Extended abstract for EPC 2010

Sex-specific Child Mortality During the Swedish Mortality Decline: Why is SES Important for Girls Only, and Food Prices for Boys Only?

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Was there any sex-specific mortality difference during the European mortality decline, and – if so – what does it depend on? Is it for biological reasons, or are there differences due to the different treatment of the two sexes?

For Sweden, several historical studies have shown differences between the sexes, but many of them show only small or insignificant differences in both directions, and the results also differ for different age groups. Also, the differences seem to change over time (Fridlizius 1988, 1989, Willner 1999, Bengtsson 2000, Bengtsson & Dribe 2002, Johansson 2004).

If we leave out adult mortality that was thoroughly investigated in Fridlizius (1988) and later again by Willner (1999), as well as infant mortality, which primarily – at least in Europe (Lynch 2000, Lee & Campbell 1997, Lee & Wang 1999) – would be mostly dependent on biological factors, sex-differentials in pre-industrial child mortality has been studied by Bengtsson, Bengtsson & Dribe, and by Johansson.

In Johansson (2004), child mortality in southern Sweden was studied, and the investigation was made with a data on several thousands of individuals from four parishes in Scania, using survival regressions with shared frailty, divided into three sub-periods during the period 1766-1894. The division into three sub-periods rests on the changes that the society is going through during this period: the first period is a pre-transition period before the enclosure and land-partitioning movement, the second is the period when the land-partitionings and enclosures takes place, while the last sub-period, is the industrialisation period.

The mortality model used in the investigation uses a number of fixed as well as time-varying variables at three levels; an individual, a family, and a community level, to explain the child mortality. It accounts for age of mother at birth, family-belonging, birth-season, socio-economic status (SES), current food prices, parish, and it focus especially on the conditions regarding disease load and nutrition intake during very early life (the foetal stage and in infancy). It also includes sex, but the sex variable is only used as a control.

When controlling for sex, the Cox regressions in the investigation showed a significant 50 % higher mortality for female children in the first sub-period (1766-1814), a significant 20 % lower mortality for females in the second sub-period (1815-1864), and equal mortality in the last sub-period (1865-1894). The conclusion regarding the sex specific differences in the investigation is that the differences mostly are due to randomness, and not to any underlying differences between the sexes. This is partly to the fact that the large disadvantage in mortality for the girls in the first sub-period (50 % higher) is substituted for a 20 % lower mortality for the girls in the second sub-period, and such large changes – also considering that there is no difference at all in the last sub-period – in such a short time, seem not likely to be real but rather due to randomness.

However, the results stated above are when using sex only as a control. Separate regressions for boys and girls show that two of the variables in the regression are very different for the boys and the girls. Boys respond to changes in food prices while girls don't, and the socio-economic status of the family affects the girls but not the boys.

Reporting the most important variables from the results for the separate regressions for boys and for girls, first for the pre-transition period, shows no differences; not compared to each other, and not compared to the regressions where sex was only used as control: (extra-reduced partial tables for compared to the other rest)

Girls

	coef	exp(coef)	se(coef)	z	p
lryedtv	0.06876	1.071	0.5189	0.132	0.890
lryedtv1	0.09550	1.100	0.5316	0.180	0.860
as.factor(socc)Small	-0.05576	0.946	0.3115	-0.179	0.860
as.factor(socc)Fr+Cr	0.29738	1.346	0.3659	0.813	0.420
as.factor(socc)Noble	-0.48566	0.615	0.3275	-1.483	0.140

Boys

	coef	exp(coef)	se(coef)	z	p
lryedtv	0.54364	1.722	0.44881	1.2113	0.230
lryedtv1	-0.46944	0.625	0.45794	-1.0251	0.310
as.factor(socc)Small	-0.02826	0.972	0.23779	-0.1189	0.910
as.factor(socc)Fr+Cr	0.08018	1.083	0.26900	0.2980	0.770
as.factor(socc)Noble	-0.59776	0.550	0.28231	-2.1174	0.034

However, for the transformation period, there are clear differences between the boys and the girls. The girls does not seem to react at all to changes in current food prices; not in time t or in time t-1 (lagged one year). However, they are clearly sensitive to what SES group they belong to: both the smallholder group and the freeholder/crown tenant group has significantly lower mortality than the control group of landless, and the differences are also rather large; about 35 % lower mortality for both these groups. Only the difference for the noble tenant group is non-significant.

