second or higher order births, which implies that we do not analyze the interval between marriage and first birth. The reason behind this is that first births are connected as much with marriage as with decisions on fertility, and thus needs somewhat different models and deserves a separate analysis. We analyze the likelihood of childbirth, live or dead, using survival analysis with time since last birth as the duration time to the event. The models include covariables on individual, family and community level, and capture theoretically relevant determinants of fertility. 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 unobserved family specific factors, which cannot be modeled. This means that the events (the births) cannot be treated as independent events and doing so means that our statistical tests become to optimistic (the p-values become too low). To take the dependence between births of the same women into account, we add frailty effects (or random effects) to our survival models. More specifically we use a Cox proportional hazards model with frailty, which can be written as (see Therneau and Grambsch 2000: 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 time 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.

We estimate several sets of models, using somewhat different samples depending on which model that is being estimated. The first set of models include social (social status of the head), demographic (age, life status of previous child, age at first birth and age difference between spouses) and economic (rye prices at community level) covariates, and in these models the sample include all women in the parishes for which we have observed at least one birth. We also control for parish of residence to capture potential multilevel structures in the data as well as seasonality patterns in the price response. The second set of models focus on the effects of previous childbearing on the risk of giving birth (number of children ever born and sex composition of surviving children) controlling for social, demographic and economic covariates as well as parish of residence. In the estimations of these models the sample is limited to women married in the parishes, since it is vital to know the entire childbearing history in this case.

Turning to fertility differences between social groups we may think of at least two hypotheses. First, since landed peasants demanded more household labor, we might expect this group to show higher fertility, provided that active measures were taken by the families to influence their child bearing. Moreover, children in preindustrial societies often play an important role in providing security in case of sickness or in old age; a role which often is as important, if not more important, than the direct productive contribution of children to the household economy (see e.g. Cain 1981; Lee 2000; Meuller 1976; Stecklov 1999). The great importance of children, together with high infant and child mortality, provide incentives for preindustrial families to have many children (cf. Easterlin and Crimmins 1985) and also makes a strategy of family limitation rather risky (Wrigley 1978). Although this reasoning applies to all groups in preindustrial society it was probably of special concern for landowning peasants, because of their greater demand for labor, importance of having a surviving heir to take over the farm, and higher standard of living to safeguard in old age. Hence, one hypothesis would be that landowning peasants had higher fertility than landless laborers.

An alternative hypothesis instead focuses on the problem of providing land for all children of landed peasants. It has been argued that peasants in partible inheritance systems, where all children, or at least all male children, inherited part of the family farm, high fertility could be a danger to the viability of the farm in the long run because of far reaching parcellization of the holding. This was for example singled out by an early twentieth century observer as an important reason for the low fertility in eastern Sweden, especially the island of Gotland (Wohlin 1915). Subsequent research has, however, questioned this conclusion, since there is little change over time in fertility despite increasing population and presumably greater pressure on the land (Gaunt 1973). However, in another study of fertility patterns in east-central Sweden, Eriksson and Rogers (1978) found landowning peasants to have had lower marital fertility than landless laborers, which they explain by a wish of these peasants to provide land to their children, leading to deliberate control of fertility in the peasant group. Thus, according to this hypothesis we would expect landed peasants to have had lower fertility than landless laborers. To the extent that nutritional deficiencies have an impact on fecundity, differences in this respect could, of course, also lead to social differences in fertility.

Table 14 shows the results of estimating the base model for all women in the sample. The age pattern turns out as expected, with the highest levels for younger women and then gradually falling risks of childbearing. It shows that there are some differences between women in different social groups in the level of fertility, with landless and semi-landless women having significantly lower risk of giving birth to a child. A test of the proportionality assumption using the test suggested by Grambsch and Therneau (1994), however, revealed that hazards are non-proportional in this covariate, which warrants some caution in interpreting this result, although the presence of a statistically significant effect indicate that there are differences between social groups at least in some part of the age interval. It is impossible, with certainty, to state whether this results stems from deliberate planning of births or from unintentional effects of nutrition, repeated exposure to economic stress, cultural differences in breast-feeding, or some other factor. The evidence on fertility patterns in the area presented previously did not show any signs of parity-specific family limitation, but there might have been differences in non-parity-specific control. Whether these were intentional or not is impossible to say.

There are also differences between the parishes left after controlling for the other covariates in the model; the parish Hög seems to have experienced lower levels of fertility compared to the other parishes. Parish of origin also seems to influence fertility, although the effect is statistically significant only at the 10 percent level. In-migrants show higher fertility, by about eight to nine percent, than women born in the parishes. One obvious reason, though perhaps not the only, is that the interval from in-migration to first birth in the parish is shorter than average since most mothers probably did not migrate with a newborn child.

