Childlessness, Celibacy and Net Fertility in Pre-Industrial England: The Middle-class Evolutionary Advantage Online Appendix

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A Sample

1	Labourers/Servants	incl. seamen
2	Husbandmen	small farmers, weavers
3	Craftsmen	tailors, carpenters
4	Traders	innkeepers, butchers, bakers
5	Farmers	
6	Merchants/Professionals	clerks, clergy, medical
7	Gentry	gentlemen, esquire

Table A.1: Social Groups Employed in the Analysis

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Died Age	9,007	45.932	21.136	16	27	43	64	104
Married	9,007	0.589	0.492	0	0	1	1	1
Labourers & Serv.	9,007	0.110	0.313	0	0	0	0	1
Husbandmen	9,007	0.086	0.280	0	0	0	0	1
Craftsmen	9,007	0.096	0.295	0	0	0	0	1
Traders	9,007	0.045	0.208	0	0	0	0	1
Farmers	9,007	0.029	0.169	0	0	0	0	1
Upper class	9,007	0.041	0.197	0	0	0	0	1
Unknown Occupat.	9,007	0.593	0.491	0	0	1	1	1

Note: the means on the father's occupational dummies show the proportion of the sample falling into each occupational group. The largest group is the Labourers and Servants (11.1 per cent) while the smallest one is the Farmers (2.9 per cent).

Table A.2: Sample to Compute $m(c)$

Statistic	N	Mean	St. Dev.	Min	Median	Max
At Risk for First Birth						
I(First Birth)	14,730	0.850	0.357	0	1	1
Spacing marriage to 1st birth	12,517	1.373	1.354	0.000	0.940	18.014

Table A.3: Sample to Compute $z(c)$

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Died Age	24,260	24.964	27.373	0	1	13	47	103
Died before 15	48,514	0.256	0.436	0	0	0	1	1

Table A.4: Sample to Compute $d(c)$

Statistic	N	Mean	St. Dev.	Min	Median	Max
At Risk for Second Birth						
I(Second Birth)	12,519	0.858	0.349	0	1	1
Spacing 1st to 2nd	10,739	2.362	1.317	0.000	2.071	11.444
At Risk for Third Birth						
I(Third Birth)	10,738	0.838	0.369	0	1	1
Spacing 2nd to 3rd	8,994	2.561	1.335	0.000	2.301	11.471
At Risk for Fourth Birth						
I(Fourth Birth)	8,993	0.810	0.392	0	1	1
Spacing 3rd to 4th	7,283	2.632	1.339	0.000	2.389	11.808
At Risk for Fifth Birth						
I(Fifth Birth)	7,280	0.780	0.414	0	1	1
Spacing 4th to 5th	5,682	2.600	1.286	0.000	2.397	9.929
At Risk for Sixth Birth						
I(Sixth Birth)	5,679	0.740	0.439	0	1	1
Spacing 5th to 6th	4,204	2.594	1.265	0.000	2.400	10.203
At Risk for Seventh Birth						
I(Seventh Birth)	4,201	0.704	0.456	0	1	1
Spacing 6th to 7th	2,959	2.555	1.252	0.000	2.384	9.748
At Risk for Eighth Birth						
I(Eight Birth)	2,959	0.653	0.476	0	1	1
Spacing 7th to 8th	1,932	2.530	1.202	0.000	2.397	10.222
At Risk for Nineth Birth						
I(Nine Birth)	1,932	0.597	0.491	0	1	1
Spacing 8th to 9th	1,154	2.475	1.244	0.000	2.286	9.463
At Risk for Tenth Birth						
I(Tenth Birth)	1,154	0.545	0.498	0	1	1
Spacing 9th to 10th	629	2.303	1.113	0.000	2.162	9.841

Note: Spacing between the n and $n+1$ birth displays descriptive statistics on the time in years between the births. Spacing values of zero are possible when twins were born.
The sample size of the spacing variables and children at risk in the line below do not always agree because we do not have precise birth dates for a small sample of children, which prevents us of calculating spacing between two children. These have been checked and confirmed.

Table A.5: Sample to Compute $b(c)$

B Additional Data

Figure B.1: The 26 parishes of Wrigley et al. (1997) and the 3 counties of Clark and Cummins (2015)

			Social groups						
	Mean	Unknown	1	2	3	4	5	6	7
0	0.974	0.969	0.981	0.979	0.979	0.983	0.982	0.982	0.974
1	0.916	0.903	0.933	0.926	0.934	0.933	0.944	0.925	0.917
2	0.923	0.916	0.939	0.925	0.929	0.941	0.921	0.939	0.917
3	0.914	0.909	0.923	0.916	0.921	0.938	0.905	0.919	0.904
4	0.919	0.913	0.938	0.907	0.920	0.946	0.916	0.927	0.905
5	0.908	0.901	0.917	0.907	0.927	0.893	0.883	0.944	0.948
6	0.910	0.895	0.930	0.921	0.926	0.915	0.889	0.928	0.973
7	0.916	0.910	0.924	0.912	0.932	0.908	0.854	0.952	0.952
8	0.924	0.929	0.902	0.920	0.924	0.913	0.886	0.962	0.916
9	0.941	0.930	0.956	0.945	0.932	0.957	0.978	0.964	0.898

Note: estimated from logistic regressions

Table B.1: 5-year Survival Probabilities of Mothers by parity n and social group

Occupations	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9
Labourers, Servants	0.89	0.86	0.82	0.77	0.74	0.71	0.63	0.52	0.56
Husbandmen	0.92	0.88	0.83	0.80	0.76	0.69	0.67	0.60	0.54
Craftsmen	0.92	0.88	0.85	0.83	0.79	0.72	0.63	0.62	0.58
Traders	0.93	0.90	0.88	0.86	0.73	0.79	0.60	0.63	0.68
Farmers	0.93	0.89	0.86	0.79	0.73	0.75	0.66	0.50	0.46
Upper Class	0.94	0.91	0.87	0.82	0.78	0.79	0.72	0.70	0.56
Unknown	0.88	0.83	0.80	0.77	0.73	0.69	0.66	0.60	0.52

Note: Parity progression ratios computed from estimated survival functions 10 years after previous birth, and assuming average levels for parish and time period dummies

Table B.2: Estimated Parity Progression Ratios Across Social Groups

	Mean age at marriage	95% conf. interval	
Labourers, Servants	24.63	24.18	25.08
Husbandmen	25.45	24.95	25.95
Craftsmen	25.62	25.09	26.16
Traders	25.40	24.61	26.18
Farmers	23.83	23.06	24.60
Merchants, Professionals	25.22	24.18	26.27
Gentry	25.29	23.79	27.79
Unknown Occupation	25.67	25.47	25.86

Table B.3: Mean female age at marriage by social group

Occupation	Mean number of marriages	
	Women	Men
Labourers, Servants	1.061	1.126
Husbandmen	1.061	1,128
Craftsmen	1.063	1,124
Traders	1.064	1.135
Farmers	1.055	1.129
Merchants, Professionals	1.052	1.110
Gentry	1.048	1.123
Unknown Occupation	1.047	1.116
All	1.053	1.120

Table B.4: Mean Number of Marriages per Married Woman and Men and per occupation

Occupation	Both Non-migrant	Mother In-Migrant	Father In-Migrant	Both In-Migrant	Total
Labourers and Servants	547	277	262	371	1457
Husbandmen	372	271	157	276	1076
Craftsmen	451	263	223	252	1189
Traders	202	122	80	119	523
Farmers	144	88	36	57	325
Merchants and Professionals	174	47	64	67	352
Gentry	55	35	31	30	151
Unknown	2349	1623	1368	2104	7444
Total	4294	2726	2221	3276	12517

Table B.5: Number of marriages by migrant status

C Individual Occupational Mobility

As mentioned in the main text, the occupations in the reconstitution data were recorded at several points in a man's life: at his marriage, at the baptisms of his children and at his burial. Thus, it is possible to quantify men who moved up or down in the wealth categories during their lifetime. In total 9 per cent of the father's occupations in our dataset changed over the father's life course. Thus, we needed to figure out a way to categorise those fathers who experienced mobility across social groups. Table C.1 shows the movement of father's occupations between the Clark and Cummins social groups during the father's lifetime. The rows in the table represent the minimum social group of the father, which could occur at marriage, baptism of a child or burial, whereas the columns represent the maximum social group of the father. Thus, Table C.1 does not reveal whether there was upward or downward mobility.

