Old-Age Mortality in a Life-Course Perspective. Southern Sweden, 1829–1894

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Abstract

Previous research has shown that the disease load experienced during the birth year, measured as local infant mortality rate, had a significant influence on old-age mortality in nineteenth century rural Sweden. Children born in years with very high infant mortality, due to outbreaks of smallpox or whooping cough, who still survived to adulthood, lived several years shorter than those born in years with small to moderately high exposure to diseases. The question posed in this paper is whether factors during the life course mediated this pattern. The data come from five rural parishes in southern Sweden, 1829–1894. Longitudinal demographic data on individuals and household socioeconomic data from parish registers are combined with community data on food prices and disease load for analyzing the mortality among ever married persons in ages 50–80 years. Migrants into the parishes have been traced back to their birth parish in order to gather information about the socioeconomic conditions of their early childhood. By including random effects we control for possible dependencies in the data due to kinship and marriage. While a negative situation during early childhood has an impact on a person's ability to accumulate wealth, still we find no support for the hypothesis that the socioeconomic experience in adulthood altered the negative influence on old-age mortality of the disease load in the first year of life. Socio-economic situation in adulthood simply did not influence remaining life span. Furthermore, when unobserved characteristics at family level were taken into account, it did not alter the conclusions.

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Introduction

In 1934, Kermack, McKendrick and McKinley proposed that cohort factors were major determinants of the mortality decline in England, Wales, Scotland, and Sweden (Kermack et al 1934). They argued that reductions in the death rates of the various age groups, attained at any particular time, depended primarily on the individuals' date of birth, and only secondary on the particular year under consideration. The essential effects on health and survival of adults and older persons were mainly caused by improvements and beneficial effects on their respective birth cohorts during childhood. This life-course perspective has received increased attention in recent years (Barker 1994, Elo and Preston 1992, Fogel 1994, Fridlizius 1989, Kuh and Ben-Schlomo 1997, Preston et al. 1998, Finch and Crimmins 2004). The plausible causal relationships between early-life experiences and old-age mortality have been discussed, with special attention to intrauterine cellular development and cellular development during early childhood.

In two recent essays, Bengtsson and Lindström (2000, 2003) investigated the different cohort hypotheses using longitudinal data for individuals instead of aggregated data like Kermack et al, Fridlizius, and many others. Bengtsson and Lindström analyzed effects of food prices and disease load at time of birth on mortality on old age in four of the five parishes that we are analyzing in this paper but for a longer time period (1766–1894). The analyses included variables measuring conditions during the fetal stage and the first year of life, as well as the disease load and access to nutrition (food prices). Conditions during the fetal stage, as well as during childhood and later in life, were also considered. Strong support was found for the hypothesis that the disease load experienced during the birth year had a consistent impact on mortality in old age (Bengtsson and Lindström 2003). A similar finding has also been shown for ages 25–55 years (Bengtsson 1997).

In this paper we analyze whether factors during the life course mediate the effects of early-life factors on mortality in later life, in particular whether the individual's own access to land in adult life play a role. Various ways of exploring effects of life-course conditions on mortality in later life can be found in the epidemiological literature (Kuh and Ben-Schlomo 1997, Power and Hertzman 1997). Often, the socioeconomic conditions at various stages of life are taken into account: e.g., during childhood (father's social class), during the life course (person's first social class), and current conditions (person's current social class), as in Smith (1997). Sometimes effects of the accumulated experience are analyzed and sometimes changes in experience.

From a conceptual point of view, it seems useful to distinguish between three different ways of modeling life-course factors. One way is to view life-course factors as something a person *accumulates* over the life course, e.g., number of years of exposure to asbestos or to smoking or number of years having good access to economic resources. Another way is to consider *changes in exposure or resources* over time, e. g. social mobility. Social mobility has often been measured over generations comparing the socioeconomic position of a father/mother with his/her son/daughter. Yet a third way is to measure resources at *given points* in life, say, at the time a person secure access to land, settles on his occupation, marries, or simply obtain his first job. One problem is that people start working and marry at different ages, which makes comparisons more difficult. To avoid this problem, one could measure resources at a certain age instead, which is what we are doing in this essay. We model the influence of socioeconomic conditions at birth, at age 50 years, as well as the individual's current condition, on mortality in ages 50–80 years. The reason for focusing on age 50 years is that at this age most people still preserve the amount of wealth (land) they have accumulated over their lifetime. Furthermore, we take into account unobserved characteristics at family level, such as the ability to store wealth and other aspects of economic resources, which may have a strong impact on mortality in later life.

Environmental factors, whether shared with other family members or not, influence the health of a person from the fetal stage throughout life. In this paper we define early-life factors as those that potentially influence the development of cells and organs. The reason is that the speed of the development is much faster in the beginning of life and then gradually declines until ages around 20 to 30 years when it stops. Late-life factors consequently affect an individual after its cells and organs are fully developed. While some early- and late-life factors cause only a temporary retardation of health, others cause life-long health problems whether manifested directly or later in life.

