DO ABLER PARENTS HAVE FEWER CHILDREN?

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Abstract

The quality v quantity theory of fertility predicts that more able parents chose to produce fewer children because they wish to invest more in the education of their children. Using Mincer residuals to measure the unobserved ability of parents, data for Israel are used to show that given everything else more able parents tend to produce fewer children. This is true for fertility data and for birth hazards. Fertility is also found to depend upon social norms, education and child benefit.

Introduction

The trade-off between the quality and quantity of children has become an important focus of economic research, both in its own right and for its wider implications for economic growth (Galor and Moav 2002) and intergenerational mobility (Mulligan 1997). The basic idea, originally raised by Becker[1] has the following components. i) Human capital and ability are gross complements in the determination of labor productivity, implying that the return to education varies directly with ability. ii) Children inherit to some degree their parents' ability, so that more able parents tend to have more able children. iii) Parents are altruistic; their preferences are defined inter alia in terms of the number of children and their children's earning capacity. iv) Parents cannot raise capital on the security of their children's unproven ability.

Parents can predict, albeit imperfectly, their children's average ability via component ii. Component i implies that parents wish to invest more in their children's education if they are more able. In a perfect capital market parents would raise capital to finance their children's education, but due to component iv they do not have this option. So given component iii they bring fewer children into the world, and invest more in them. They prefer quality to quantity.

The quantity v quality theory (QQT) has two main empirically testable implications. First, more able parents invest more in the education of their children (QQT1). Secondly, more able parents have fewer children (QQT2). QQT predicts that better-off parents will tend to have better-off children. Since the intergenerational correlation coefficient for earnings is about 0.4 (Solon 1999), the data appear to be broadly consistent with QQT. However, this correlation on its own does not necessarily corroborate QQT1. If ability is inherited, or parents and children share common backgrounds, the earnings of parents and children will be correlated even if QQT1 is false.

Indeed, Shea (2000) rejects QQT1. He argues that the intergenerational correlation is entirely "genetic" or due to inherited ability. It does not mean that better-off parents invest more in their children. It simply means that more able parents, who are better-off as a

[1] The idea was first raised by Becker (1960), and developed in Becker and Lewis (1973). Becker and Tomes (1978) introduced heredity and intergenerational mobility into the model. See Becker (1991) for the most comprehensive statement of the thesis.

result, happen to have more able children, who are also better-off as a result. By contrast, Beenstock (2004) argues in favor of QQT1, although the causal effect is small. Mayer too (1997) claims that the empirical evidence supports QQT1, although she does not establish that the effect is unambiguously causal.

Empirical testing of QQT1 dates back to De Tray (1973). Rosenzweig and Wolpin (1980) used micro data on twin births in India to proxy exogenous increases in fertility. They showed that twin births lower the educational attainment of children in the family. Indeed, the empirical consensus in the US (Powell and Steelman 1993, Downey 1995) is that more quantity means less quality: controlling for parental and other covariates, the educational attainment of children varies inversely with the number of siblings. If, however, less able parents have less able children, and prefer more quantity to less quality, this empirical consensus may simply be picking up reverse causality. This is the conclusion of Guo and VanWey (1999), who use longitudinal data to conclude that there is no causal effect from the number of children to educational attainment. Conley (2000, 2004), on the other hand uses natural experimentation to show that there is an inverse causal effect from the number of siblings to the probability of parents providing private schooling for their children.

Whereas QQT1 has received substantial empirical attention, QQT2 has received no empirical attention at all. The focus in this paper is therefore upon QQT2. It is well known that education and fertility are inversely correlated, which seems to suggest that more able parents have fewer children. However, this correlation does not necessarily support QQT2. More educated women face a greater opportunity cost of raising children because their earning power is greater. They have fewer children, not because they prefer quality to quantity, but simply because the opportunity cost of their time is greater. A proper test of QQT2 must condition on parents' ability in addition to their education and other variables. QQT2 predicts that given everything else, including parents' education and income, more able parents have fewer children. This is what I set out to test empirically in the present paper.