There were 17,666 children whose father's minimum and maximum social group for their occupation was one, and there were 1,087 children whose father's minimum social group was one but also had a group two occupation listed. In order to simplify our analysis and improve our sample size among the occupational groups, we reassigned some groups experiencing mobility to their maximum social group. However, we only did this for social groups that could have easily been fluid to minimise measurement error in the analysis. Thus, we assign the 1,087 observations who were mobile between groups one and two to group two since the line between a labourer and a husbandmen was rather small. We also assigned those mobile between groups two and three to group three (463 obs.) and those mobile between groups three and four to group four (368 obs.). For groups five, six and seven, a more nuanced approach was required. For the farmers, group five, it made more sense to merge them with men who were mobile between group two, husbandmen, and five since both were agricultural occupations (230 obs.). Likewise, assigning those mobile between groups four and six to group six made sense because there would obviously be mobility between traders and merchants and small scale proprietors and larger scale proprietors (578 obs.). Finally, we assigned men mobile between group five and seven and group six and seven to group seven. There would obviously be some crossover between farmers, professionals and gentry, but if a person was ever ascribed an occupation of being a gentleman or esquire, they were likely to be a member of the gentry whatever their occupation recorded elsewhere in their life (91 and 232 obs.). All other individuals experiencing mobility were placed in the unknown occupation category.

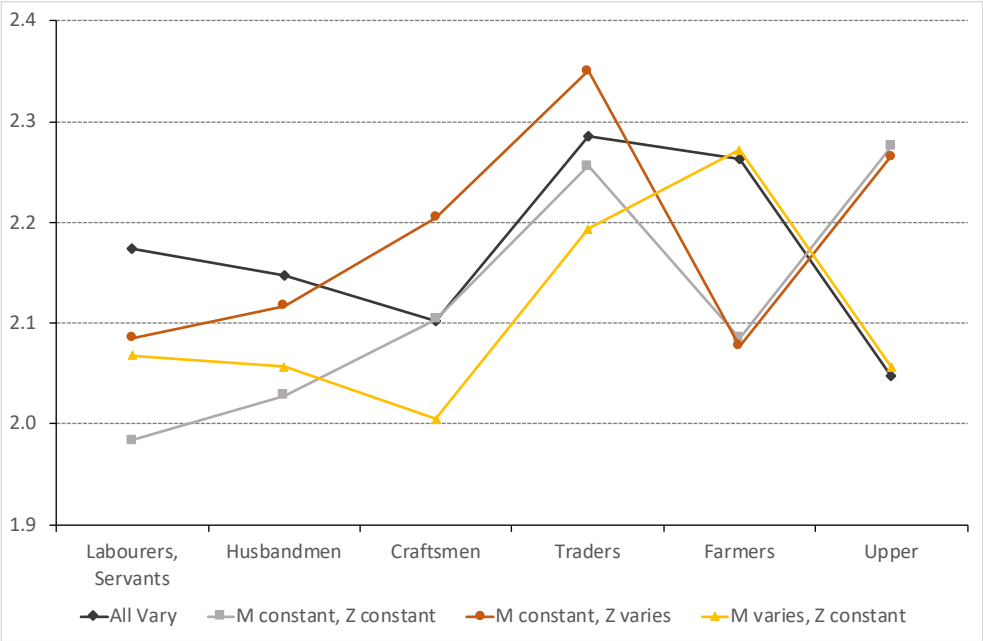
Lowest occupation of father	Highest occupation of father: 1	2	3	4	5	6	7
1	17666	1087	624	330	187	229	37
	87.6%	5.4%	3.1%	1.6%	0.9%	1.1%	0.2%
2	0	11827	463	168	230	139	28
		92.0%	3.6%	1.3%	1.8%	1.1%	0.2%
3	0	0	14440	368	38	236	43
			95.5%	2.4%	0.3%	1.6%	0.3%
4	0	0	0	7904	129	578	96
				90.8%	1.5%	6.6%	1.1%
5	0	0	0	0	3528	78	91
					95.4%	2.1%	2.5%
6	0	0	0	0	0	3516	232
						93.8%	6.2%
7	0	0	0	0	0	0	1581
							100%

Note: The individuals in the table above do not represent individual men. Instead, they represent the occupations of fathers in the dataset. Thus, a farmer who remained a farmer across his life cycle and had six children is counted in the table six times. Gray areas represent the persons to whom we actually assign an occupation. White areas are assigned as unknown occupation.

Table C.1: Reassigning Fathers Mobile Between Social Groups

D Decomposing the Extensive Margin

We can decompose the influence of the extensive margin on fertility differences across social groups more precisely by testing the influence of childlessness and celibacy separately. Figure D.1 replicates the gray reproduction rates produced in Figure 4 showing the difference between holding the extensive margin constant and allowing it to vary. In addition to these two lines, we have now added a line that holds the marriage rate constant while allowing all other margins to vary (orange line) and a line that holds the childlessness rate constant while allowing all other margins to vary. This figure suggests that allowing childlessness to vary increases the fertility of the lower classes but does not substantially influence the net reproduction of farmers and the upper classes. Allowing marriage rates to vary has a greater influence on the social gradient in net reproduction and is responsible for the much lower net reproduction of the upper classes. Thus, marriage, rather than childlessness, drives social differences in net fertility.



Note: Data from Table F.1.

Figure D.1: Decomposing the Extensive Margin: Net Reproduction Rates Across Social Groups

E Simple Count of Surviving Children by Social Group

One of the key features of our analysis is to break down net fertility into its four margins (see Section 2). However, one might wonder whether the net fertility gradient that we estimate is similar to what would arise simply from counting the number of surviving children of all women born to fathers in a given social group. This would incorporate the intensive and extensive margin because single and married women would be counted alike. This appendix performs this simple count. However, the calculation is quite restrictive because, as mentioned in the main text, we can only observe life-long single women among non-migrant women, i.e. those who are born and die in the same parish. Thus, the starting point for this calculation is the subsample of women in the $m(c)$ calculation as reported in Table A.2. For these women, we count the number of children surviving to 15 that each has. Single and childless women have zero children. We then report the mean number of children per woman by the woman's father's occupation rather than the husband's occupation which we use to compute $z(c)$, $b(c)$ and $d(c)$ above. We have to use the father's occupation because life-long single women do not have a husband's occupation.

The results are presented in Table E.1. We find a very similar gradient to the one reported in Figure 4 and Table F.1. The upper classes have the lowest net fertility rate; the middle classes of traders and farmers have the highest; and the lower classes were somewhere in between. These figures are lower than our estimates of $n(c)$ for a couple of reasons. Most importantly, restricting the calculations to non-migrants may mean that single women dying before marriage are over-represented in this sample since women who migrated short distances for marriage are excluded. This helps explain the very large share of women in the sample that never have children. However, in this case, we are more interested in the comparative level of fertility across groups rather than the overall fertility level, so this is not a problem for our analysis.

Occupation	Number of observations	Average number of children per women
Labourers / Servants	988	1.393
Husbandmen	771	1.319
Craftsmen	869	1.224
Traders	409	1.555
Farmers	264	1.462
Upper class	366	0.839
Unknown occupations	5340	1.217
All	9007	1.253

Note: Mean number of children surviving to age 15 born to women whose fathers were in the reported social group.

Table E.1: Simple Count of Surviving Children by Social Group

F Uncertainty Surrounding the Estimates - Details

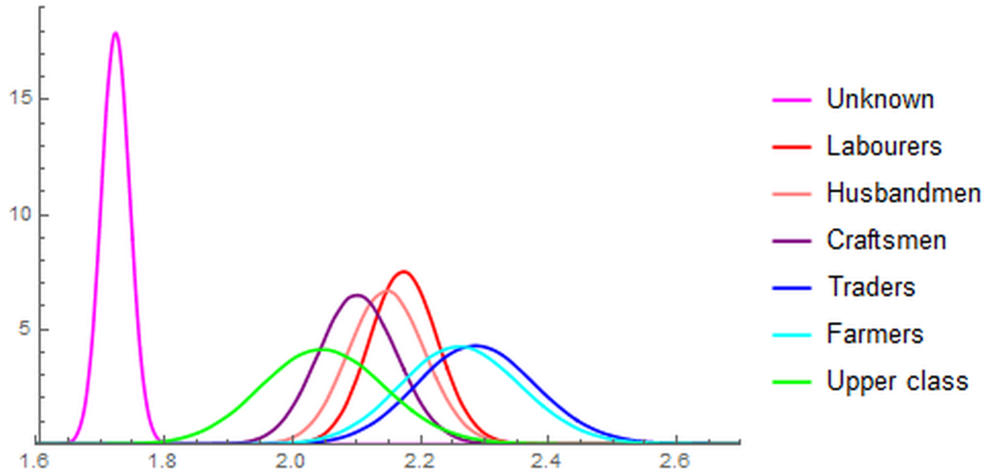
In order to measure the uncertainty surrounding our estimates of net reproduction for the various class groups, we simulate and accumulate the errors for the four margins using the estimates and standard errors from the regressions as described in Section 4.6 in the main text. Table F.1 summarizes the various moments involved. Figure F.1 plots smooth kernel densities for the sampling distribution for $n(c)$ for each occupational group. As noted in the text, the unknown occupational group has much lower net reproduction partially because of biases that arise from the sources of occupations discussed at length in Section 5.3 in the main text and in Appendix L. It has a narrower distribution because of the much larger sample size for this group than the others.