Table 14. *Cox regression estimates of fertility, 2+ intervals (excl. first births), all women in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge 1766-1865.*

Covariates	Relative risk	P-value
Age		
25-30	1.00	reference
15-25	1.50	0.0000
30-35	0.64	0.0000
35-40	0.42	0.0000
40-45	0.17	0.0000
45-50	0.03	0.0000
Social Status		
Freeholders/Crown	1.00	reference
Noble tenants	0.91	0.3000
Semi-landless	0.78	0.0005
Landless	0.70	0.0000
Parish		
Hög	1.00	reference
Kävlinge	1.16	0.0600
Halmstad	1.27	0.0024
Sireköpinge	1.27	0.0021
Parish of origin		
Parish of residence	1.00	reference
Other parish	1.09	0.0960
Life status of previous child		
Alive	1.00	reference
Dead < 2 years since previous birth	6.67	0.0000
Dead > 2years since previous birth	1.15	0.0290
Age at first birth		
20-25	1.00	reference
-20	0.75	0.0120
25+	1.02	0.7300
Age difference between spouses		
Wife older	1.00	reference
Husband older < 6 years	0.77	0.0001
Husband older > 6 years	0.68	0.0000
Rye price (t)	0.64	0.0000
Rye price (t-1)	1.08	0.3900
Frailty (family): Variance (P-value)	0.403 (0.0000)	
Events	4291	
Likelihood ratio test	4456	
Overall p-value	0.0000	

In order to measure the effect of breast-feeding, a covariate is included which measure differences in fertility with respect to life status of the previous child born. We expect that women whose previous child died experienced higher fertility than other women, due to interrupted breast feeding, and thus shorter period of lactational amenorrhea, or perhaps due to a deliberate replacement of the dead child. We also separate out the cases where it was less than two years since previous birth. The idea is that to the extent that the effect of loosing a child is greater when it was less than two years since previous birth compared to when it was more than two years, this should mainly capture a breast feeding effect, rather than a planned replacement effects, although it is conceivable that we also capture women who are more inclined to replace with this covariate. In any case the results show significantly higher risk of childbirth when the previous child died, and it is also clear that the effect is considerably stronger in the cases where it was less than two years since previous birth. Most likely, this result is due to the interruption of breast-feeding, and thus the loss of its contraceptive effect, although it is impossible to rule out the possibility that it also could be due to a deliberate action rather than a completely unintentional effect of interrupted breast-feeding.

Women having their first birth early (before age 20) show lower fertility, as do women with older husbands. We could, however, not see a corresponding pattern in the age-specific fertility by woman’s age at marriage in Table 12 above. Whether this should be interpreted, as deliberate control, or not, is uncertain for the reasons previously mentioned.

Finally, there is a negative, statistically significant, effect of rye prices, indicating lower fertility in times of high prices; a result also commonly found in aggregate studies, as previously discussed. In order to explore the mechanisms behind this fertility response to economic fluctuations, we have estimated a series of interaction models controlling for all covariates in the model. The results of these estimations are reported in Table 15. The table only shows base effects of rye prices and interaction effects of the different covariates, excluding all information on the control variables.

***Table 15**. Effects of price fluctuations on fertility by other covariates in the model. All women in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

	Rye price		**Rye price (-1)**	
	Relative risk	P-value	Relative risk	P-value
Age				
25-30	0.64	0.0110*	0.89	0.5100*
15-25	0.88	0.3900**	0.79	0.7500**
30-35	0.65	0.9500**	1.01	0.6000**
35-40	0.64	0.9800**	1.21	0.2200**
40-45	0.57	0.7200**	1.40	0.1300**
45-50	0.22	0.1200**	3.89	0.0290**
Social Status				
Freeholders/Crown	0.85	0.4400*	1.29	0.2200*
Noble tenats	0.85	0.9900**	0.84	0.1200**
Semi-landless	0.52	0.0600**	1.41	0.7400**
Landless	0.53	0.0720**	0.85	0.1200**
Parish				
Hög	0.68	0.0720*	1.35	0.1500*
Kävlinge	0.53	0.3900**	1.08	0.4200**
Halmstad	0.79	0.5700**	1.02	0.2800**
Sireköpinge	0.56	0.4600**	1.01	0.2600**
Parish of origin				
Parish of residence	0.64	0.0018*	1.17	0.2800*
Other parish	0.64	0.9800**	1.03	0.4800**
Life status of previous child				
Alive	0.68	0.0001*	1.02	0.8800*
Dead < 2 years since previous birth	0.56	0.4500**	1.20	0.5100**
Dead > 2 years since previous birth	0.51	0.3400**	1.46	0.2300**
Age at first birth				
20-25	0.82	0.1400*	0.89	0.3900*
-20	0.62	0.4600**	1.27	0.3300**
25+	0.54	0.0220**	1.21	0.0860**
Age difference between spouses				
Wife older	0.41	0.0000*	1.24	0.2500*
Husband older < 6 years	0.66	0.0440**	1.20	0.8700**
Husband older > 6 years	0.81	0.0044**	0.87	0.1400**

* Reference category
** P-value for interaction effect
Note: based on interaction models including the covariates Age, Social Status, Parish, Parish of origin, Life status of previous child, Age at first birth, Age difference between spouses, Rye price (t), Rye price (t-1), and frailty (family).