It should be said that fertility theory goes well beyond the limited concerns of QQT2. Fertility is most probably influenced by social norms (Hammel 1990) as embodied in pro or anti-fertility cultures. It is more socially acceptable to have fewer children when peers do the same. Child benefit and related incentives may affect fertility. Gauthier and Hatzius (1997) claim that countries with more generous child benefit have slightly higher fertility. Manski and Mayshar (2003) have suggested that the unusually generous child benefit system in Israel may have increased fertility among ultra-religious (haredi) Jews and Bedouins, and encouraged welfare dependence[2]. They also suggest that social norms may be important.

A further issue is gender preferences. Parents may prefer boys to girls, either because the economic return to boys is greater, or because in more traditional societies boys may have advantages in the marriage market. Also, parents who have more than one child may prefer mixed sexes. They prefer a boy and a girl to two children of the same sex (Angrist and Evans 1998). Since parents cannot generally control the sex of their offspring, their fertility is likely to be path-dependent. A revealed preference for boys may be consistent with QQT1 if sons are a "better investment" than daughters because men have greater rates of participation in the labor market. QQT2 predicts that more able parents, whose firstborn happens to be male, will be less likely to have a second child because they plan to invest more in their son's education than had their firstborn been a girl.

1. Theory

In what follows C denotes consumption, W earnings, A ability, and N the number of children. Subscript p refers to parents and subscript c refers to their children. The utility function of parents is written generically as:

$$U_p = F(C_p, W_c, N; X) \qquad (1)$$

where X denotes a vector of controls discussed in section 4. Because parents are altruistic, $F_{Wc} > 0$. Also, given everything else parents like having children, hence $F_N > 0$. The utility function is assumed to be convex. In equation (1) parents are altruistic, but not as altruistic

[2] According to Berman (2000) the problem is deeper than this. The extraordinarily high fertility among the ultra-orthodox should be seen as a rejection of modernity. The generous child benefit system is a result and not a cause of haredi fertility. Since the mid 1990s Arabs with no military service have been eligible to national child benefit rates. Frish (2004) has been unable to find any change in fertility resulting from this natural experiment. In 2004 there was a radical cut in child benefit for large families. It remains to be seen whether this has any effect on fertility.

as in Barro and Becker (1988), who assume that parents are altruistic towards their entire dynasty. Also, in contrast to Mulligan (1997), parents are concerned about their children's earnings rather than their consumption. They see their responsibility as setting their children up in life, without being concerned with how their children allocate resources between themselves and their grandchildren. Nor do our "puritanical" parents leave bequests because they have no direct interest in their children's consumption. Their altruism is limited to helping their children acquire education so that they might earn more.

Earnings are assumed to vary directly with acquired human capital (H) and ability (A): W = J(H, A). The marginal product of human capital ($J`_H$ = MPH) is positive but decreasing (MPH` < 0), and ability and human capital are gross complements, i.e. MPH varies directly with A. The derivative of MPH/W with respect to A is denoted by ξ. If ability raises MPH by more than it raises W, then $\xi > 0$. If J( ) is linear homogeneous in A then $\xi = 0$. Parents' earnings are equal to $W_p = J(H_p, A_p)$, their consumption is $C_p = W_p - (a - b)N - \delta NH_c$, where a denotes the cost of raising children, b denotes the rate of child benefit, and δ denotes the unit cost of education. Parents assume that their children's earnings are determined according to $W_c = J(H_c, A_c)$. Ability is partly inherited with $A_c = \rho A_p + e_c$, where $e_c \sim$ iid and $0 \leq \rho \leq 1$, hence parents can predict their children's ability provided $\rho \neq 0$. Parents do not know e_c ex ante, so each child is expected to have the same ability[3].

If the capital market were perfect parents would invest in their children's education up to the point where the marginal product on human capital equals the rate of interest ($MPH_c = r$). In this case children's human capital (H_c) varies directly with their parents' ability (A_p) and inversely with the rate of interest (r) and the cost of education (δ), and parents do not face a trade-off between quality and quantity. They simply borrow to invest in quality, which is paid back once their children start earning. If, however, the capital market is imperfect, they will face a trade-off between quality and quantity, because investment in their children's education must be at the expense of the number of children and their own consumption.