We next aggregate the social classes into three larger groups as follows: the lower class includes Labourers, Servants, Husbandmen, and Craftsmen; the middle class includes Traders and Farmers and the upper class includes Merchants, Professional and Gentry. We exclude the group with unknown occupations. Figure F.2 plots the corresponding smooth kernel histograms of the values for $n(c)$. Table F.2 reports one-tailed mean difference tests of statistical signifance between the three groups. We find that the difference in net reproduction between the middle-class and upper-class group was statistically significant, but the other differences between groups were not quite statistically significant.

	$m(c)$	$1-z(c)$	$b(c)$	$1-d(c)$	$n(c)$	$\bar{n}(c)$
Mean	0.77	0.87	3.76	0.75	1.90	1.90
Labourers, Servants	0.80	0.92	3.91	0.75	2.17	1.98
Husbandmen	0.78	0.91	3.99	0.75	2.15	2.03
Craftsmen	0.74	0.91	4.19	0.75	2.10	2.10
Traders	0.75	0.91	4.53	0.74	2.29	2.26
Farmers	0.84	0.87	4.11	0.75	2.26	2.09
Upper class	0.70	0.87	4.58	0.74	2.05	2.27
Unknown	0.77	0.85	3.50	0.75	1.72	1.77

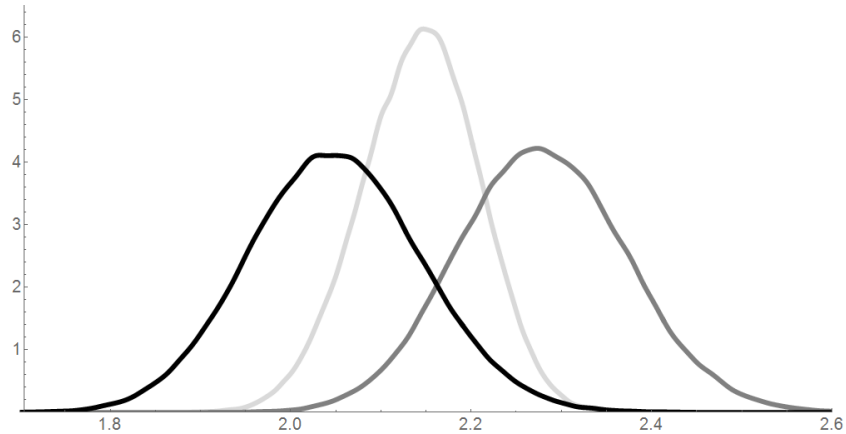
Note: $n(c)$ and $\bar{n}(c)$ computed from Equations (1) and (6) respectively.

Table F.1: Computed Reproductive Rates - n and $\bar{n}$



Note: Lower class includes Labourers, Servants, Husbandmen, and Craftsmen. Middle class includes Traders and Farmers.

Figure F.1: Sampling distributions of $n(c)$ by social class



Note: Lower class includes Labourers, Servants, Husbandmen, and Craftsmen. Middle class includes Traders and Farmers.

Figure F.2: Sampling distributions of $n(c)$ by social class (black=upper, gray=middle, light gray=lower)

	Lower Classes	Middle Classes	Upper Classes
Lower Classes		0.14	0.09
		(0.11)	(0.21)
Middle Classes			0.23
			(0.04)

Note: Mean net reproduction gap between groups from the simulation with one-tailed p-value on mean difference in parentheses.

Table F.2: Tests of statistical significance on mean differences between groups

G Fertility Differences across Social Groups and the Composition of the Population

One might question whether fertility differentials between groups were really large enough to have important quantitative effects on the relative representation of the groups in the economy over time. To test whether this was the case, we do some simple back-of-the-envelope calculations to see how fertility differences might have mattered. We look at the shares of children in each successive generation for ten generations. This is based on the assumption that the average generation is 30 years in length and our data cover just over 300 years, 1541-1851. We use the shares of individuals with known occupations from Table A.2 times one thousand as the notional population sizes for the fifth generation so that the shares in the reconstitution data reflect the mean share across all ten generations. We then assume that half the population of each group are women and multiply the number of women by the net reproduction rate $n(c)$ from Table F.1, producing the number of individuals in the subsequent generation, i.e.

$$Pop_g = \frac{Pop_{g-1}}{2} \times n(c)$$

The notional population levels and relative representation of each social group are presented in Tables G.1 and G.2. The relative representation of husbandmen, craftsmen and the upper classes fall across the generations, while the relative representation of labourers and servants remains fairly stable. However, the relative representation of traders and farmers increases substantially. As Table G.3 shows, this leads the middle classes to increase their share from 13.7% in generation zero to 23.6% in generation ten. This is a very large increase for a pre-Industrial, agricultural economy, as England was in 1541. The lower and upper classes decline as a whole. Thus, the differences in fertility that we measure could have strong effects on the relative representation of various groups in society over time and can explain in part the rising share of people working in middle class occupations over time.

Generation	Labourers, Servants	Husbandmen	Craftsmen	Traders	Farmers	Upper
0	73	60	75	23	16	36
1	79	65	79	26	18	37
2	86	70	83	30	20	38
3	93	75	87	34	23	39
4	101	80	91	39	26	40
5	110	86	96	45	29	41
6	120	92	101	51	33	42
7	130	99	106	59	37	43
8	141	106	111	67	42	44
9	153	114	117	77	48	45
10	167	123	123	88	54	46

Note: We set the average shares in our data as the shares in the fifth generation so that the average share across generations is equal to the average in the reconstitution dataset. We then calculate the population of each social group by assuming half the population of each group are women and ascribing our predicted net reproduction rates $n(c)$ to each group.

Table G.1: Notional Population of the Social Groups across 10 generations

Generation	Labourers, Servants	Husbandmen	Craftsmen	Traders	Farmers	Upper
0	25.6	21.3	26.5	8.2	5.5	12.9
1	26.0	21.3	25.9	8.7	5.8	12.3
2	26.3	21.3	25.4	9.2	6.1	11.7
3	26.5	21.3	24.8	9.8	6.5	11.1
4	26.8	21.2	24.2	10.4	6.8	10.6
5	27.0	21.1	23.6	11.1	7.1	10.1
6	27.2	21.0	23.0	11.7	7.5	9.6
7	27.4	20.9	22.4	12.4	7.8	9.1
8	27.6	20.8	21.7	13.1	8.2	8.6
9	27.7	20.6	21.1	13.8	8.6	8.1
10	27.8	20.4	20.5	14.6	9.0	7.7

Note: See Table G.1 and text for details of the calculations.

Table G.2: Predicted Relative Representation (%) of Each Social Group Across 10 Generations

Generation	Lower	Middle	Upper
0	73.4	13.7	12.9
1	73.2	14.5	12.3
2	72.9	15.4	11.7
3	72.6	16.3	11.1
4	72.2	17.2	10.6
5	71.7	18.2	10.1
6	71.2	19.2	9.6
7	70.7	20.2	9.1
8	70.1	21.3	8.6
9	69.4	22.4	8.1
10	68.7	23.6	7.7

Note: See Table G.1 and text for details of the calculations.

Table G.3: Predicted Relative Representation (%) of the Lower, Middle and Upper Classes Across 10 Generations

H Removing Late Marriages from the Sample

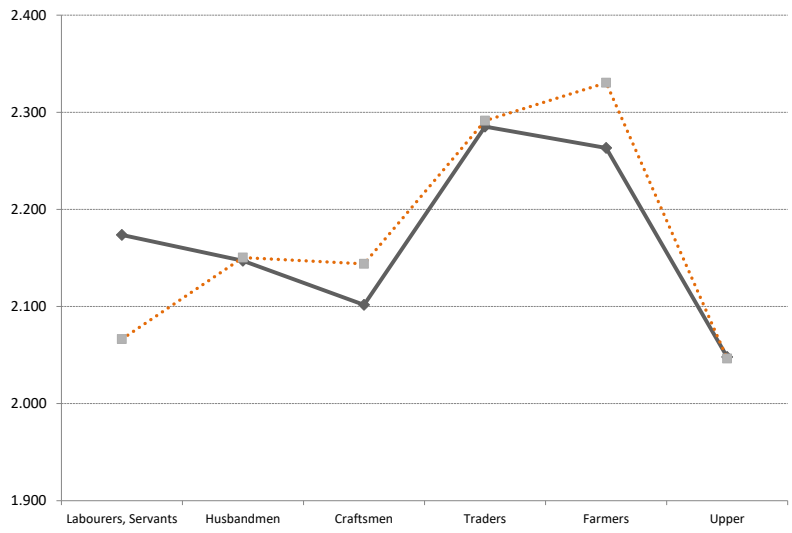
One of the interesting findings of Clark and Cummins (2015) and Boberg-Fazlic, Sharp, and Weisdorf (2011) was that the survival advantage of the rich began to decline after the 1780s as the rich began to control their fertility and opt for smaller families. Although we have included time dummies in our analysis, one might wonder whether part of our low net reproduction result for the upper classes could be related to this early decline in fertility among the upper classes. To assuage fears of this, we have redone all of the regressions and calculations for our baseline excluding marriages after 1780. The social gradient that we found is very similar suggesting that our results are not being exclusively driven by reductions in fertility among the wealthy in this later period (see Table H.1 and Figure H.2). In fact the hump-shaped gradient is even more accentuated.