There are no statistically significant age differences in the price response, although it appears, judged from the size of the coefficients, as if older women show a stronger response than younger. There is no fertility response to grain prices among peasants, which probably indicate that they were differently affected by prices and also had better opportunities to deal with economic stress using accumulated capital or borrowing resources in times of scarcity (see e.g. Bengtsson and Dribe forthcoming; Dribe 2000: Ch. 5 and 8). Landless and semi-landless women, on the other hand, show a statistically significant response to grain price fluctuations. Fertility in these groups declined in times of high prices, when food became more expensive and their real wages declined. At this stage it is impossible to ascertain whether this response is due to intentional postponement of births using some form of contraception or induced abortion, or if it is the result of subfecundity due to malnourishment or spousal separation following temporary migration. We will return shortly to this issue.

It also appears as if women having their first birth above age 25 responded stronger to grain price fluctuation, as did women who were older than their husbands. This result is opposite to what one would expect if families had a rather high target. Since they had fewer years to reach the target, they should be less willing to postpone childbirths. Such targets, however, does not appear to have existed, since the average age-specific marital fertility is about the same regardless of age at marriage as shown in Table 12. Marrying late might be an indicator of the willingness for family planning, which implies that the observed difference could be due to a selection effect. This argument is in line with the finding that the decline in marital fertility started in areas with higher ages at marriage (Coale 1992: 340-341). An alterative interpretation is that women marrying late were less wealthy, which would imply that, within the different socioeconomic groups, people with fewer resources married later and were more willing to postpone births. Alternatively, women who marry late might have been less healthy and thus more vulnerable to short-term economic stress. This would then be a non-deliberate response to short-term economic stress. Likewise, that women married much older men indicates that they had less personal resources in terms of money or health.

In order to explore the mechanisms behind the observed price responses for the landless and semi-landless more in depth, a model was estimated only for these social groups, excluding the peasants. One way of getting at the causal mechanisms is to look at the seasonal pattern in the response. If the fertility response to high grain prices is unintentionally caused by malnourishment leading to lower fecundability, then we would expect the strongest effect to be nine months after the time when food supply was at its lowest, or food prices were highest. To the extent that price increases were caused by lower supply (bad harvest) the situation should have been worst not immediately after the harvest, but in the late spring after the harvest when all supplies had been emptied. In this scenario the strongest effect on fertility would be 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 is intentional, as a result of a deliberate postponement of childbirth, the response should be more immediate, in fact within nine months. It is likely that people knew pretty well what the harvest would be like already in the summer before the harvest, and if they were planning their fertility, we might 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 thus expected prices could have been available.

Table 16 shows the results of estimating a model for landless and semi-landless women, including covariates for season and interactions between price and season. Table 17 displays the price effects on fertility by season following the price change. Since prices were determined in late fall, the period October-December is the reference category. It is interesting to note that there is no observable effect of grain prices of fertility after the first year, which was also evident in the model estimation for the entire sample in Table 14. There is a strong effect already in October-December and in January-March the effect is strongest, and then gets weaker later in the year. To say the least, these results give no support for the hypothesis that fertility was influenced by grain prices mainly through subfecundity following malnourishment. Instead, the evidence points, quite strongly, to deliberate planning as the main mechanism through which fertility was related to economic fluctuations. When it comes to temporary migration, it seems less likely that this happened as a response to projected bad harvests later in the year. Moreover, although we have very little of 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 could affect fertility to the extent shown here. Evidence on permanent migration in response to economic stress in the same area also corroborates this conclusion (Dribe 2002; Dribe and Lundh 2002).