[3] In a more general model parents would allocate resources according to the different abilities of their children. Becker (1991) cap 6 assumes that parents know e_c.

It is assumed that parents cannot borrow on the collateral of their children's ability. Equation (1) is specified as: U = αlnC_p + βln(NW_c) + γlnN. Parents make two independent decisions regarding N and H_c. The first order conditions are:

$$\frac{\partial U}{\partial N} = -\frac{\alpha(a-b+\delta H_c)}{C_p} + \frac{\beta+\gamma}{N} = 0 \qquad (2)$$

$$\frac{\partial U}{\partial H_c} = -\frac{\alpha\delta N}{C_p} + \beta\frac{MPH_c}{W_c} = 0 \qquad (3)$$

The second order derivatives are:

$$\frac{\partial^2 U}{\partial N^2} = -\frac{\beta+\gamma}{N^2} - \frac{\alpha(a-b+\delta H_c)^2}{C_p^2} = B < 0$$

$$\frac{\partial^2 U}{\partial N \partial H_c} = -\frac{\alpha\delta}{C_p}[1+\frac{N}{C_p}(a-b+\delta H_c)] = D < 0$$

$$\frac{\partial^2 U}{\partial H_c^2} = -\frac{\alpha\delta^2 N^2}{C_p^2} + \beta\left(\frac{MPH`}{W_c} - \frac{MPH^2}{W_c^2}\right) = E < 0$$

and the second order conditions for a maximum are B < 0 and BE – D^2 = K > 0. The former holds for sure and the latter is assumed to hold. Note that because MPH` < 0 E must be negative.

The model implies that if children are more able and ξ > 0, parents reduce the number of children they produce and invest more in their human capital:

$$\frac{dN}{dA_c} = \frac{D\beta\xi}{K} < 0 \qquad (4)$$

$$\frac{dH_c}{dA_c} = -\frac{B\beta\xi}{K} > 0 \qquad (5)$$

It also implies that if children are more expensive to raise (a increases) the demand for children falls and the investment in their human capital may either increase or decrease:

$$\frac{dN}{da} = \frac{\alpha\beta}{C_p K}[1+\frac{a-b+\delta H_c}{C_p}][\frac{MPH`}{W_c} - \frac{MPH^2}{W_c^2}] < 0$$

$$\frac{dH_c}{da} = \frac{\alpha\delta}{C_p^2 K}\left(\frac{\alpha[1+N(a-b+\delta H_c)]}{C_p} - (\beta+\gamma)\right)$$

If parents invest more in their children's human capital it is because they trade-off quantity against quality in view of the increase in the relative price of quantity as measured by (a-b)/δ. If, instead, parents invest less it is because they chose to increase their own consumption (C_p) and to spend less on parenting.

Finally, better off parents may have more or less children, which they educate to a greater or lesser degree:

$$\frac{dN}{dW_p} = -\frac{\alpha\beta(a-b+\delta H_c)}{C_p^2 K}\left(\frac{MPH`}{W_c} - \frac{MPH^2}{W_c^2} + \frac{\alpha\delta^2 N}{C_p}\right)$$

$$\frac{dH_c}{dW_p} = \frac{\alpha\delta}{C_p^2 K}\left(\frac{\beta+\gamma}{N} - \frac{\alpha(a-b+\delta H_c)}{C_p}\right)$$

The inability to sign these derivatives stems from the arbitrariness of the income effect on parenting. The greater is the relative value of α, the more likely it is that the income effect is negative, because it implies that parents are less altruistic. As a result they have fewer children and invest less per child in their education. If, however, parents are better-off because they are more able, and if ρ > 0, they will chose to reduce quantity and raise quality, as already mentioned, because they predict that their children are more able too.