We are using event-history analysis and include a factor for modeling unobserved heterogeneity, *frailty*, which in our case means that we are exploring the possibilities of clustering-effects of birth family and marriage family on old-age mortality (in ages 50–80). The data are from the Scanian Demographic Database, which consists of records of births, marriages, deaths, and migrations for nine rural parishes and one town situated in the southernmost part of Sweden. Data for five of the rural parishes are included in this study.

Models

We are assuming a *proportional hazards model* (Cox 1972) for the mortality analyses. This means that we are assuming that a relative effect on mortality of any covariate is constant over age. The model allows time-varying covariates. It is very important to check the assumptions behind this model, especially the proportionality assumption. We have therefore routinely tested all models for deviations from the proportionality assumption.[1] The test we have used is based on the correlation between log(t) and the Schoenfeld residuals for each covariate. A large correlation indicates that the corresponding coefficient varies with time; in other words, that the hazards are not proportional. We found no sign of non-proportionality, neither on any of the covariates, nor globally.[2]

We also model unobserved heterogeneity, *frailty*, which in our case means that we are exploring the possibilities of clustering effects of birth family and marriage family on old-age mortality (in ages 50–80). We assume that the frailty effect has normal distribution.

For the analyses of how factors early in life influence wealth at age 50 years, we use logistic regression to model the probability of being landed at age 50, with early-life factors as explanatory variables. Again, we find test for unobserved family-level effects.

The statistical analyses were performed in the R environment for statistical computing (R Development Core Team, 2006). The packages eha (Broström 2005) and survival (Therneau and Lumley 2006) were especially useful.

Data

The data are from the Scanian Demographic Database, which consists of records of births, marriages, deaths, and migrations for nine rural parishes and one town situated in the southernmost part of Sweden. The material for two of the parishes dates back to 1646 and for the others to the 1680s. The publicly available records end in 1895. Five of the rural parishes—Hög, Kävlinge,

[1] We used the function 'cox.zph' in the 'survival' package in R.
[2] For a more detailed description of the test, see Therneau and Grambsch (2000), Chapter 6. Testing Proportional Hazards, pp. 127–152.

Halmstad, Sireköpinge, and Kågeröd—are included in this study. The parish register material is of high quality and shows no gaps for births, deaths, and marriages for the period we analyze here. Migration records are less plentiful, but continuous series exist from the latter part of the eighteenth century. Information concerning farm size, property rights, and various other items from the poll tax records and land registers, are linked to the family reconstitutions based on the parish records of marriages, births, and deaths.

Our interest in life-course effects on later-life mortality further limits our dataset. We need information about socioeconomic conditions at birth not only for those born in the parish but also for in-migrants. To learn the socioeconomic condition at birth of an in-migrant, we need to know his birth parish, and that information is generally available only after 1829. We have therefore had to limit the period of our analyses to 1829–1894.

The sampled parishes are compact in their geographical location, showing the variations that could occur in peasant society with regard to size, topography, and socioeconomic conditions, and they offer good, early source material. The entire area was open farmland, except northern Halmstad, which was more wooded. Halmstad and Sireköpinge were "noble" parishes, while freehold and crown land dominated in Kävlinge and Hög. While most of the land was noble land in Kågeröd too, some land was owned by freeholders. The parishes each had 200–900 inhabitants in the latter half of the eighteenth century. The agricultural sector in Sweden, and Scania, became increasingly commercialized in the beginning of the nineteenth century. New crops and techniques were introduced. Enclosure reforms and other reforms in the agricultural sector influenced the population growth, in particular in Sireköpinge, which experienced a fast population growth. In Kävlinge the establishment of several factories and railroad communications led to rapid expansion from the 1870s onwards.[3]

The social structure of the agricultural sector is often difficult to analyze since differences in wealth between the various categories of farmers and occupations are unclear and subject to change with the passage of time. Land was the most important source of wealth in the societies we analyze. Data from land registers on types of tenure must be combined with information from poll-tax records concerning farm size in order to arrive at a better understanding of each household's access to land. The category *peasant* includes freeholders, tenants on crown land, and tenants on noble land as well

[3] For more details, see Bengtsson (2001).

as a few tenants on church land. We only include peasants with farms larger than 1/16 *mantal* in this group since it has been argued that peasants with smaller farms were not self-supporting. The few persons belonging to the nobility are also included in this group. *Mantal* was not a measure of the actual size of the farm but a tax-assessment unit based on potential productivity. The second group includes farmers with land smaller than 1/16 *mantal,* i.e. crofters and landless workers, the latter being in majority.[4] Thus we are only differentiating between two social groups: those with land enough to feed a family and those who need to work for someone else to be able to support a family.