We also performed the simulations to understand the uncertainty around these estimates. Figure H.2 plots the sampling distributions of the net reproduction for each of the three classes. The standard errors on the estimates did increase since the sample size was reduced by removing the later marriages. However, the higher net reproduction point estimate for farmers shifts the middle class distribution upward. Now the difference in net reproduction between the middle class and upper class on the one hand and between the middle class and lower class are both statistically significant on a one-sided test of mean differences (see Table H.2). The upper class and lower class were not statistically different.

	$m(c)$	$1-z(c)$	$b(c)$	$1-d(c)$	$n(c)$	$\bar{n}(c)$
Mean	0.77	0.87	3.73	0.74	1.87	1.87
Labourers, Servants	0.79	0.91	3.84	0.74	2.07	1.92
Husbandmen	0.79	0.91	4.03	0.75	2.15	2.04
Craftsmen	0.76	0.92	4.19	0.74	2.14	2.09
Traders	0.76	0.91	4.54	0.73	2.29	2.25
Farmers	0.86	0.88	4.12	0.74	2.33	2.07
Upper Class	0.70	0.87	4.58	0.73	2.05	2.25
Unknown	0.77	0.85	3.46	0.75	1.70	1.75

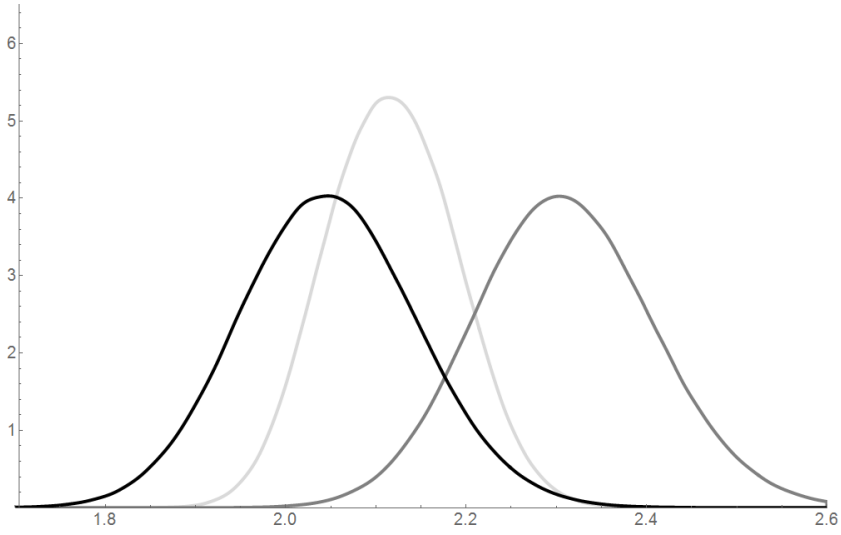
Note: $n(c)$ and $\bar{n}(c)$ computed from Equations (1) and (6) respectively.

Table H.1: Computed Reproductive Rates - n and $\bar{n}$ - Restricted Sample



Note: solid, benchmark, dotted, excluding marriages after 1780.

Figure H.1: Net reproduction rates $n(c)$ with and without late marriages



Note: Lower class includes Labourers, Servants, Husbandmen, and Craftsmen. Middle class includes Traders and Farmers. Sample restricted to marriages before 1780.

Figure H.2: Sampling distributions of $n(c)$ by social class (black=upper, gray=middle, light gray=lower)

	Lower Classes	Middle Classes	Upper Classes
Lower Classes		0.19	0.07
		(0.05)	(0.28)
Middle Classes			0.26
			(0.03)

Note: Mean net reproduction gap between groups from the simulation with one-tailed p-value on mean difference in parentheses.

Table H.2: Tests of statistical significance on mean differences between groups excluding marriages after 1780

I Robustness: Non-Random Censoring

The Cox model assumes that censoring is independent of survival time. It might be difficult to defend this assumption in the context of childlessness: it is reasonable to assume that the probability of the mother dying (censoring) is dependent on the time she remains without a child (survival time). One can easily think of medical conditions that affect both.

We relax the independent censoring assumption in the Cox proportional hazard model using the γ-imputation method proposed by Jackson et al. (2014). The procedure generates hypothetical datasets where individuals who were censored now have a hypothetical survival, under the assumption that at the point of censoring the hazard function jumps by a constant γ. If $\gamma < 0$, which is the relevant case for our problem, there is decreased risk (of having one child) after censoring. By varying the size and magnitude of this constant γ, and reestimating the model under this condition, sensitivity analyses can be performed. Table I.1 reports results obtained with the `InformativeCensoring` `R` library described in Burkoff et al. (2016). Obviously, the coefficients of interest are barely affected by the choice of γ because of the small number of observations which are effectively subject to censoring because of early death. Thus, the fact that censoring may not be independent of the survival time does not influence our results in practice.

	(1) benchmark	(2) $\gamma = -5$	(3) $\gamma = -0.5$	(4) $\gamma = -0.1$
Husbandmen	−0.030	−0.033	−0.030	−0.030
	(0.051)	(0.040)	(0.041)	(0.041)
Craftsmen	−0.013	−0.013	−0.013	−0.013
	(0.050)	(0.039)	(0.040)	(0.040)
Traders	−0.038	−0.024	−0.034	−0.038
	(0.064)	(0.051)	(0.052)	(0.051)
Farmers	−0.203***	−0.200***	−0.204***	−0.205***
	(0.079)	(0.053)	(0.062)	(0.062)
Upper Class	−0.204***	−0.212***	−0.206***	−0.204***
	(0.060)	(0.053)	(0.053)	(0.053)
Unknown Occupation	−0.284***	−0.294***	−0.287***	−0.285***
	(0.038)	(0.032)	(0.032)	(0.032)
Observations	14,730	14,730	14,730	14,730

Note: Dependent variable is risk of first birth. Reference category is Labourers/Servants. 26 parish dummies and 4 period dummies are included. *p<0.1; **p<0.05; ***p<0.01

Table I.1: $z(c)$. Relaxing independent censoring with γ-imputation method

J Robustness: In-migrants vs. Non-migrants

In this appendix, we explore whether migration poses a potential threat to the social gradient in fertility that we found in our main results. As mentioned in the text, the only migrants that we can observe demographic behaviour for in our sample are those who move into our parish upon marriage, i.e. those individuals with missing baptism dates, but known marriage and burial dates. However, aside from the urban migrants, these migrants are likely similar to those leaving our parishes and heading to similar parishes. To this end, we examine how the social gradients of three of our margins of female fertility looked for in-migrants compared to non-migrants. We can measure differences across three of our margins, but unfortunately we cannot measure celibacy for in-migrants because we cannot be sure that individuals moving into the parish were not married before migrating and we would not observe their father's occupation.

We break our migrants into three groups: a mother in-migrant father non-migrant group; a mother non-migrant father in-migrant group; and a final group where both husband and wife were in-migrants. To test whether migration influenced demographic behaviour, we introduce a dummy variable for each migrant group and interact that dummy variable with the social groups dummies in the regressions to test for differences between migrants and non-migrants across the social groups.

Table J.1 presents the results for childlessness. Column 1 shows the baseline results from table 1 above. Columns 2, 3 and 4 show the results for in-migrant mothers, in-migrant fathers and both husband and wife in-migrant respectively. Controlling for various types of in-migrants did not substantially change the coefficients on the initial social groups. There were significant differences in childlessness for certain groups of migrants. For instance, in-migrant fathers were less likely to be childless, and families where both husband and wife were in-migrants were more likely to be childless. However, on the whole there were no significant differences between the social gradient of non-migrants and in-migrants. There are a few possible explanations for why joint in-migrant couples might have had higher rates of childlessness. First, we limit the data to first marriages only in an attempt to limit the maternal age and parity effects that could come with second marriages. Second, it is possible that in-migrants married at later ages than their non-migrant counterparts. Since female sterility is strongly linked to age, this would naturally increase childlessness rates. Unfortunately, we do not know the ages of in-migrant mothers because we do not observe their baptism date, so it is impossible to test this directly. However, as Ruggles (1992) notes, out-migration in reconstitution data can bias certain estimates such as mean age at marriage and life expectancy even if the characteristics and demographic rates of out-migrants and non-migrants were the same. This is because if the probability of migrating is renewed each year for all individuals at the same rate before and after marriage, then the overall probability of migrating out of the parish before marriage is greater for people who marry at older ages. Thus, the mean age of marriage for people in a parish may be an underestimate of the mean age including all out-migrants. This means that it is possible that our in-migrants (out-migrants from elsewhere) were older than the non-migrants who married in the parish. Ruggles showed that this effect could be large, but Wrigley (1994) conducted some additional tests with the actual reconstitution data and found that the bias of out-migration on marriage ages was very small. In the end, this could explain our higher childlessness rates and lower marital fertility (seen below), but we cannot be sure.