3 Econometrics

3.1 Identification

The basic version of QQT2 that we wish to test may be expressed linearly as follows:

$$N_i = \alpha + \beta A_i + \gamma Y_i + \delta E_i + \theta Z_i + u_i \qquad (6)$$

where i labels parents, A denotes parents' ability, Y their permanent income or wage, E their education, and Z denotes a vector of personal characteristics, including age at marriage, birth cohort etc. In practice, we disaggregate the variables in equation (6) for both spouses, i.e. we distinguish between the ability of heads of households (typically husbands) and spouses (typically wives). QQT2 predicts β < 0; given everything else, more able parents have fewer children. The error term $u = u_1 + u_2$ captures unobserved heterogeneity in fertility, where u_1 reflects fecundity and u_2 reflects the sex pattern in births and parents' gender preferences. For example, parents wanting a girl and a boy are more likely to try for a third child if their first two children are boys or girls. Since both components of u are entirely random, the parameters in equation (6) are identified.

Note that equation (6) would have been under-identified had A been relegated to the error term, because in this case N, Y and E are affected by A. This is typically what happens in studies of fertility in which income, education and similar variables are used as controls. Since the theory presented in section 2 predicts that more able parents will be more educated and have higher incomes, the inverse relationship between fertility and education confounds three phenomena. First, the opportunity cost of time varies directly with education thereby reducing fertility. Second, since ability and investment in education are complements, education and ability are positively correlated. If there is a positive correlation between the ability of parents and children, parents will chose to have fewer children. Third, income varies directly with education. Depending upon the income effect, better-off parents may chose to have more or less children as discussed in section 2.

In equation (6) N refers to completed fertility, which is only observed for women who are beyond childbearing age. If data for younger women are used, their fertility is censored at their age at the time the data were collected. A 30 year-old woman is naturally more censored than a 40 year-old woman. We include younger women in the data, but specify a logistical censoring indicator, which depends upon their age. It is defined as:

$$\Theta = \frac{1}{1 + \exp[f + g(Age - Age_0)]} \qquad (7)$$

where Age_0 denotes the age at which fertility commences, and f and g are parameters to be estimated. This indicator varies directly with age and has an upper asymptote as Θ approaches unity.

3.2 Mincer Residuals

We follow Juhn, Murphy and Pierce (1993) in assuming that unobserved ability may be measured by "Mincer residuals" obtained from earnings regressions. Ability is measured by the residual between explained earnings and actual earnings, where the former are derived from a Mincer model in which X_i is a vector of covariates hypothesized to determine earnings:

$$Y_i = \mu X_i + A_i \qquad (8)$$

These "Mincer residuals" may serve as generated regressors for unobserved ability in equation (6)[4]. Pagan (1984) has shown that such generated regressors provide parameter estimates that are consistent in both mean and variance.

[4] Mincer residuals have the same status as Solow residuals as measures of unobserved total factor productivity.

If A_i and X_i happen to be correlated[5], Mincer residuals will be inconsistent with $\hat{\mu} = \mu + m$ in which case $\hat{A}_i = A_i - mX_i$. Note that inconsistent residuals span the true residuals and X. Substituting for A in equation (6) produces:

$$N_i = \alpha + \beta\hat{A}_i + \beta m X_i + \gamma Y_i + \delta E_i + \theta Z_i + u_i \qquad (9)$$

Equation (9) shows that even inconsistent estimates of Mincer residuals may be used to estimate consistent estimates of the parameters in equation (6) provided the auxiliary variables (X) used to estimate the Mincer residuals are specified in the model. Since, no doubt, E will serve as one of the elements in X, this means that δ is not identified. However, the key parameter of interest,β, is identified. Identification of γ requires that Z ≠ X, or E be instrumented. In section 4 we compare results in which the Mincer residuals are assumed to be consistent (m = 0) with results in which they are assumed to be inconsistent.