The nineteenth century was a period of considerable social changes in the countryside. It has been described as a period of proletarianization and pauperization.[5] The numbers of landless increased (Carlsson 1968). The downward mobility was significant since many children of farmers were unable to obtain a farm themselves. This was true both for Sweden in general and for the area we study (Lundh 1998, Bengtsson and Broström 2004). Downward mobility was also common among the elderly, since many either sold their farms or gave them to their children. They could, however, still be rather well off since the new owner of their farm often had to look after them in accordance with special contracts (*undantagskontrakt*). Not only did social stratification increase in the beginning of the nineteenth century, the economic condition of the landless worsened. They were, for example, more vulnerable to short-term economic stress than both before and after this period (Bengtsson and Dribe 2005).

The nineteenth century was also a period of rapidly expanding population in Scania as well as in Sweden in general. Fertility rates were rather stable and mortality fell, first among infants and children, later among adults and the elderly. Life expectancy in this area was slightly above the national average.[6] Figure 1 show that the crude death rate for ages 50–80 years during the period of our study was, as in Sweden in general, declining in the four parishes. Life expectancy of Swedish women was the highest in the world (about 45 years around 1830), and remaining life expectancy at age 50 was about 16 years. The figures for men were several years lower. The corresponding figures for our five parishes are slightly higher than for Sweden.

- Figure 1 here

[4] For more details, see Bengtsson and Lindström (2000).
[5] For an overview, see Lundh (1983).
[6] See Bengtsson (2000) and Bengtsson and Dribe (1997).

The models that we will apply include a number of variables, most which are related to access to resources: socioeconomic status at birth, at age 50 years, and currently; sex; whether a person has in-migrated to the parish or not; the parish of residence; birth year; current food prices; and season of birth.[7] The infant mortality rate in the year of birth, shown in Figure 2, a time-varying community variable, is used as a fixed early-life covariate. This is the covariate that in previous studies has had a significant impact on adult mortality in the period 1766–1894, with regard to both its trend[8] and its cycles.[9] We have arbitrarily categorized the infant mortality rate-cycle variable into two groups with the cut point at 0.05, shown in Figure 3.[10]

-Figure 2 and 3 here

The aggregated indicator of food prices is included in the regressions as a time-varying communal covariate (Bengtsson 1989, 1993). We use the deviation from the trend in rye prices as an indicator, shown in Figure 4.[11] This means that the aggregated economic information is used as a time-varying covariate common to all individuals in the risk set at each point in calendar time. We use local prices of rye, the most common crop, referring to the conditions in the fall, and we estimate the effects of food prices during the subsequent year.[12]

- Figure 4 here

Those exposed to a very high disease load at time of birth, relative to surrounding cohorts, experience a much higher mortality in ages 50–80 years, as shown in Figure 5. Thus the process previously observed for the period 1766–1894 (Bengtsson and Lindström 2000, 2003) was also present during the period we analyze here. Furthermore, the curves are quite smooth which means that there are no indications of age-heaping or other problems related to the death records.

- Figure 5 here

[7] For details see Bengtsson and Lindström (2000, 2003).
[8] 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).
[9] Other early-life covariates that have been tested include food prices prior to and at time of birth and crude death rates for adults (Bengtsson and Lindström 2000). We were unable to find any effects of these covariates on old-age mortality.
[10] For further discussion of the functional form, see Bengtsson, Broström and Lindström (2002).
[11] See footnote 8.
[12] For more details, see Bengtsson (2000, 2004).

Results

The overall issue is whether the effects of conditions in childhood on mortality in older ages, shown in previous works, affect mortality in older ages directly or indirectly, through social mobility, or both ways. We analyze the effects of condition in childhood on wealth at age 50 years, by estimating a logistic regression model of belonging to the landed class or not. Covariates include sex, birth date, birth parish, household socioeconomic positions at birth, parish of residence, disease exposure during birth year, food prices during birth year, and current food prices. As for birth parish, we only differ between those born in any of the five parishes and those born elsewhere. For the socioeconomic position of parents at the birth of the index person, we only differ between landed and landless. This information are, however, lacking for a small number of persons, about 8 percent.

The infant mortality rate, which we use as an indicator of disease load in first year of life, is estimated for the five parishes included in this study. This is obviously not an equally good indicator for those in-migrating to the parishes as for those born in the parishes. We know, however, that most of those who migrated into the parishes are born within a short distance from our parishes. We also know that the peaks in the infant mortality rate are due to outbreaks of smallpox and whooping cough (Bengsson and Lindström 2003). This means that the infant mortality rate in the five parishes bears strong resemblances with the surrounding area, at least after years with extraordinary high infant mortality. Still, we assume that the indicator has lower precision for those who in-migrated and hence we also estimate the interaction between birth parish and the infant mortality rate.

When it comes to food prices, strong evidence indicates that these had different bearing on landed and landless; the latter suffering from high food prices as net consumers, while the landed, in their role as producers, benefited from high food prices (Bengtsson 2004, Bengtsson and Dribe 2005). This effect is controlled by estimating the interaction between food prices and socioeconomic position. Finally, we have tested for proportionality and possible family-level effects not included in the models as observables.