Tables J.2 and J.3 present the results of the same exercise for the parity progression ratio from one to two children and two to three children. Again, there are very few substantial differences in the social gradient between migrants and non-migrants and controlling for the various types of migrants does not alter the coefficients for non-migrants very much.

Table J.4 presents the results for the mortality rate of children under the age of 15. In-migrants couples had moderately higher mortality levels for children, but there were no statistically significant differences between non-migrants and in-migrants of each specific social group. Thus, our social gradient remains intact.

In conclusion, there were some relatively minor differences in the margins of female fertility between in-migrants and non-migrants. However, there is no significant social gradient to these effects, so not accounting for migration does not seem to strongly influence at least these three margins of reproductive success.

Dependent variable: Risk of first birth	(1) benchmark	(2) mother only	(3) father only	(4) both parents
Unknown Occupation	-0.284^{***}	-0.265^{***}	-0.275^{***}	-0.305^{***}
	(0.032)	(0.035)	(0.035)	(0.037)
Husbandmen	-0.030	-0.027	-0.002	-0.047
	(0.041)	(0.047)	(0.045)	(0.048)
Craftsmen	-0.013	-0.013	-0.008	-0.050
	(0.039)	(0.044)	(0.044)	(0.045)
Traders	-0.038	-0.014	-0.055	-0.069
	(0.051)	(0.058)	(0.056)	(0.059)
Farmers	-0.203^{***}	-0.203^{***}	-0.204^{***}	-0.249^{***}
	(0.062)	(0.072)	(0.066)	(0.069)
Upper Class	-0.204^{***}	-0.190^{***}	-0.161^{***}	-0.269^{***}
	(0.053)	(0.058)	(0.058)	(0.059)
Mother Migrant		0.040		
		(0.067)		
Unknown Occupation:Mother Migrant		-0.098		
		(0.073)		
Husbandmen:Mother Migrant		-0.024		
		(0.097)		
Craftsmen:Mother Migrant		-0.005		
		(0.097)		
Traders:Mother Migrant		-0.114		
		(0.123)		
Farmers:Mother Migrant		-0.014		
		(0.142)		
Upper Class:Mother Migrant		-0.088		
		(0.138)		
Father Migrant			0.131^{*}	
			(0.069)	
Unknown Occupation:Father Migrant			-0.048	
			(0.075)	
Husbandmen:Father Migrant			-0.156	
			(0.110)	
Craftsmen:Father Migrant			-0.028	
			(0.101)	
Traders:Father Migrant			0.171	
			(0.140)	
Farmers:Father Migrant			0.096	
			(0.190)	
Upper Class:Father Migrant			-0.228^{*}	
			(0.133)	
Both Migrant				-0.275^{***}
				(0.062)
Unknown Occupation:Both Migrant				0.070
				(0.066)
Husbandmen:Both Migrant				0.041
				(0.093)
Craftsmen:Both Migrant				0.103
				(0.093)
Traders:Both Migrant				0.076
				(0.121)
Farmers:Both Migrant				0.130
				(0.158)
Upper Class:Both Migrant				0.231^{*}
				(0.129)
Observations	14,730	14,730	14,730	14,730

Note: Dependent variable is risk of first birth. Reference category is Labourers/Servants. 26 parish dummies and 4 period dummies are included. *p<0.1; **p<0.05; ***p<0.01

Table J.1: Cox Model. Risk of first birth $z(c)$: baseline vs. in-migrant mothers, in-migrant fathers and in-migrant couples interactions

Dependent variable: Risk of second birth	(1) benchmark	(2) mother only	(3) father only	(4) both parents
Unknown Occupation	-0.070^{**}	-0.021	-0.069^{*}	-0.030
	(0.035)	(0.045)	(0.038)	(0.040)
Husbandmen	0.099^{**}	0.157^{***}	0.101^{**}	0.125^{**}
	(0.044)	(0.060)	(0.048)	(0.051)
Craftsmen	0.126^{***}	0.181^{***}	0.105^{**}	0.170^{***}
	(0.042)	(0.056)	(0.047)	(0.048)
Traders	0.182^{***}	0.265^{***}	0.160^{***}	0.236^{***}
	(0.055)	(0.074)	(0.060)	(0.062)
Farmers	0.196^{***}	0.165^{*}	0.207^{***}	0.181^{**}
	(0.065)	(0.086)	(0.069)	(0.072)
Upper Class	0.197^{***}	0.120^{*}	0.210^{***}	0.158^{**}
	(0.057)	(0.072)	(0.062)	(0.064)
Mother Migrant		-0.022		
		(0.058)		
Unknown Occupation:Mother Migrant		-0.110^{*}		
		(0.063)		
Husbandmen:Mother Migrant		-0.118		
		(0.087)		
Craftsmen:Mother Migrant		-0.133		
		(0.085)		
Traders:Mother Migrant		-0.185^{*}		
		(0.110)		
Farmers:Mother Migrant		0.074		
		(0.129)		
Upper Class:Mother Migrant		0.218^{*}		
		(0.116)		
Father Migrant			-0.024	
			(0.074)	
Unknown Occupation:Father Migrant			-0.001	
			(0.081)	
Husbandmen:Father Migrant			-0.021	
			(0.120)	
Craftsmen:Father Migrant			0.118	
			(0.109)	
Traders:Father Migrant			0.145	
			(0.148)	
Farmers:Father Migrant			-0.106	
			(0.199)	
Upper Class:Father Migrant			-0.072	
			(0.144)	
Both Migrant				-0.019
				(0.066)
Unknown Occupation:Both Migrant				-0.149^{**}
				(0.072)
Husbandmen:Both Migrant				-0.113
				(0.100)
Craftsmen:Both Migrant				-0.210^{**}
				(0.100)
Traders:Both Migrant				-0.244^{*}
				(0.131)
Farmers:Both Migrant				0.095
				(0.164)
Upper Class:Both Migrant				0.227
				(0.138)
Observations	12,519	12,519	12,519	12,519

Note: Dependent variable is risk of second birth. Reference category is Labourers/Servants. 26 parish dummies and 4 period dummies are included. *p<0.1; **p<0.05; ***p<0.01

Table J.2: Cox Model. Risk of second birth: baseline vs. in-migrant mothers, in-migrant fathers and in-migrant couples interactions

Dependent variable: Risk of third birth	(1) benchmark	(2) mother only	(3) father only	(4) both parents
Unknown Occupation	-0.102^{***}	-0.108^{***}	-0.088^{**}	-0.126^{***}
	(0.038)	(0.041)	(0.041)	(0.043)
Husbandmen	0.070	0.103^{*}	0.056	0.062
	(0.048)	(0.054)	(0.052)	(0.054)
Craftsmen	0.047	0.046	0.065	0.036
	(0.046)	(0.051)	(0.050)	(0.051)
Traders	0.166^{***}	0.214^{***}	0.172^{***}	0.130^{*}
	(0.059)	(0.066)	(0.064)	(0.067)
Farmers	0.117^{*}	0.113	0.114	0.077
	(0.069)	(0.080)	(0.074)	(0.077)
Upper Class	0.180^{***}	0.120^{*}	0.192^{***}	0.147^{**}
	(0.061)	(0.067)	(0.067)	(0.069)
Mother Migrant		−0.005		
		(0.078)		
Unknown Occupation:Mother Migrant		0.027		
		(0.085)		
Husbandmen:Mother Migrant		−0.129		
		(0.113)		
Craftsmen:Mother Migrant		0.004		
		(0.112)		
Traders:Mother Migrant		−0.204		
		(0.144)		
Farmers:Mother Migrant		0.013		
		(0.159)		
Upper Class:Mother Migrant		0.404^{**}		
		(0.158)		
Father Migrant			0.060	
			(0.080)	
Unknown Occupation:Father Migrant			−0.083	
			(0.088)	
Husbandmen:Father Migrant			0.123	
			(0.126)	
Craftsmen:Father Migrant			−0.093	
			(0.117)	
Traders:Father Migrant			−0.031	
			(0.160)	
Farmers:Father Migrant			0.060	
			(0.213)	
Upper Class:Father Migrant			−0.065	
			(0.157)	
Both Migrant				-0.192^{***}
				(0.073)
Unknown Occupation:Both Migrant				0.081
				(0.079)
Husbandmen:Both Migrant				0.008
				(0.110)
Craftsmen:Both Migrant				0.006
				(0.111)
Traders:Both Migrant				0.122
				(0.142)
Farmers:Both Migrant				0.156
				(0.175)
Upper Class:Both Migrant				0.116
				(0.150)
Observations	10,738	10,738	10,738	10,738