If the X variables used to estimate the Mincer model happen to be the same as the covariates in equation (6), (E and Z), then the estimate of A will be perfectly collinear with the other covariates in equation (6) and the model will be under-identified. Identification therefore requires instrumental variables, which are specified in the Mincer model, but which are not specified in equation (6). Such instrumental variables affect earnings but do not affect fertility. For example, pay in Israel's electricity sector is relatively high because monopoly rents dissipate to workers, but there is no reason to believe that electricity workers are less fertile. Nor is there any reason to believe that workers as a whole in the electricity sector are more able than workers elsewhere. Similar arguments apply in other economic branches in Israel, which are used as instruments for estimating Mincer residuals.

The dependent variable in equation (6), the number of children born to a couple, should be regarded as count data. Therefore, estimation should be by Poisson regression, or by negative binomial regression if there is over-dispersion. OLS would not take into account the discrete nature of the data, and might be inconsistent as well as inefficient.

3.3 Child Bearing Hazard

Equation (6) uses data on completed fertility, and does not use information on birth order by sex. We have already remarked that if the second child happens to have the same sex as the first, this might increase the couple's interest in trying for a third child in the

[5] For example, the vector X may include education, which may vary directly with ability.

hope that it will be of the opposite sex. Or, if parents have preferences for boys, and the first child happens to be a boy, they will be less likely to try for a second child. Fertility is, therefore, likely to be path-dependent.

QQT2 may also be tested using data on individual births. Let P_{12i} denote the probability that couple i has a second child, given that it already has one child. This probability, or child-bearing hazard, may be estimated by logit or probit using the covariates of equation (6) as regressors. QQT2 predicts that P_{12} varies inversely with ability. Let e_{12i} denote the generalized residual from the model for P_{12}, which measures unexplained fertility. QQT2 also predicts that the hazard of having a third child varies inversely with ability. We may test whether P_{23i} varies inversely with A and other controls, and whether it varies directly with the couples' fertility as measured by e_{12}. Having investigated P_{23}, we may investigate P_{34} and so on, using estimates of e_{12} and e_{23} etc.

The hazard models are specified linearly as:

$$P_{(j-1)j,i} = \alpha_j + \beta_j A_i + \gamma_j Y_i + \delta_j E_i + \theta_j Z_i + \kappa_j B_{(j-1),i} + \lambda_j S_{ij} + \sum_{k=2}^{j-1} \psi_{j,j-k} e_{(j-k-1)(j-k),i} + e_{(j-1)j,i} \qquad (10)$$

Equation (10) is estimated sequentially for j = 2, 3, 4,..,J. QQT2 predicts $\beta_j < 0$, because more able parents choose to have fewer children. Indeed, QQT2 predicts that β_j will become increasingly negative in j, i.e. more able parents are increasingly less likely to have more children. In equation (10) B_{j-1} denotes a dummy variable that characterizes the sex composition of the j-1 children that the couple already have. If j = 2 they already have either a boy or a girl. If j = 3 they have 2 boys, 2 girls or one of each sex. This term captures sex preferences and sex mixes.

S_{ij} denotes a vector of environmental variables hypothesized to influence birth hazards. We focus attention on two such variables. The first is the child benefit that comes with having an additional child. For example, if j = 2, S_{ij} denotes the child benefit received by couple i if they have a third child. The key question of interest here is whether the hazard of having an extra child varies directly with the level of child benefit that would be obtained thereby. This was a question that could not be asked in section 3.1 because equation (6) does not relate to individual births. The second component of S refers to social fertility norms, which are defined as completed fertility for different social groups. In this case S_{ij} denotes the fertility norm in couple i's social group after having produced their j'th child.

Since fertility norms may change over time S_{ij} depends upon birth timing. The key question of interest here is the strength of the relationship between birth hazards and social fertility norms. Further details of these environmental variables are presented in section 4.3.

Finally, the autocorrelation coefficients (ψ) in equation (10) capture two effects. Insofar as the generalized residuals express unobserved fertility, then $\psi > 0$, because more fertile couples are likely to have more children. If, however, the previous child was a "mistake", then $\psi < 0$, because the couple will be more "careful" in the future.