Table 1 shows the results for a full model of life-course effects on wealth at age 50 years including interactions as well as the results of a reduced model. We have performed likelihood ratio tests in order to estimate the overall significance of each covariate as a complement to the Wald test of each category included in the model. Tests of effects of unobserved heterogeneity at family level show no signs of sibling effects (not reported here).

- Table 1 here

We find that the disease load in year of birth indeed has an effect on socioeconomic position at age 50 years, albeit that the significance is weak. We also find that the socioeconomic situation at birth has a similar effect, in particular for females. Food prices at birth have an influence too, but only for the landed, which is unexpected. The overall effect is, however, only weakly significant. Finally, year of birth is important—being born later in the period between 1829 and 1894 means that a person was less likely to become a farmer, which reflects the gradual decline of this class and the strong downward mobility that farmers' children experienced, especially the girls.

Taken together, conditions in early childhood influenced a person's chance of belonging to the landed class at age 50 years, most likely for health reasons. The results seem reasonable. Peasants wanted their farms to be transferred to a child who had the capacity to keep it and provide for their parent's old-age care. And it was only landless children who were healthy that were able to accumulate the economic resources needed for buying a farm, or for becoming tenants on estate land.

The factors influencing mortality in ages 50–80 years are basically the same as in the previous models but now also obtained socioeconomic position and current food prices are included, with interactions. The results are shown in Table 2. Our main focus is on the effects of conditions in early childhood and on the effects of socioeconomic status at age 50 years. We find support for the hypothesis that the disease load in the birth year has an influence on mortality in ages 50–80 years, the results being similar to what we obtained for the period 1766–1894 (Bengtsson and Lindström 2000, 2003). Children born in years with very high disease load, face more than 90 percent higher mortality than the others after controlling for all the covariates included in the model, the effect being weaker for those born outside the five parishes. This is likely to be an effect of the precision of the indicator of the disease load, as discussed above.

- Table 2 here

We are also able to show effects of current food prices. Higher prices meant higher mortality, as expected. Socioeconomic conditions at age 50 years have, however, no affect on mortality; neither have current socioeconomic position. Furthermore, we find that being born later in the period between 1829 and 1894 is favorable, also as expected.

Tests of effects of unobserved heterogeneity at family level show no signs of sibling effects, only of effect of current family. Married couples shared certain characteristics not picked up by the observables. Even though the family-level effects with regard to family at marriage are significant, they only marginally altered the estimations of the influences of the observed factors during the life course on mortality in older ages, as shown in Table 2.[13] As for siblings, we find no family-level effects at all (not reported here). Furthermore, tests of proportionality show no problems, neither for any of the covariates, not globally (not reported here).

To summarize, we find no support for the hypothesis that the influence of the disease load in the first year of life is not permanent throughout life but is moderated by an individual's socioeconomic condition later in life, more specifically at age 50 years. Those who have been economically unsuccessful by that age suffer no more from the damage caused by the disease load in the birth year than do those who have been doing well, who have attained or retained access to land, the main source of wealth in this society. For those who were exposed to a heavy disease load in the first year of life and survived until age 50 years, we estimate the remaining median life expectancy to be about two years shorter compared to those who were born in years with low to moderately high infant mortality, which makes it a more important determinant than sex or socio-economic status.

Discussion

There is a large body of studies concluding that conditions very early in life, in the fetal stage and in the first year of life, have an impact on health and mortality in later life. Robert Fogel (1994) has proposed several plausible causal mechanisms that connect malnutrition *in utero* and during early life to chronic diseases in later life, propositions supported by the work of Barker (1994, 1995), who suggested that the preconditions for coronary heart disease, hypertension, stroke, diabetes, and chronic thyroiditis are initiated *in utero* without becoming clinically manifest until much later in life. To the extent the damage caused by malnutrition in early life shows up late in life, we label it "permanent" damage. In fact, such damage could be difficult to distinguish from adverse effects that are not permanent in nature but where the damaging factor remains. It is, for example, difficult to distinguish between early-life effects of poor nourishment from poor nourishment later in life in a society with little social mobility. It is therefore important to take into account social mobility when analyzing effects of early-life conditions on mortality later in life, and this was also our intention with this study.

We have previously shown that the disease load in the birth year affected mortality in ages 50–80 years (Bengtsson and Lindström 2000, 2003). The question is whether the damage caused by exposure to diseases is permanent or not; in other words, if the effects are moderated by life-course conditions, such as social mobility. The fact that we find evidence that exposure to diseases in year of birth influence both wealth at age 50 years and mortality in ages 50–80 years, suggests that the causality either could be direct or indirect, via ability to attain wealth during working years. We find, however, no effects of socioeconomic situation at age 50 years and mortality in later life. Thus, the damages caused by a heavy disease load in first year of life could seem to be permanent, affecting both health and working capacity and mortality in older ages. While the socioeconomic situation of parents at the time of birth of a child influence the probability of becoming wealthy in adulthood—which is equal to having access to land—it has no effect on old-age mortality, neither has wealth later in life. The lack of a social gradient in mortality seem surprising, since we have become accustomed to this in present day societies. It was, however, not until the nineteenth century that social differences in mortality started to emerge.[14] Before then, the societal differences in mortality were small; sometimes the well-off even had shorter life-spans than the ordinary man (Livi-Bacci 1991).