Note: Dependent variable is risk of third birth. Reference category is Labourers/Servants. 26 parish dummies and 4 period dummies are included. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table J.3: Cox Model. Risk of third birth: baseline vs. in-migrant mothers, in-migrant fathers and in-migrant couples interactions

Dependent variable: Risk of death	(1) benchmark	(2) mother only	(3) father only	(4) both parents
Unknown Occupation	0.001	0.002	−0.003	0.030
	(0.032)	(0.034)	(0.035)	(0.036)
Husbandmen	−0.001	0.008	−0.022	0.034
	(0.039)	(0.043)	(0.044)	(0.044)
Craftsmen	0.039	0.042	0.018	0.062
	(0.036)	(0.040)	(0.042)	(0.042)
Traders	0.067	0.116**	0.028	0.106**
	(0.046)	(0.050)	(0.053)	(0.053)
Farmers	0.004	−0.008	0.002	−0.012
	(0.062)	(0.071)	(0.068)	(0.069)
Upper Class	0.071	0.098*	0.047	0.078
	(0.048)	(0.051)	(0.055)	(0.055)
Mother Migrant		−0.025		
		(0.068)		
Unknown Occupation:Mother Migrant		−0.011		
		(0.075)		
Husbandmen:Mother Migrant		−0.044		
		(0.098)		
Craftsmen:Mother Migrant		−0.019		
		(0.096)		
Traders:Mother Migrant		−0.330**		
		(0.133)		
Farmers:Mother Migrant		0.053		
		(0.146)		
Upper Class:Mother Migrant		−0.252*		
		(0.148)		
Father Migrant			0.001	
			(0.058)	
Unknown Occupation:Father Migrant			0.017	
			(0.066)	
Husbandmen:Father Migrant			0.109	
			(0.091)	
Craftsmen:Father Migrant			0.105	
			(0.086)	
Traders:Father Migrant			0.207*	
			(0.112)	
Farmers:Father Migrant			0.007	
			(0.171)	
Upper Class:Father Migrant			0.112	
			(0.113)	
Both Migrant				0.122**
				(0.059)
Unknown Occupation:Both Migrant				−0.115*
				(0.066)
Husbandmen:Both Migrant				−0.148
				(0.091)
Craftsmen:Both Migrant				−0.093
				(0.086)
Traders:Both Migrant				−0.169
				(0.112)
Farmers:Both Migrant				0.160
				(0.159)
Upper Class:Both Migrant				−0.018
				(0.113)
Observations	48,514	48,514	48,514	48,514

Note: Dependent variable is risk of death. Reference category is Labourers/Servants. 26 parish dummies and 4 period dummies are included. *p<0.1; **p<0.05; ***p<0.01

Table J.4: Cox Model. Risk of child death ($d(c)$): baseline vs. in-migrant mothers, in-migrant fathers and in-migrant couples interactions

K Men's Reproductive Success

Although we have presented our baseline results in the main paper from the perspective of women, we are also able to produce the same statistics for men, and there is some reason to believe that these may actually be more accurate in reflecting fertility differences by occupational group. Because female occupations were very rarely recorded in parish records, we have to assign a woman's occupational class in relation to the men in her life. When calculating the marriage rate, we use her father's occupation, and for the other three margins, we use her husband's occupation. If there was not strong marital homogamy, there could be measurement error in the occupational groups, which might lead to a different pattern across groups.

Thus, we present the equivalent regression tables and graphs for men that we included in the original paper for women. In the case of men, there were a few additional issues that needed to be dealt with to estimate the results. First, men were nearly twenty times more likely to baptise children in a parish without having been married in the parish, i.e. we do not observe the father's marriage date. It seems that men would occasionally get married in their spouse's parish, but then return to their home parish to live. Thus, we count all men who returned to their parish of birth to baptise children as being married even if we do not observe their marriage date. However, we need a marriage date to estimate the risk of marriage, so we imputed their marriage date to be one year before the birth of their first child. We do not use these individuals in calculating $z(c)$ and $b(c)$ though because the results would be sensitive to our imputed marriage dates.

Another potential issue is remarriage since men could remarry and continue to produce offspring at much later ages than women. Remarriage would obviously not influence the celibacy, childlessness or child mortality margins, but it could potentially influence the marital fertility of wealth groups. However, given the data constraints in determining the marriage order of individuals and the minuscule differences in marriage order across wealth groups, described in Section 4.2 of the main text and in Table B.4, we proceed just using the births from first marriages. Excluding remarriage likely leads to an overstatement of childlessness rates in men since some men who had childless first marriages would go on to have children in a second marriage and underestimate marital fertility since the children in second marriages would not be counted.

Finally, we also update all factors that were specific to women for men, so we adjust the parity progression ratios for male mortality rather than female mortality. This is especially important since men would not have suffered the high death rates in childbirth that women did.

Table K.1 reports the regressions for $m(c)$, $z(c)$ and $d(c)$, the equivalent of table 1 above, and the predicted marriage rates and childless rates for men are presented next to the rates for women in figures K.1 and K.2. The greater celibacy and childlessness of the upper classes holds when looking at fertility for men. In fact, the gradients across classes are even larger. We also see that $b(c)$ for men has been shifted upward relative to women in figure K.3 although the gradient is more or less the same. This higher level of fertility then produces a higher net reproduction rate for men relative to women (figure K.5) when all of the calculations are completed. Overall, the general patterns of net reproduction remain. When the extensive margin is held at average levels, we find that the upper classes had higher fertility than the middle and lower classes (see Table K.2 and Figure K.5). However, when we allow the extensive margin to vary across

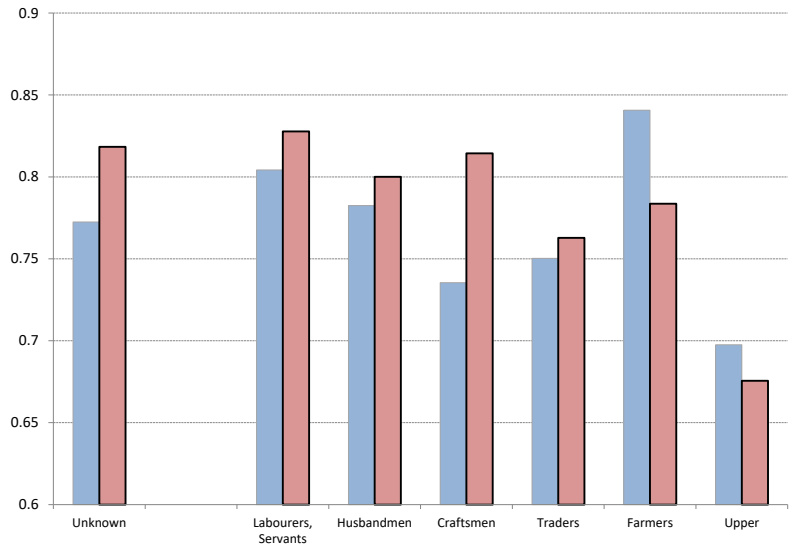
social groups, the upper classes have the lowest level of fertility by a large margin. Their net reproduction rate is far below the lower classes, and the middle classes maintain the highest net reproduction.

Similarly to what is done in Section F, we can assess the significativity of the results by simulation. Figure K.6 plots smooth kernel densities for the sampling distribution for $n(c)$ for the three groups (Low, Middle, and Upper social classes). It can be compared to Figure F.2. Table K.3 reports one-tailed mean difference tests of statistical significance between the three groups (comparable to Table F.2 for women). We find that the difference in net reproduction between the middle-class and upper-class group was statistically significant, as well as the gap between upper and lower classes.

	(1) risk of marriage $m(c)$	(2) risk of first birth $z(c)$	(3) risk of child death $d(c)$
Husbandmen	−0.089	−0.007	0.003
	(0.057)	(0.043)	(0.040)
Craftsmen	−0.044	0.003	0.038
	(0.055)	(0.041)	(0.038)
Traders	−0.201***	−0.015	0.093**
	(0.069)	(0.053)	(0.047)
Farmers	−0.139*	−0.237***	0.025
	(0.076)	(0.064)	(0.063)
Upper Class	−0.446***	−0.252***	0.088*
	(0.075)	(0.055)	(0.050)
Unknown Occupation	−0.031	−0.250***	−0.003
	(0.046)	(0.033)	(0.033)
Observations	11,080	13,292	45,887