Expected fertility for couple i, who already have one child is:

$$E(N_i) = \prod_{j=2}^{J} jP_{(j-1)j,i} + 1 \qquad (11)$$

The effect of ability upon expected fertility depends upon the effect of ability on the birth hazards. QQT2 does not necessarily predict that each birth hazard varies inversely with ability. It predicts that expected fertility varies inversely with ability. It also predicts an inverse relationship between ability and the birth hazard as j increases.

4 Empirical Analysis

4.1 The Data

I use census data for Israel in 1983 and 1995 to construct fertility histories for females in the household. The census in Israel comprises two parts. All households are required to complete part A, which lists all the members of the household, their date of birth, and their relationship to the head of household. Part A reveals information on the number of children present in the household and their birth order. Part B is completed by a 20% random sample and provides more detailed information on household members, including education, earnings (if any), number of live births by women in the household[6], and a wide variety of other information. Therefore the data on the number of children come from two sources, the counts of children in the household from part A (N_A) and reported fertility in part B (N_B).

If a woman reports in part B that she has had N children and there happen to be N children in the household according to part A ($N_A = N_B$), these children are assumed to be hers'[7]. However, there may be less than N children in the household according to part B, either because adult children have left home, or because for one reason or another minors

[6] In 1983 only married women were asked this question. In 1995 the question was extended to all women.

do not happen to be at home[8] at the time of the census. This does not matter for equation (6) where N_B is used. However, it matters for equation (10) because birth order and timing are important. Note also that N_A may be greater than N_B, either because some of the children in the household were born to another woman, or because in 1983 the children were born out of wedlock, or because in 1995 unmarried mothers did not want to report that they were mothers.

Figure 1 reports the frequency distribution of the number of children for N_A and N_B in 1983 and 1995 for all women and women age 40+ years. Note that $N_A > N_B$ for N = 1, suggesting that there were unmarried mothers with one child in 1983. Although in 1995 all women were asked to report the number of children born to them, most probably many unmarried mothers reported that they had no children.

4.2 Measuring Ability

Table 1 Summary Statistics from the Mincer Models

	Observations	R^2	sd(v)	Skewness	Kurtosis	Jarque-Bera
1983	126,970	0.3511	0.6492	-0.8106	3.3633	14,599
1995	286,450	0.3323	0.6366	-0.8850	2.7034	38,437

The estimated model is $\ln W_{it} = \alpha_t + X_{it}\beta_t + v_{it}$. $S = m_3/sd^3$, $k = m_4/sd^4$, $JB = n[S^2/6 + (k-3)^2/24] \sim \chi^2_2$. m_3 and m_4 are 3rd and 4th moments respectively.

In the absence of direct measures of ability, such as IQ tests, ability is measured using equation (8). The X covariates used to estimate the Mincer model are quite standard and include age and its square, years of schooling, gender and ethnic controls, dummy variables for 9 occupational groups, 9 economic branches in 1983 and 15 in 1995, 9 regions in 1983 and 9 locality types in 1995, and time since migration for immigrants. Table 1 reports summary statistics for models estimated using census data for Israel in 1983 and 1995. The estimated standard deviations of the Mincer residuals suggest that within group wage inequality fell slightly between 1983 and 1995. There is negative skewness (skewness to the left) in the Mincer residuals in both years. Insofar as the Mincer residuals measure ability this means that ability is asymmetrically distributed; there are more highly unable people than there are highly able people. In 1995 this asymmetry was more pronounced

[7] She might have remarried and the children may have been born to another woman.
[8] Children conscripted into the army are counted as living at home.

than in 1983. Finally, there was excess kurtosis relative to the normal in 1983 implying that the tails in the distribution of ability are fat. However, the opposite applies in 1995.