Girls

	coef	exp(coef)	se(coef)	z	p
as.factor(parish)Kävlinge	0.18384	1.202	0.19733	0.932	0.3500
as.factor(parish)Halmstad	0.05674	1.058	0.20375	0.278	0.7800
as.factor(parish)Sireköpinge	-0.06597	0.936	0.20610	-0.320	0.7500
lryedtv	**-0.09537**	**0.909**	**0.34887**	**-0.273**	**0.7800**
lryedtv1	**-0.07693**	**0.926**	**0.35291**	**-0.218**	**0.8300**
as.factor(socc)Small	**-0.46155**	**0.630**	**0.15092**	**-3.058**	**0.0022**
as.factor(socc)Fr+Cr	**-0.41806**	**0.658**	**0.20696**	**-2.020**	**0.0430**
as.factor(socc)Noble	**-0.13097**	**0.877**	**0.21956**	**-0.597**	**0.5500**
bthdat	0.00583	1.006	0.00603	0.967	0.3300
mage25	-0.38700	0.679	0.22399	-1.728	0.0840
mage35	0.29793	1.347	0.15224	1.957	0.0500
as.factor(season)Spring	-0.02679	0.974	0.16893	-0.159	0.8700
as.factor(season)Summer	-0.24978	0.779	0.18612	-1.342	0.1800
as.factor(season)Autumn	-0.08986	0.914	0.17093	-0.526	0.6000

With the boys, on the other hand, the opposite is true: they respond to changes in food prices, and the response is both strong and highly significant for food prices in time t, but not for time t-1. Regarding the SES, two of the groups have an unexpected sign, indicting higher mortality relative to the landless, but what is maybe more important, all three SES group estimates are for from being significant from zero, so clearly the boys are not sensitive to their SES group belonging.

Boys

	coef	exp(coef)	se(coef)	z	p
as.factor(parish)Kävlinge	0.360167	1.434	0.2319	1.5534	0.12000
as.factor(parish)Halmstad	-0.022630	0.978	0.2472	-0.0916	0.93000
as.factor(parish)Sireköpinge	-0.113212	0.893	0.2458	-0.4606	0.65000
lryedtv	**1.316505**	**3.730**	**0.3960**	**3.3246**	**0.00089**
lryedtv1	**-0.331558**	**0.718**	**0.4187**	**-0.7918**	**0.43000**
as.factor(socc)Small	**0.185162**	**1.203**	**0.1750**	**1.0580**	**0.29000**
as.factor(socc)Fr+Cr	**-0.145980**	**0.864**	**0.2469**	**-0.5912**	**0.55000**
as.factor(socc)Noble	**0.255832**	**1.292**	**0.2488**	**1.0282**	**0.30000**
bthdat	0.000451	1.000	0.0069	0.0654	0.95000
mage25	-0.222485	0.801	0.2530	-0.8794	0.38000
mage35	0.313867	1.369	0.1739	1.8045	0.07100
as.factor(season)Spring	-0.219577	0.803	0.2026	-1.0839	0.28000
as.factor(season)Summer	-0.319694	0.726	0.2157	-1.4823	0.14000
as.factor(season)Autumn	-0.089661	0.914	0.1935	-0.4633	0.64000

The industrialisation regression estimates shows the same results as the transformation period results: the girls are sensitive to what SES they belong to, while the boys are not. The only difference is that there is one group of SES that is significant from zero also for the boys in this period; the Free + Crownholder group, with over 40 % lower mortality also for the boys.