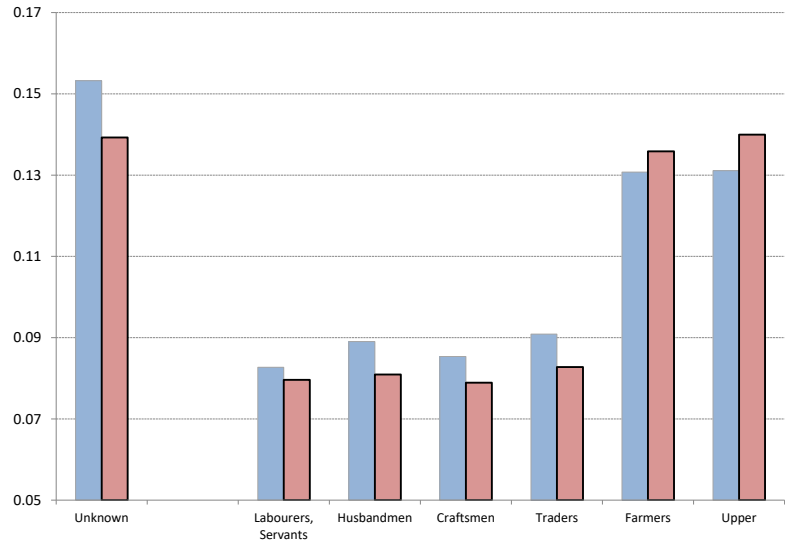
Note: Reference category is Labourers/Servants. 26 parish dummies and 4 period dummies are included. *p<0.1; **p<0.05; ***p<0.01

Table K.1: Cox Model. Analysis of $m(c)$, $z(c)$, $d(c)$ for men



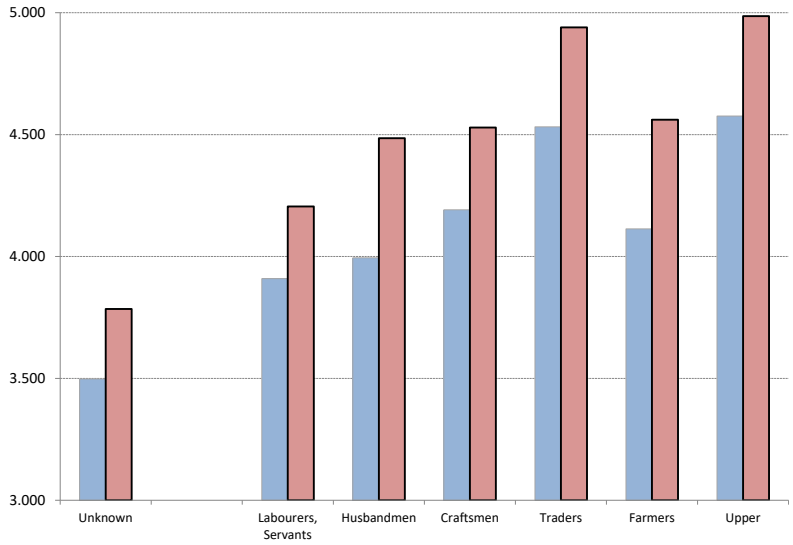
Note: filled blue, women; filled red with borders, men.

Figure K.1: Computed Marriage rates: the point of view of men



Note: filled blue, women; filled red with borders, men.

Figure K.2: Computed Childlessness Rate: the point of view of men



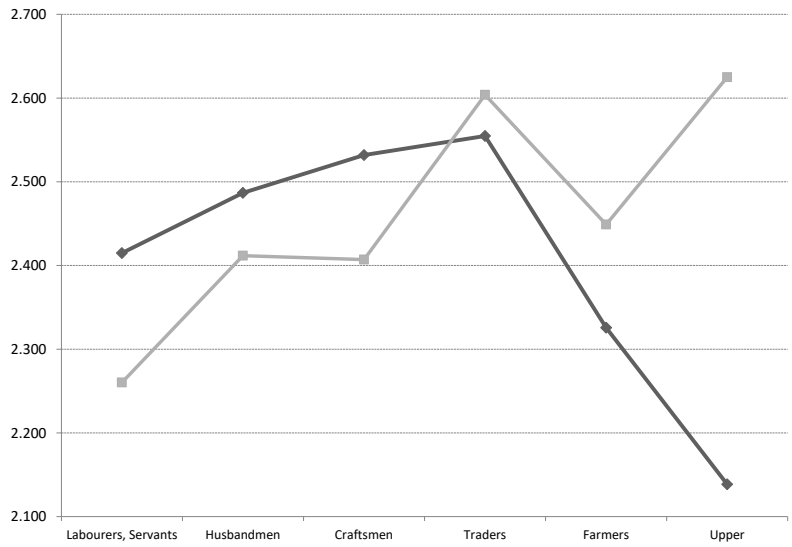
Note: filled blue, women; filled red with borders, men.

Figure K.3: Computed Births: the point of view of men

	$m(c)$	$1-z(c)$	$b(c)$	$1-d(c)$	$n(c)$	$\bar{n}(c)$
Mean	0.81	0.88	4.10	0.75	2.20	2.20
Labourers, Servants	0.83	0.92	4.21	0.75	2.41	2.26
Husbandmen	0.80	0.92	4.49	0.75	2.49	2.41
Craftsmen	0.81	0.92	4.53	0.75	2.53	2.41
Traders	0.76	0.92	4.94	0.74	2.55	2.60
Farmers	0.78	0.86	4.56	0.75	2.33	2.45
Upper	0.68	0.86	4.99	0.74	2.14	2.62
Unknown	0.82	0.86	3.78	0.75	2.01	2.03

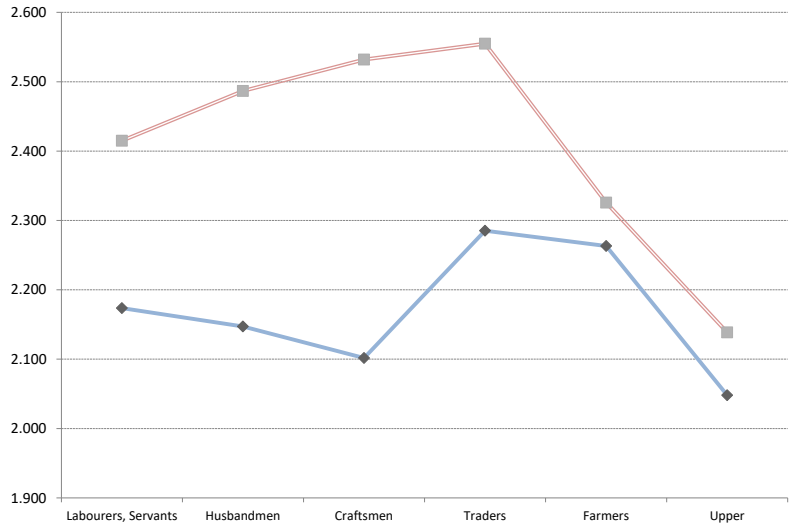
Note: $n(c)$ and $\bar{n}(c)$ computed from the point of view of men.

Table K.2: Computed Reproductive Rates - n and $\bar{n}$



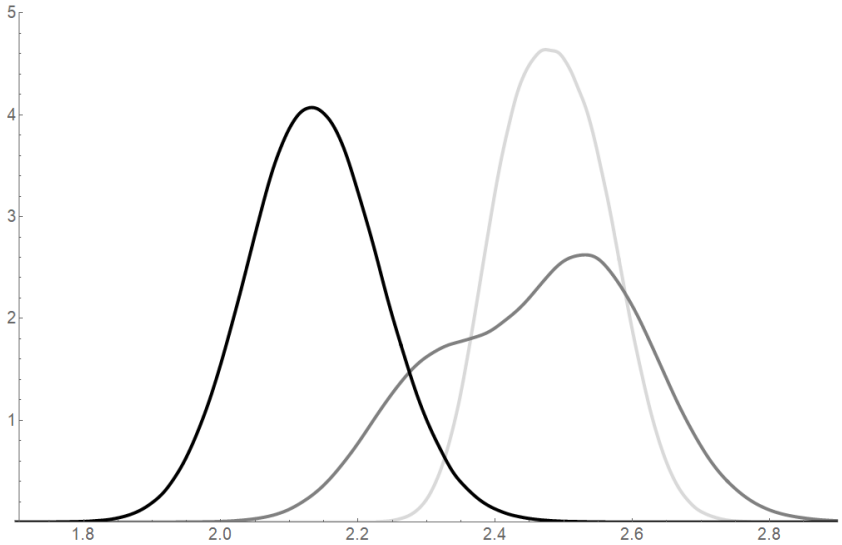
Notes: dark grey line: $n(c)$. light grey line: $\bar{n}(c)$. Data from Table K.2.

Figure K.4: Net reproduction rates Across Social Groups



Notes: blue, women; red, men.

Figure K.5: Net reproduction rates $n(c)$: the point of view of men



Note: Lower class includes Labourers, Servants, Husbandmen, and Craftsmen. Middle class includes Traders and Farmers.

Figure K.6: Sampling distributions of $n(c)$ for men by social class (black=upper, gray=middle, light gray=lower)

	Lower Classes	Middle Classes	Upper Classes
Lower Classes		-0.02	-0.35
		(0.45)	(0.00)
Middle Classes			0.32
			(0.03)

Note: Mean net reproduction gap between groups from the simulation with one-tailed p-value on mean difference in parentheses.