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[13] For analyses of family at marriage effects on mortality in this area, see Nystedt (2002) Tsuya and Nystedt (2004).
[14] See Bengtsson (2001) and Riley (2001) for overviews.

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Figure 1. Crude Death Rate in ages 50—80 years in the Five Parishes in 1829—1894.

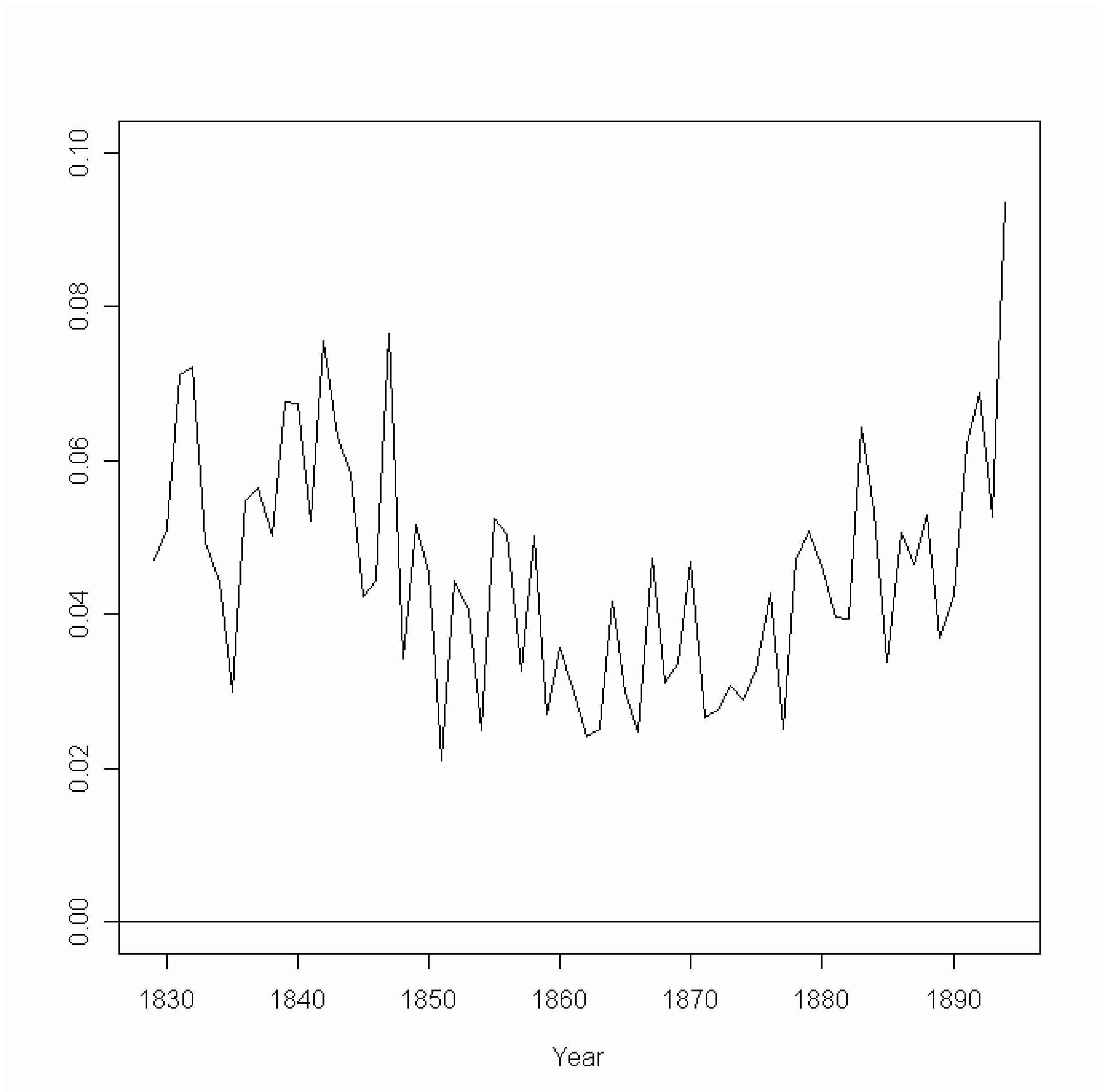

Figure 2. Infant Mortality Rate and Hodrick-Prescott Trend in the Five Parishes 1749—1844.