4.3 Count Data Models

Table 2 The Demand for Children: Poisson Regression Estimates of Equation (6)

	1983		1995	
	Model 1 Household Heads	Model 2 Couples	Model 3 Household Heads	Model 4 Couples
Intercept	-1.1711 (16.54)	-1.1308 (11.92)	-1.7521 (32.0)	-1.6967 (29.63)
Ability: head of Household	-0.2531 (4.42)	-0.0137 (1.97)	-0.0082 (1.95)	-0.0087 (1.92)
Ability: spouse		-0.0417 (4.79)		0.0004 (0.06)
Earnings: head of household	-1.6800 (8.02)	0.204 (0.70)	-8.8100 (8.41)	-6.2200 (3.64)
School: Head of household	-0.0187 (21.40)	-0.0041 (3.52)	-0.0133 (17.41)	-0.0086 (9.37)
Schooling: spouse		-0.0337 (25.69)		-0.0108 (10.09)
Age: head of household	-0.0231 (30.18)	-0.0195 (22.96)	-0.0111 (16.73)	-0.0109 (16.18)
Censor	6.0577 (32.50)	6.2673 (25.16)	6.6017 (46.37)	6.6193 (44.81)
Censor^2	-3.4674 (25.44)	-3.6588 (20.64)	-4.4421 (42.83)	-4.4237 (41.17)
Years married	0.0356 (41.64)	0.0297 (30.74)	0.0917 (60.20)	0.0906 (57.76)
Years married^2			-0.0013 (43.57)	-0.0013 (42.24)
Non Jew	0.5052 (27.11)	0.5296 (24.05)	0.2332 (19.54)	0.2241 (18.15)
Non Jew Immigrant			-0.1817 (6.74)	-0.1955 (6.95)
Observations	33,849	23,614	68,069	64,653
Pseudo R^2	0.1078	0.1224	0.1155	0.1158

Absolute t statistics are reported in parentheses. Country of origin controls in use. Censor = Θ in equation (7) with f = 2.0189, g = 0.2079, and A_0 = 17.

In this section we report estimates of equation (6) by Poisson regression[9]. Since the generated regressors for ability have been derived from wage regressions, the estimates

[9] In the absence of excess dispersion the Poisson specification is appropriate.

reported in Table 2 refer to heads of households and couples who happened to be earning at the time of the census. There are naturally fewer observations for couples because both head of household and spouse have to be earning at the time of the census.

Table 2 controls for several time-related variables including the age of head of household, the age of the woman in the household (via the censor variable), and the duration of marriage. Model 1 implies that a 35 year-old woman has 0.1377E(N) more children than a 30 year old woman[10], a couple married 10 years has 0.178E(N) more children than a couple married 5 years, and a 40 year-old head of household has 0.23E(N) children less than his 30 year-old counterpart. Since the latter controls for marriage duration and the age of the woman, it suggests a birth cohort effect, i.e. household heads born later tend to be more fertile. Model 1 further implies that Non-Jews have 66% more children than Jews, and that fertility varies inversely with income and education. For our present purposes, the most important implication of Model 1 is that fertility varies inversely with estimated ability. Since ability is measured in logarithms, the elasticity of fertility with respect to ability is -0.2531.

Model 2 is estimated using information on spouses. Fertility varies inversely with the ability of spouses and the head of the household. However, the elasticity is substantially smaller than in Model 1. It should be noted that the ability of household heads and their spouses are positively correlated (r = 0.4) suggesting a substantial degree of assortative mating. There is natural colinearity therefore between the ability of household heads and spouses, which is likely to inflate the standard errors of the estimated parameters. Moreover, there is likely to be selectivity in households where both spouses work. If such households are positively selected on ability, this would explain the smaller elasticity of fertility with respect to ability in Model 2. Also, in Model 2 income ceases to be significant, perhaps for similar reasons.

Models 3 and 4 in Table 2 are estimated using census data for 1995. The evidence in favor of an adverse effect of ability upon fertility is much weaker. The elasticity in Models 3 and 4 is only -0.008 for household heads while for spouses, it ceases to be statistically significant. The demand for children varies inversely with income and education, the cohort

[10] In Poisson regressions the derivative of the expected value of the dependent variable, E(N), with respect to a unit change in an explanatory variable is equal to βE(N) so that β is a semi-elasticity.

effect continues to be negative, and the fertility gap between Jews and Non-Jews narrows substantially.