Table K.3: Tests of statistical significance on mean differences between groups

L Robustness: Source of Occupations

As mentioned before, the occupations in our data could have been recorded at three types of events: a marriage, a baptism of a child, and a death. For our general analysis, we did not distinguish between these three, but for the childlessness rates, we worried that the pattern across social groups could be skewed if we were more likely to observe an individual's occupation if they had children. This would be true if an individual's occupation was observed in a baptism register. Thus, in this robustness check, we limit the occupations to those given at marriage or burial, moving the other individuals into the unknown occupation category. Table L.1 shows what this implies for the sample size of the different groups.

The results of the Cox regression for the probability to move from zero to one child are presented in Table L.2. The first column is the one reported in the main text, while the second column is based on the alternative way of defining occupations. After removing the occupations obtained from baptism registers, all of the occupation groups become insignificant, though the basic gradient in childlessness remains across all classes. Farmers and the upper classes have much higher rates of childlessness although these rates are insignificant because of the smaller sample size under the restricted occupations. We also see a sharp decrease in the childlessness rate of couples of unknown occupation, which confirms our suspicion that the high rates of childlessness in this group were largely driven by this issue. We do not use this as our primary specification because the sample size for each occupational category shrinks a lot when restricting occupations, increasing the standard errors. Figure L.1 shows the average levels of childlessness between the two specifications and confirms these findings.

We also re-estimated all the parity progression ratios with the alternative definition of occupations and compute the gross fertility of women using Equation (5). As Figure L.2 shows, the source of occupations does not strongly influence the gross marital fertility of women in our dataset. The general class gradient remains the same or even becomes slightly more pronounced.

Figure L.3 displays the female net reproduction rates recalculated from all of the various regressions. The net reproduction of the lower classes decreases a bit since removing the baptism occupations increased their childlessness and decreased their fertility. However, the general gradient holds. The middle classes have higher net reproduction rates than the lower and upper classes. Thus, the source of occupations does not explain away the social gradient found in our baseline results.

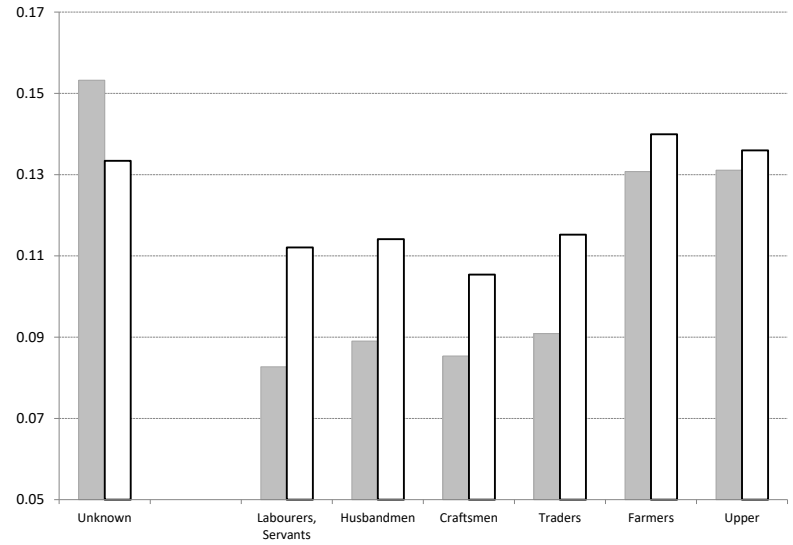
	benchmark	excluding occupations from baptism registry
Labourers, servants	1665	996
Husbandmen	1222	846
Craftsmen	1371	919
Traders	603	415
Farmers	379	241
Merchants, Professionals	406	359
Gentry	183	149
Unknown Occupation	8901	10805

Table L.1: Number of married women with known death date

	(1)	(2)
Dependent Variable: Risk of first birth	benchmark	excluding occupations from baptism registry
Husbandmen	−0.030	−0.008
	(0.041)	(0.051)
Craftsmen	−0.013	0.0278
	(0.039)	(0.050)
Traders	−0.038	−0.013
	(0.051)	(0.064)
Farmers	−0.203***	−0.107
	(0.062)	(0.079)
Upper Class	−0.204***	−0.092
	(0.053)	(0.060)
Unknown Occupation	−0.284***	−0.083*
	(0.032)	(0.038)
Observations	14,730	14,730

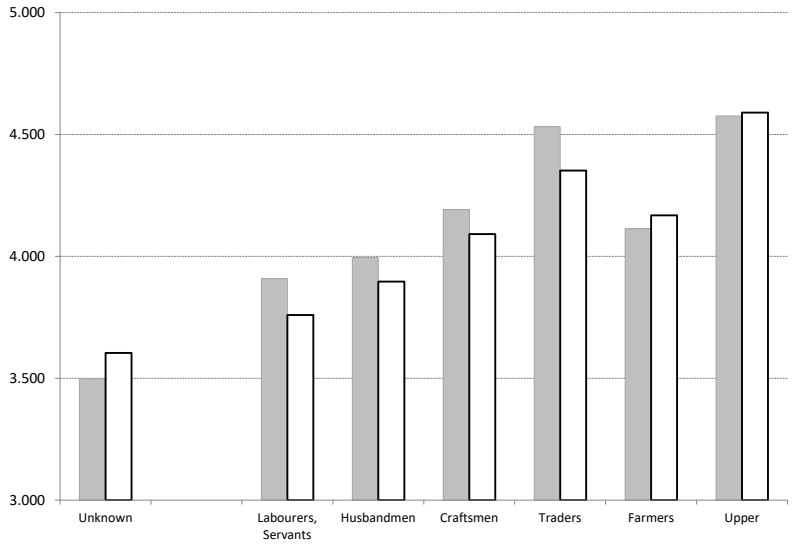
Note: Dependent variable is risk of first birth. Reference category is Labourers/Servants. 26 parish dummies and 4 period dummies are included. *p<0.1; **p<0.05; ***p<0.01

Table L.2: With and without Recording Occupations from Baptism Registry: $z(c)$



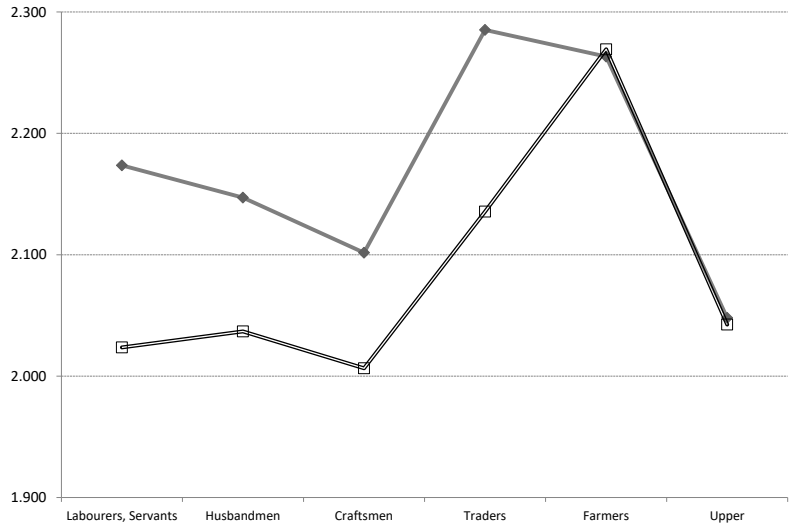
Note: filled grey, benchmark; solid white, alternative.

Figure L.1: Computed Childlessness Rate with Alternative Definition of Occupations



Note: filled grey, benchmark; solid white, alternative.

Figure L.2: Computed Births with Alternative Definition of Occupations



Note: filled grey, benchmark; solid white, alternative.

Figure L.3: Net reproduction rates $n(c)$ across Social Groups of the Baseline compared with the Sample Excluding Occupations from Baptism Registers

References

Boberg-Fazlic, Nina, Paul Sharp, and Jacob Weisdorf. 2011. "Survival of the richest? Social status, fertility and social mobility in England 1541-1824." *European Review of Economic History* 15:365–392.

Burkoff, Nikolas S., Paul Metcalfe, Jonathan Bartlett, and David Ruau. 2016. "Gamma imputation tutorial." mimeo.

Clark, Gregory, and Neil Cummins. 2015. "Malthus to modernity: wealth, status, and fertility in England, 1500–1879." *Journal of Population Economics* 28 (1): 3–29.

Jackson, Dan, Ian White, Shaun Seaman, Hannah Evans, Kathy Baisleyb, and James Carpenter. 2014. "Relaxing the independent censoring assumption in the Cox proportional hazards model using multiple imputation." *Statistics in Medicine* 33:4681–4694.

Ruggles, Steven. 1992. "Migration, Marriage, and Mortality: Correcting Sources of Bias in English Family Reconstitutions." *Population Studies* 46 (3): 507–522.

Wrigley, Edward Anthony. 1994. "The Effect of Migration on the Estimation of Marriage Age in Family Reconstitution Studies." *Population Studies* 48 (1): 81–97.