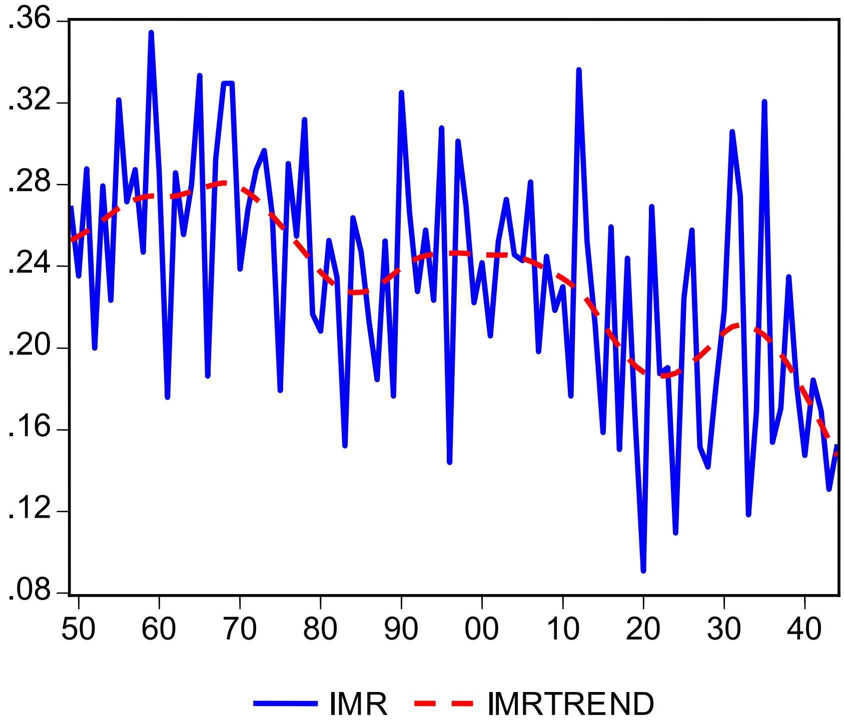

Figure 3. Cycles in Infant Mortality Rate in the Five Parishes 1749—1844. Deviation from a Hodrick-Prescott trend. Cut level 0.05.

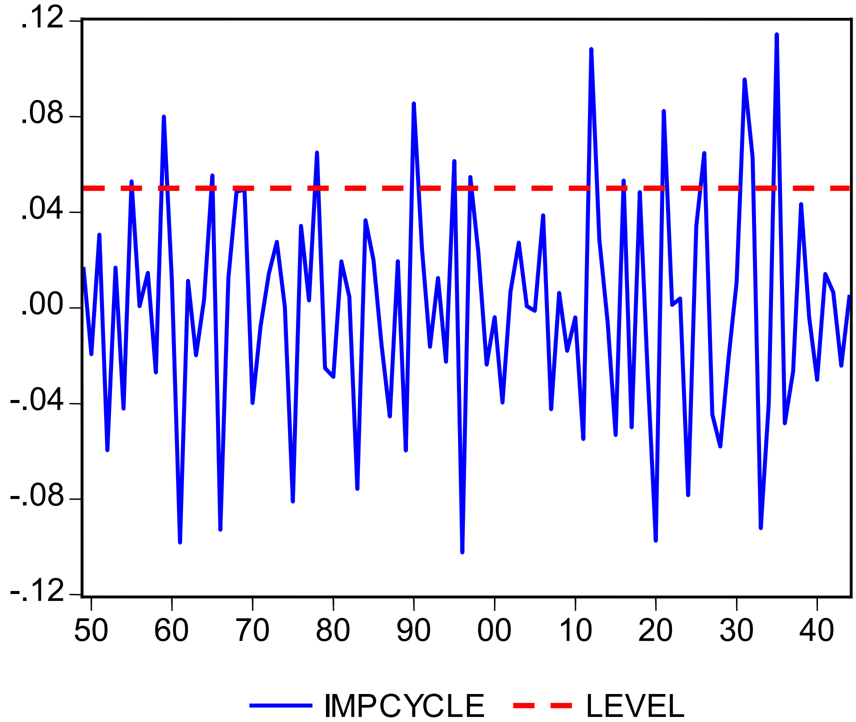

Figure 4. Cycles in local log rye prices 1680—1894. Deviation from a Hodrick-Prescott trend.