***Table 16**. Cox regression estimates of fertility, 2+ intervals. Landless and Semi-landless women in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

Covariates	Relative risk	P-value	Relative risk	P-value
Age				
25-30	1.00	reference	1.00	reference
15-25	1.12	0.3000	1.12	0.3100
30-35	0.69	0.0000	0.69	0.0000
35-40	0.44	0.0000	0.44	0.0000
40-45	0.18	0.0000	0.18	0.0000
45-50	0.03	0.0000	0.03	0.0000
Parish				
Hög	1.00	reference	1.00	reference
Kävlinge	1.23	0.0250	1.23	0.0250
Halmstad	1.38	0.0003	1.38	0.0003
Sireköpinge	1.30	0.0024	1.30	0.0024
Parish of origin				
Parish of residence	1.00	reference	1.00	reference
Other parish	1.08	0.2300	1.08	0.2300
Life status of previous child				
Alive	1.00	reference	1.00	reference
Dead < 2 years since prev. birth	8.28	0.0000	8.30	0.0000
Dead > 2years since prev. birth	1.31	0.0005	1.31	0.0005
Age at first birth				
20-25	1.00	reference	1.00	reference
-20	0.84	0.2800	0.85	0.2900
25+	0.98	0.7700	0.98	0.7700
Age difference between spouses				
Wife older	1.00	reference	1.00	reference
Husband older < 6 years	0.84	0.0170	0.84	0.0170
Husband older > 6 years	0.69	0.0000	0.69	0.0000
Price fluctuations				
Rye price (t)	0.53	0.0000	0.46	0.0004
Rye price (t-1)	1.15	0.2200	1.10	0.6500
Season				
Oct-Dec	1.00	reference	1.00	reference
Jan-Mar	0.89	0.0370	0.88	0.0260
Apr-Jun	0.86	0.0055	0.86	0.0071
Jul-Sep	0.87	0.0090	0.87	0.0140
Interactions				
Rye price (t) * Jan-Mar	---	---	0.63	0.1300
Rye price (t) * Apr-Jun	---	---	1.70	0.0830
Rye price (t) * Jul-Sep	---	---	1.63	0.1100
Rye price (t-1) * Jan-Mar	---	---	1.12	0.7200
Rye price (t-1) * Apr-Jun	---	---	1.00	0.9900
Rye price (t-1) * Jul-Sep	---	---	1.06	0.8600
Frailty (family): Variance	0.319	0.0000	0.319	0.0000
Events	2590		2590	
Likelihood ratio test	2682		2698	
Overall P-value	0.0000		0.0000	

Table 17*. Effects of rye prices on fertility by season. Landless and semi-landless women, in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

	Relative risk	P-value
Year 1		
October-December	0.46	0.0004*
January-March	0.29	0.1300**
April-June	0.79	0.0830**
July-September	0.76	0.1100**
Year 2		
October-December	1.10	0.6500*
January-March	1.23	0.7200**
April-June	1.11	0.9900**
July-September	1.16	0.8600**

* Reference category
** P-value for interaction effect

Thus, 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 their births deliberately, but they also did so using knowledge and information on local as well as more distant conditions in agriculture, in either by predicting their economic situation the coming year.

There is also a possibility that fertility responses differed according to previous childbearing. Provided that families had some kind of target family size, and/or desired mix between sons and daughters, and, which is equally important, that the risk of not reaching the target was judged to be serious enough if fertility was controlled, we might expect the response to have been strongest among those families who were closer to the target. More specifically, this implies that women who had had more children should be more willing to postpone births in times of crises and the same goes for women with a more even mix of boys and girls. Table 18 shows results of estimating two separate models: one with number of children ever born and one with sex composition of surviving children. Only base effects of prices and interaction effects between prices and the two covariates are shown in the table. The results show very little of systematic differences in the price response according to number of children previously born or sex composition of surviving children. This means that even if people had targets concerning the size and composition of the family, they did not judge the cost of the risk of not being able to attain this target to be higher than having a birth in times of scarcity.

***Table 18**. Effects of rye prices on fertility by children ever born and child composition. Landless and semi-landless women married in the four parishes of Hög, Kävlinge, Halmstad and Sireköpinge, 1766-1865.*

	Rye price		**Rye price (-1)**	
	Relative risk	P-value	Relative risk	P-value
Number of children ever born				
2	0.58	0.0730*	0.73	0.3100*
1	0.51	0.7600**	1.23	0.2300**
3	0.78	0.5200**	1.57	0.1100**
4	0.20	0.0370**	1.73	0.0880**
5	0.40	0.5300**	1.84	0.1000**
6	1.91	0.0670**	0.67	0.9000**
7	0.53	0.9200**	1.32	0.5100**
8+	0.48	0.8500**	0.84	0.8800**
Child composition of surviving children				
Both sexes	0.60	0.0190*	1.25	0.3100*
Only daughters	0.28	0.0470**	0.90	0.4000**
Only sons	0.69	0.7000**	1.50	0.6200**
No surv. children	0.61	0.9700**	0.96	0.5500**

* P-value for reference category
** P-value for interaction effect

Note: based on interaction models including the covariates Age, Parish, Parish of origin, Life status of previous child, Age at first birth, Age difference between spouses, Rye price (t), Rye price (t-1), and frailty (family).