Girls

	coef	exp(coef)	se(coef)	z	p
as.factor(parish)Kävlinge	0.2281	1.256	0.2974	0.7670	0.4400
as.factor(parish)Halmstad	0.0930	1.098	0.2817	0.3303	0.7400
as.factor(parish)Sireköpinge	0.0183	1.018	0.2662	0.0686	0.9500
lryedtv	**-0.8361**	**0.433**	**0.5331**	**-1.5682**	**0.1200**
lryedtv1	**1.1097**	**3.033**	**0.5517**	**2.0113**	**0.0440**
as.factor(socc)Small	**-0.6365**	**0.529**	**0.2148**	**-2.9625**	**0.0031**
as.factor(socc)Fr+Cr	**-0.7265**	**0.484**	**0.2598**	**-2.7961**	**0.0052**
as.factor(socc)Noble	**-1.5445**	**0.213**	**0.7241**	**-2.1330**	**0.0330**
bthdat	-0.0153	0.985	0.0225	-0.6818	0.5000
mage25	-0.4047	0.667	0.3174	-1.2750	0.2000
mage35	0.2052	1.228	0.1986	1.0333	0.3000
as.factor(season)Spring	-0.4899	0.613	0.2556	-1.9169	0.0550
as.factor(season)Summer	0.1818	1.199	0.2254	0.8067	0.4200
as.factor(season)Autumn	-0.0070	0.993	0.2299	-0.0305	0.9800

A similar thing is happening for the girls when it comes to their response to changes in food prices: in the periods before, they have been totally insensitive to changes in food prices, but now they also respond to them, just as the boys still does – both have significantly higher mortality when food prices have risen in period t-1. This delay in mortality is thought to be due to the different disease spectra in this sub-period compared to the other ones: in the industrialisation period, tuberculosis was common, and it is known to work slow and depend on malnutrition (Johansson [2004]). Regarding the response of boys to being in the Crown+Freeholder group, this might be because the effect is so strong that it also affects the boys, and the same goes for the lagged effect of food prices on the girls.

Boys

	coef	exp(coef)	se(coef)	z	p
as.factor(parish)Kävlinge	0.59042	1.805	0.2844	2.0757	0.038
as.factor(parish)Halmstad	-0.32446	0.723	0.3020	-1.0745	0.280
as.factor(parish)Sireköpinge	-0.07733	0.926	0.2750	-0.2812	0.780
lryedtv	**-0.04620**	**0.955**	**0.5445**	**-0.0848**	**0.930**
lryedtv1	**1.05189**	**2.863**	**0.5594**	**1.8804**	**0.060**
as.factor(socc)Small	**-0.02915**	**0.971**	**0.2018**	**-0.1444**	**0.890**
as.factor(socc)Fr+Cr	**-0.55127**	**0.576**	**0.2718**	**-2.0284**	**0.043**
as.factor(socc)Noble	**-0.08399**	**0.919**	**0.4885**	**-0.1719**	**0.860**
bthdat	-0.00228	0.998	0.0228	-0.1001	0.920
mage25	-0.06134	0.940	0.3112	-0.1971	0.840
mage35	0.35652	1.428	0.1952	1.8262	0.068
as.factor(season)Spring	-0.05460	0.947	0.2453	-0.2226	0.820
as.factor(season)Summer	0.06643	1.069	0.2349	0.2828	0.780
as.factor(season)Autumn	0.11245	1.119	0.2295	0.4900	0.620

There are at least two possible explanations for this. It could be an effect of how food supply affects the sexes differently biologically. However, it is also possible that this is due to that the boys and girls were treated differently within the family. There will be an extensive discussion on this in the full paper.

Paper will be updated regarding:

1) Background + theory
2) Details on the previous studies
3) Updated regressions + more data
4) The possible explanations/conclusions made from the results
5) References

Short note on the data:
The empirical analysis uses data from SDD on four parish populations in Scania, Southern Sweden.[1] This database contains data on demographic events and economic conditions for several thousands of individuals from 1650-1894 collected from parish registers and church records, and supplemented with socio-economic information from poll tax register. The area is an rural area, where a selection of farmers, smallholders, semilandless, and landless has been made for this study, which means that there are no priest, teachers, estate-owners, and similar in the study due to small numbers for these categories. Since most of the supplement information on socio-economic status is only available for all parishes after 1766, the sample studied is selected to be from 1766 to 1894.

[1] Scanian Demographic Database.