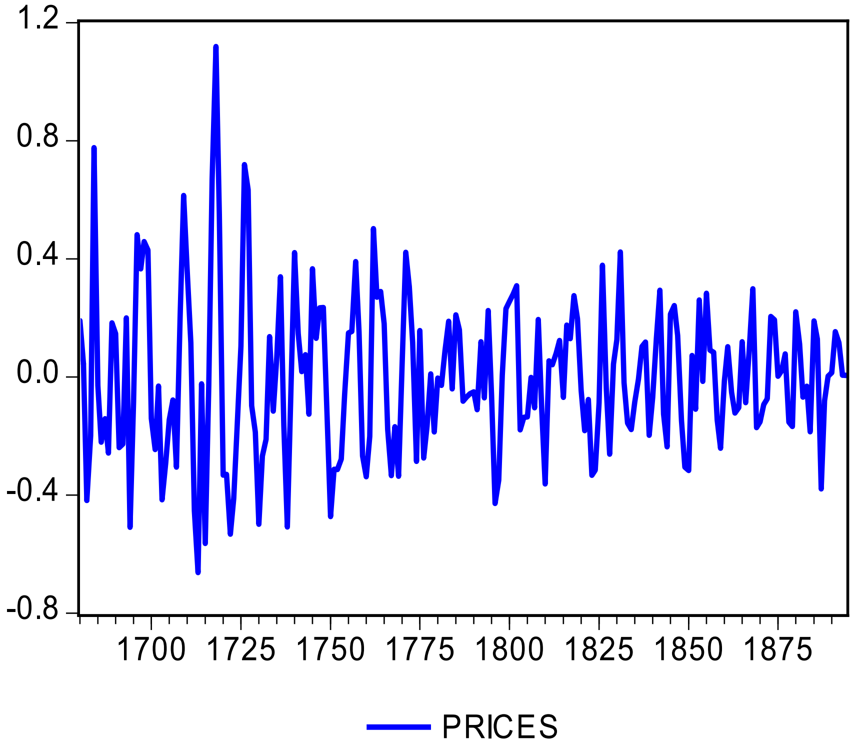

Figure 5. Cumulative Hazard Rate for those experiencing high and low disease load in year at birth.