Conclusion

The aim of this paper has been to study, at the individual level, whether the fertility response to economic stress resulted from a deliberate planning of births by the family or rather was an effect of reduced fecundability following malnutrition, or spousal separation due to migration. We also analyze whether fertility was controlled to limit family size.

Using mainly individual level data for four rural parishes in western Scania in southern Sweden, we could not detect any indications that parity-specific control was practiced in the area. Instead, most indicators pointed to a situation of natural fertility, as has been shown for many other parts of Europe before the fertility transition. This makes it highly unlikely that families had clear targets in terms of the size of the family, or if they had, they must have been well above the level of natural fertility given the age at marriage; or, to put it differently, that the supply of children was lower than the demand and no deliberate family limitation took place (cf. Easterlin and Crimmins 1985). This does not preclude, however, that families could have had other targets than the actual final family size, for example related to optimal intervals between births and their effect on children's and mother's health, consumption smoothing over the life cycle, etc. That such spacing targets can be of importance in pre-transitional societies have been shown in research on developing countries during the twentieth century (e.g. Caldwell and Caldwell 1977; Bledsoe 1994). Yet another spacing target might have been to secure consumption in years of economic stress; postponing births not only affects consumption in the short run but also family labor supply.

The analysis of the fertility response to short-term economic stress showed a clear response only for the landless. The response to economic stress was neither dependent on number of children previously born nor on the sex composition, which makes it likely that the response was not connected to a target in terms of either family size or sex composition - in accordance with the more general pattern of fertility just mentioned. An analysis of the seasonal pattern in the response, however, shows that the fertility effect was strongest less than six months after the harvest. This led to the conclusion that the observed response was deliberate; people foresaw bad times already in the late spring and early summer and planned their fertility accordingly. Thus, although there were no signs of parity-specific control, there are evidence that fertility was deliberately controlled in years of economic stress. This highlights the importance of not only focusing on parity-specific measures, but also on measures affecting birth intervals independent of parity, when analyzing pre-transitional fertility patterns. Thus, although families in our area do not seem to have planned their fertility according to a target family size, or sex composition of the children, they appear to have planned childbirth carefully in order to stabilize consumption in a short run perspective.

Turning to the wider implications of these results, we have previously shown that people in pre-industrial rural Scania, a surplus grain producing area, were affected by short-term changes in food prices to such a degree that the mortality of parents and children among the landless increased (Bengtsson, forthcoming). We have also shown that the landless were not better off during the period of agricultural development and commercialization in the beginning of the nineteenth century, than previously (Bengtsson and Dribe, forthcoming). It was not until a more complex economy evolved, characterized by industrialization, urban development, long distance trade and migration, that their vulnerability to short-term economic stress diminished. Furthermore, we have shown that before this new economy was established they did not have the possibility to escape by moving out of the area where they lived simply because of lack of opportunities (Dribe 2000; Dribe, forthcoming). Postponing marriages of grown-up children was a potential measure to smooth consumption only during the later stages of the family life cycle. What they could do in terms of demographic measures was to postpone births; and as we have shown in this paper, this was also what they did. This measure, however, was not efficient enough to prevent them from experiencing increased mortality risks after years with high food prices.

References

Bengtsson, T. (1993). “Combined Time-Series and Life-Event Analysis. The Impact of Economic Fluctuations and Air Temperature on Adult Mortality by Sex and Occupation in a Swedish Mining Parish, 1757-1850,” in Reher, D and R. Schofield (eds.) *Old and New Methods in Historical Demography*. Oxford: Oxford University Press.

Bengtsson, T. (1999). “The Vulnerable Child. Economic Insecurity and Child Mortality in Pre-industrial Sweden: A Case Study of Västanfors, 1757-1850.” *European Journal of Population* 15: 117-151.

Bengtsson, T. (2000). “Inequality in Death. The Effects of the Agricultural Revoluiton in Sweden: 1765-1865,” in Bengtsson, T. and O. Saito (eds.) *Population and Economy: From Hunger to Modern Economic Growth.* Oxford: Oxford University Press.

Bengtsson, T. (Forthcoming). “Mortality and Social Class in Four Scanian Parishes, 1765-1865,” in Bengtsson, T, C. Campbell, J. Lee *et al*. *Life Under Pressure: Mortality and Living Standards in Europe and Asia, 1700-1900.*

Bengtsson, T. and M. Dribe (1997). “Economy and Demography in Western Scania, Sweden, 1650-1900.” Paper presented at the EAP meeting in Kyoto, Japan, January 11-17, 1997. *EAP Working Paper*, No. 10, IRCS, Kyoto, Japan.

Bengtsson, T. and M. Dribe (Forthcoming). “New Evidence on the Standard of Living during the 18th and 19th Centuries: Long-term Development of the Demographic Response to Short-term Economic Stress among Landless in Western Scania,” in Allen, R. C., T. Bengtsson and M. Dribe (eds.) *New Evidence on the Standard of Living in Europe and Asia.* Book manuscript.

Bengtsson, T. and C. Lundh (1991). “Evaluation of a Swedish Computer Program for Automatic Family Reconstitution.” *Lund Papers in Economic History* 8.

Bengtsson, T. and J. Oeppen (1993). “A Reconstitution of the Population of Scania 1650-1760.” *Lund Papers in Economic History* 1.

Bengtsson, T and R. Ohlsson (1978). “Befolkning och konjunkturer.” *Meddelande från Ekonomisk-historiska institutionen* nr 1. Lund University, Department of Economic History.

Bengtsson, T. and R. Ohlsson (1985). “The Standard of Living and Mortality Response in Different Ages.” *European Journal of Population* 1: 309-326.

Bengtsson, T. and R. Ohlsson (1994). "The Demographic Transition Revised," in Bengtsson, T (ed.), *Population, Economy, and Welfare in Sweden*. Berlin-Heidelberg: Springer-Verlag.

Bledsoe, C (1994). "'Children are Like Young Bamboo Trees': Potentiality and Reproduction in Sub-Saharan Africa," in Lindahl Kiessling, K. and H. Landberg (eds.) *Population, Economic Development and the Environment*. Oxford: Oxford University Press.

Bongaarts, J. (1978). "A Framework for Analyzing the Proximate Determinants of Fertility." *Population and Development Review* 4: 105-132.

Bongaarts, J. (1980). "Does Malnutrition Affect Fecundity? A Summary of Evidence." *Science* 208: 564-569.

Cain, M. (1981). "Risk and Insurance: Perspectives on Fertility and Agrarian Change in India and Bangladesh." *Population and Development Review* 7: 435-474.

Caldwell, J. and P. Caldwell (1977). "The Role of Marital Sexual Abstinence in Determining Fertility: A Study of the Yoruba in Nigeria." *Population Studies* 31: 193-217.

Carlsson, G. (1966). "The Decline of Fertility: Innovation or Adjustment Process." *Population Studies* 20: 149-174.

Carlsson, G. (1970). "Nineteenth Century Fertility Oscillations." *Population Studies* 24: 413-422.

Coale, A. J. and J. Trussel (1974). "Model Fertility Schedules: Variations in the Age Schedule of Childbearing in Human Populations." *Population Index* 40: 185-258.

Coale, A. J. and J. Trussel (1978). "Technical Note: Finding the Two Parameters that Specify a Model Schedule of Marital Fertility." *Population Index* 44: 203-213.

Coale, A. J. and S. C. Watkins (eds.) (1986). *The Decline of Fertility in Europe*. Princeton: Princeton University Press.

Davis, K. and J. Blake (1956). "Social Structure and Fertility: An Analytic Framework." *Economic Development and Cultural Change* 4: 211-235.

Dribe, M. (2000). *Leaving Home in a Peasant Society. Economic Fluctuations, Household Dynamics and Youth Migration in Southern Sweden, 1829-1867*. Södertälje: Almqvist & Wiksell International.

Dribe, M. (2002). "Dealing with Economic Stress Through Migration: Lessons from Nineteenth Century Rural Sweden." *Lund Papers in Economic History 79.*

Dribe, M. and C. Lundh (2002). "People on the Move. Determinants of Servant Migration in Nineteenth Century Sweden." *Lund Papers in Economic History 80.*

Easterlin, R. A. and E. C. Crimmins (1985). *The Fertility Revolution. A Supply-Demand Analysis*. Chicago: The University of Chicago Press.

Eriksson, I. and J. Rogers (1978). *Rural Labor and Population Change. Social and Demographic Developments in East-Central Sweden during the Nineteenth Century*. Uppsala/Stockholm: Almqvist & Wiksell International.

Frisch, R. E. (1978). "Population, Food Intake, and Fertility." *Science* 199: 22-30.

Galloway, P. (1988). "Basic Patterns in Annual Variations in Fertility, Nuptiality, Mortality, and Prices in Pre-industrial Europe." *Population Studies* 42: 275-303.

Gaunt, D. (1973). "Family Planning and the Pre-industrial Society: Some Swedish Evidence," in Ågren, K. *et al*. (eds.) *Aristocrats, Farmers and Proletarians. Essays in Swedish Demographic History.* Uppsala: Esselte.

Grambsch, P. M. and T. M. Therneau (1994). "Proportional Hazards Tests and Diagnostics Based on Weighted Residuals." *Biometrika* 81: 515-526.