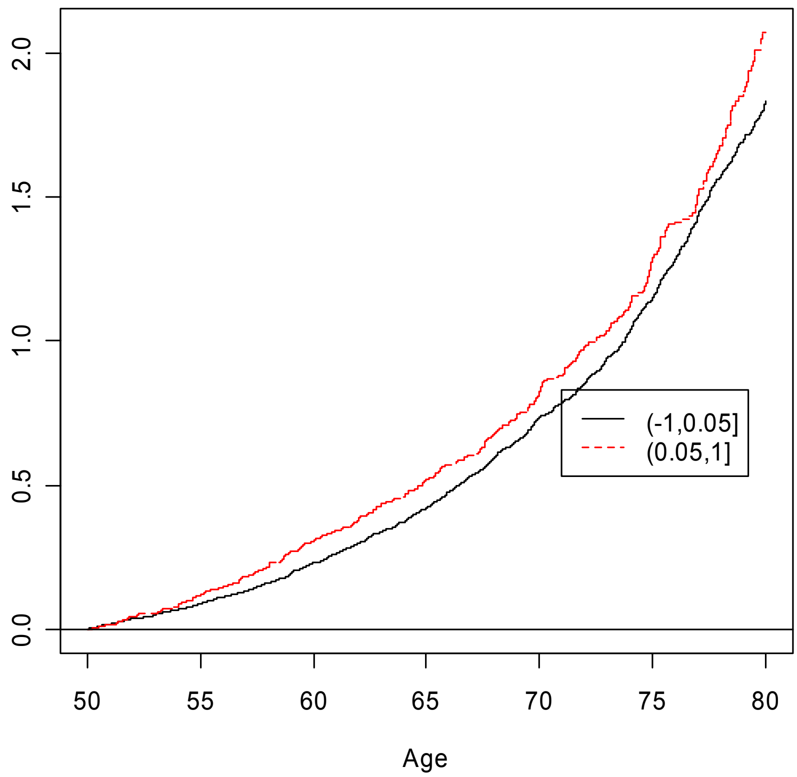

Table 1. Estimation of effects of conditions at birth on becoming wealthy at age 50 years. Logistic regression.

```
FULL MODEL

Coefficients:
                                       Estimate  Pr(>|t|)
(Intercept)                           3.89        1.38e-09 ***
sex:female                            8.60e-05    0.99
soc.birth:minus.one                   0.05        0.25
soc.birth:landed                      0.25      < 2.00e-16 ***
imrcycle.birth                       -0.27        0.08     .
foodprices.birth                      0.05        0.28
birthparish:other                     9.78e-03    0.54
parish:Kevlinge                      -0.03        0.31
parish:Halmstad                      -0.06        0.04     *
parish:Sireköpinge                   -0.03        0.26
parish:Kågeröd                       -0.05        0.07     .
birthdate                            -2.04e-03    9.06e-09 ***
sex:female*soc.birth:minus.one       -0.09        0.10
sex:female*soc.birth:landed          -0.11        1.43-03  **
soc.birth:minus.one*foodprices.birth -0.07        0.50
soc.birth:landed*foodprices.birth    -0.20        0.02     *
```

```
LR drop-term test
                           Df Deviance    AIC    scaled dev. Pr(Chi)
<none>                          515.5   3269.6
imrcycle.birth              1   516.0   3270.7         3.1  0.08      .
birthparish                 1   515.5   3268.0         0.4  0.54
parish                      4   516.3   3266.6         5.0  0.29
birthdate                   1   521.0   3300.8        33.2  8.27e-09  ***
sex:soc.birth               2   517.4   3277.0        11.4  3.37e-03  **
soc.birth*foodprices.birth  2   516.3   3270.7         5.1  0.08      .
---

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


REDUCED MODEL

Coefficients:
                                      Estimate   Pr(>|t|)
(Intercept)                           3.82       2.19e-09 ***
sex:female                           -3.61e-04   0.98
soc.birth:minus.one                   0.05       0.28
soc.birth:landed                      0.25     < 2.00e-16 ***
imrcycle.birth:high                  -0.27       0.08     .
foodprices.birth                      0.06       0.24
birthdate                            -2.01e-03   1.02e-08 ***
sex:female*soc.birthminus.one        -0.09       0.11
sex:female*soc.birthlanded           -0.11       1.54e-03 **
soc.birth:minus.one*foodprices.birth -0.07       0.54
soc.birth:landed*foodprices.birth    -0.20       0.02     *
---

(Dispersion parameter for gaussian family taken to be 0.1675015)

LR drop-term test
                           Df Deviance    AIC    scaled dev. Pr(Chi)
<none>                          516.4   3265.1
impcycle.birth              1   516.9   3266.2         3.1  0.08      .
birthdate                   1   521.9   3296.1        32.9  9.54e-09  ***
sex:soc.birth               2   518.3   3272.4        11.2  3.63e-03  **
soc.birth*foodprices.birth  2   517.3   3266.3         5.2  0.07      .
---

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Table 2 Estimation of life-course condition on mortality in age 50 years and over. Cox proportional hazards regression. 1 822 deaths.

FULL MODEL

	exp(coef)	p	
sex:female	1.050	0.42	
soc.birth:minus.one	0.915	0.52	
soc.birth:landed	1.023	0.76	
birthdate	0.994	1.4e-05	***
birthparish:other	0.999	0.98	
imrcycle.birth:high	1.989	2.9e-03	***
foodprices.birth	1.075	0.64	
parish:Kevlinge	1.037	0.71	
parish:Halmstad	0.993	0.94	
parish:Sireköpinge	0.968	0.71	
parish:Kågeröd	0.872	0.09	
soc.50:minus.one	1.414	0.21	
soc.50:landed	0.990	0.87	
foodprices	1.397	0.04	
soc:landed	0.951	0.56	
sex:female*soc.birth:minus.one	1.053	0.76	
sex:female*soc.birth:landed	1.028	0.80	
birthparish*imrcycle.birth:high	0.739	0.03	*
soc.birth:minus.one*foodprices.birth	1.025	0.94	
soc.birth:landed*foodprices.birth	0.761	0.32	
soc.50:minus.one*foodprices	1.231	0.88	
soc.50:landed*foodprices	0.941	0.87	
soc:landed*foodprices	1.025	0.96	

Likelihood ratio test=50.4 on 23 df, p=0.000806 n= 95357

LR drop-term test

	Df	AIC	LRT	Pr(Chi)	
<none>		25143.2			
birthdate	1	25159.9	18.7	1.5e-05	***
parish	4	25142.8	7.6	0.11	
sex*soc.birth	2	25139.3	0.1	0.94	
birth:parish*imrcycle.birth	1	25145.9	4.7	0.03	*
soc.birth*foodprices.birth	2	25140.3	1.1	0.57	
soc.50*foodprices	2	25139.2	0.1	0.98	
soc*foodprices	1	25141.2	0.002506	0.96	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

REDUCED MODEL

```
coxph(formula = Surv(enter, exit, event) ~ birthdate + birthparish *
    impcycle.birth + impcycle.birth + foodprices, data = paa)


                                           exp(coef)     p
birthdate                                     0.994    3.4e-06 ***
birthparish:other                             1.026    0.61
imrcycle.birth:high                           1.942    3.8e-03 **
foodprices                                    1.379    0.02    *
birthparish:other*imrcycle.birth:high         0.747    0.03    *

Likelihood ratio test=37.6  on 5 df, p=4.56e-07  n= 95357


LR drop-term test
                           Df     AIC     LRT   Pr(Chi)
<none>                         25120.0
birthdate                   1  25139.5    21.5   3.55e-06 ***
foodprices                  1  25123.3     5.2   0.02     *
birthparish:imrcycle.birth  1  25122.5     4.4   0.04     *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

REDUCED MODEL WITH FRAILTY FACTOR INCLUDED (current family)

```
                                           exp(coef)     p
birthdate                                     0.995    5.4-05 ***
birthparish:other                             1.029    0.61
imrcycle.birth:high                           1.946    8.3-03 **
foodprices                                    1.273    0.03   *
birthparish:other*imrcycle.birth:high         0.740    0.04   *
frailty(family.current)                                0.01   *
```