Hajnal, J. (1965). "European Marriage Patterns in Perspective," in Glass, D. V. and D. E. C. Eversley (eds.) *Population in History. Essays in Historical Demography*. London: Edward Arnold.

Heckscher, E. F. (1949). *Sveriges ekonomiska historia från Gustav Vasa, del 2*. Stockholm: Albert Bonniers Förlag.

Hellstenius, J. (1871). "Skördarna i Sverige och deras verkningar." *Statistisk tidskrift* 77-119.

Henry, L. (1961). "Some Data on Natural Fertility." *Eugenics Quarterly* 8: 81-91.

Henry, L. (1967). *Manuel de Dèmographie Historique.* Geneva: Libriarie Droz.

Jörberg, L. (1972). *A History of Prices in Sweden 1732-1914.* Lund: Gleerups.

Knodel, J. (1977). "Family Limitation and the Fertility Transition: Evidence from the Age Patterns of Fertility in Europe and Asia." *Population Studies* 31: 219-249.

Knodel, J. (1978). "Natural Fertility in Preindustrial Germany." *Population Studies* 32: 481-510.

Knodel, J. (1988). *Demographic Behavior in the Past. A Study of Fourteen German Village Populations in the Eighteenth and Nineteenth Centuries*. Cambridge: Cambridge University Press.

Lee, R. D. (1981). "Short-term Variation: Vital Rates, Prices and Weather," chapter 9 in Wrigley, E. A. and R. S. Schofield, *The Population History of England, 1541-1871. A Reconstruction*. London: Edward Arnold.

Lee, R. (2000). "A Cross Cultural Perspective on Intergenerational Transfers and the Economic Life Cycle," in Mason, A. and G. Tapinos (eds.) *Sharing the Wealth: Demographic Change and Economic Transfers between Generations.* Oxford: Oxford University Press.

Lundh, C. (1995). "Households and Families in Preindustrial Sweden." *Continuity and Change* 10: 33-68.

Lundh, C. (1997). "The World of Hajnal Revisited. Marriage Patterns in Sweden 1650-1990." *Lund Papers in Economic History* 60.

Lundh, C. (1999a). "Marriage and Economic Change in Sweden during the 18th and 19th Century," in Devos, I. and L. Kennedy (eds.) *Marriage and the Rural Economy. Western Europe since 1400.* CORN publication series 3. Turnhout: Brepols.

Lundh, C. (1999b). "Swedish Marriages. Customs, Legislation and Demography in the Eighteenth and Nineteenth Centuries." Manuscript, Department of Economic History, Lund University.

Lynch, K. and J. Greenhouse (1994). "Risk Factors for Infant Mortality in Nineteenth-Century Sweden." *Population Studies* 48: 117-133.

Malthus, T. R. (1803/1992). *An Essay on the Principle of Population*. Cambridge: Cambridge University Press.

Martinius, S. (1977). "En befolkning före den demografiska revolutionen," in Tedebrand, L.-G. (eds) *Historieforskning på nya vägar*. *Studier tillägnade Sten Carlsson*. Lund: Studentlitteratur.

Menken, J., J.Trussel and S. Watkins (1981). "The Nutrition Fertility Link: An Evaluation of the Evidence." *Journal of Interdisciplinary History* 11: 425-441.

Meuller, E. (1976). "The Economic Value of Children in Peasant Agriculture," in Ridker, R. (ed.) *Population and Development: The Search for Selective Interventions*. Baltimore: The Johns Hopkins Press for Resources for the Future.

Reuterswärd, E. and F. Olsson (1993). "Skånes demografiska databas 1646-1894. En källbeskrivning." *Lund Papers in Economic History* 33.

Santow, G. (1995). "*Coitus interruptus* and the Control of Natural Fertility." *Population Studies* 49: 19-43.

Skoglund, A-M. (1992). *Fattigvården på den svenska landsbygden år 1829*. Report in Social Work, No. 58, The School of Social Work, University of Stockholm.
Statistics Sweden (1999). *Befolkningsutvecklingen under 250 år. Historisk statistik för Sverige.* Stockholm: Demografiska rapporter 1999:2.
Stecklov, G. (1999).”Evaluating the Economic Returns to Childbearing in Côte d’Ivoire.” *Population Studies* 53: 1-17.
Sundbärg, G. (1907). *Bevölkerungsstatistik Schwedens 1750-1900*. Stockholm 1970: Statistics Sweden.
Szreter, S. (1993). *Fertility, Class and Gender in Britain 1860-1940*. Cambridge: Cambridge University Press.
Therneau, T. M. and P. M. Grambsch (2000). *Modeling Survival Data. Extending the Cox Model*. New York: Springer.
Tsuya, N. O. and S. Kurosu (1999). “Patterns and Correlates of Fertility in 18th and 19th Century Japan: Evidence from Two European Villages.” Paper for the annual meeting of the Social Science History Association, Fort Worth.
Utterström, G. (1957). *Jordbrukets arbetare*. Stockholm: Tidens förlag.
Wang Feng, C. Campbell and J. Lee (1999). “Fertility, Household Context and Economic Fluctuations in 18th and 19th Century Rural China.” Paper for the annual meeting of the Social Science History Association, Fort Worth.
Wargentin, P. (1976). “De l´homme; mortalité de l´homme en Suède, comparée à celle de la femme. Du nombre des naissances et des morts dans tous les mois de l´année,” in *Mémoires (abrégés) de l'Académie Royale des Sciences de Stockholm*. Paris.
Weibull, C-G. (1923). *Skånska jordbrukets historia intill 1800-talets början*. Lund: Gleerups.
Winberg, C. (1975). *Folkökning och proletarisering*. Göteborg: Department of History.
Wohlin, N. (1915). *Den äktenskapliga fruktsamhetens tillbakagång på Gotland*. Stockholm. Nordiska bokhandeln.
Wrigley, E. A. (1966). “Family Limitation in Pre-Industrial England.” *Economic History Review* 19: 82-109.
Wrigley, E. A. (1978). “Fertility Strategy for the Individual and the Group,” in Tilly, C. (ed.) *Historical Studies of Changing Fertility*. Princeton: Princeton University Press.
Wrigley, E. A. and R. S. Schofield (1981). *The Population History of England, 1541-1871. A Reconstruction*. London: Edward Arnold.

Wrigley, E. A., R. S. Davies, J. E. Oeppen and R. S. Schofield (1997). *English Population History from Family Reconstitution 1580-1837*. Cambridge: Cambridge University Press.

Lund Papers in Economic History

1999

66. Tommy Bengtsson & Christer Lundh, Child and Infant Mortality in the Nordic Countries Prior to 1900. */Population Economics/*
67. Mats Olsson, Vikingatida träldom. Om slaveriets plats i Skandinaviens ekonomiska historia. */General Issues/*
68. Jonas Ljungberg, A Revision of the Swedish Producer Price Index, 1968-1993. */General Issues/*

2000

69. Jani Saarinen, Innovation Activity in Finnish Industries - A New Pattern. */General Issues/*

2001

70. Joakim Appelquist, Ett institutionellt perspektiv på den svenska modellen. Effektivitet och institutionell förändring på den svenska arbetsmarknaden från Saltsjöbadsavtalet till Åmanlagarna. */General Issues/*
71. Göran Ahlström, "The Edison of Sweden". C.E. Johansson and the 'Standards of Standard'. */General Issues/*

2002

72. Lars Pettersson & Daniel Sjölin, Socialt kapital, nyföretagande och ekonomisk tillväxt. En jämförelse mellan några kommuner i Öresundsregionen. */Education and the Labour Market/*
73. Anders Nilsson, Yrkesutbildning och kommunal utveckling. Om yrkesutbildningens betydelse i kommunala strategier för ekonomisk tillväxt. */Education and the Labour Market/*
74. Paulina Morel-Astorga, Patterns of Entrepreneurship. Development of Chilean Wine Industry 1850-2000. */Development Economics/*
75. Grethe Banggaard, Fattigforsorgen på landet 1763-1894: Fem sogne i Skåne. */Population Economics/*
76. Grethe Banggaard, Sygdom og Sundhed: Offentlige indgreb og deres virkninger i Sydsverige, ca. 1750-1894. */Population Economics/*
77. Martin Dribe & Paul Nystedt, Information, Trust and Diffusion of Smallpox Vaccination: The Case of Scania, Sweden 1802-1835. */Population Economics/*
78. Tommy Bengtsson & Martin Dribe, Fertility Response to Short-term Economic Stress: Deliberate Control or Reduced Fecundability? */Population Economics/*

Lund Papers in Economic History are published by the Department of Economic History, Lund University, Sweden. This series replaces the former series under the title *Meddelande från ekonomisk-historiska institutionen, Lunds universitet*. The change of name reflects the orientation of the series towards an international readership. The series is multilingual, but the majority of the working papers appear in English.

Lund Papers in Economic History include papers in the following topic areas:

General Issues
Development Economics
Education and the Labour Market
Population Economics

Lund Papers in Economic History are published as occasion arises, not at fixed intervals. Printed issues are distributed to libraries. From 1999 and onwards, full-text electronic issues are also available on *www.ekh.lu.se.* Those who would be interested in receiving information by email on new issues of **Lund Papers in Economic History** are requested to send an email message to *Lund.Papers@ekh.lu.se.*

LUND
UNIVERSITY