Thus far it has been assumed that the Mincer residuals used to measure unobserved ability are consistent. In section 3.2 it was argued that even inconsistent Mincer residuals may be used to estimate consistent estimates of the effect of ability on fertility, provided the covariates of the Mincer model are used as controls in the equation for fertility. The models in Table 2 were supplemented by specifying regressors used in Table 1. Space prevents reporting the full results when the Mincer residuals are assumed to be inconsistent. In general there did not turn out to be a great deal of difference between the results in Table 2 and their consistent counterparts. For example, in Model 1 the estimated coefficient on ability becomes -0.321 with "t" value -5.34 and in Model 3 it becomes -0.021 with "t" value 2.74. The conclusion that ability induces lower fertility remains robust.

The identification of the ability effect has several sources. First, there are variables that affect earnings, such as economic branch, which are "omitted variables" in equation (6). There is no theoretical reason, for example, why electricity workers should be more or less pro-children than other workers, however, there are sound economic reasons why earnings vary by economic sector[11], where capital stocks and market structure may vary. This source of identification is similar to Shea's (2000), who used union membership for purposes of identification. The second source of identification is parametric. For example, age affects both earnings and the number of children. The typical Mincer equation includes age and its square. Age affects the number of children through the "censor" variable for women, and the duration of marriage for men. Therefore the positive effect of age upon the number of children is parametrically different from the effect of age upon earnings. The third source of identification is incidental; there happen to be variables, such as country of origin, that are not statistically significant in Table 2 that happen to be significant in the Mincer models.

4.4 Birth Hazards

In this section we report estimates of equation (10), which consist of a set of rolling logit models. We begin with couples, who already have one child because childless couples may be infertile. In stage 1 we model the hazard of having a second child, given that the couple

[11] Especially in the electricity sector in Israel where workers have extracted monopoly rents.

has one child. In stage 2 we take the couples who had a second child from stage 1[12] and model the hazard of them having a third child. This hazard is conditioned on the generalized residual estimated in stage 1, which measures couples' unobserved fecundity. In stage 3 we take the couples from stage 2 who had a third child and model their hazard of having a fourth child, conditioning on the generalized residuals estimated at stages 1 and 2. We proceed to stage 4 and beyond until we run out of sufficient observations for estimation. Note that the fertility censoring variable and duration of marriage are measured at the time when the previous child was born[13].

In equation (10) the birth hazard is conditioned upon two environmental variables denoted by S[14]. The first of these, child benefit, is plotted on Figure 2, which shows that in the first half of the 1970s child benefit was increased disproportionately for couples with more children. In the mid 1980s child benefit for 4 and more children was substantially increased, and in 1991-2 couples with 1 and 2 children ceased receiving child benefit altogether. Over the period as a whole, the incentive to produce larger families has increased substantially[15]. The relationship between child benefit and the number of children at a given point in time is J - shaped in Israel, and has grown increasingly so, whereas in OECD countries this relationship is typically (- shaped. As mentioned in section 1, child benefit policy was largely dictated by religious pressure groups, and may be considered for our present purposes as exogenous.

The second environmental variable is the fertility norm by ethnic group. Figure 3 plots total fertility rates for key subpopulations in Israel. It distinguishes between Ashkenazi and Sephardi Jews and Moslems and shows that the high fertility rates for Moslems and Sephardic Jews have been, on the whole, converging to the lower fertility of Ashkenazi Jews[16]. The "reflection problem" implies that fertility norms are endogenous to the fertility decisions of parents. However, the data in Figure 3 refer to norms established by the

[12] But omit on the grounds of censoring those who had their second child in the 2 years before the census.
[13] I do not wish to address here the endogeneity of birth timing.
[14] I wish to thank Joram Mayshar for providing these data. See Manski and Mayshar (2003) for details.
[15] In the Budget of 2004 these incentives have been largely eliminated. The change in policy stems from the loss of political power of the religious parties, whose voters have large numbers of children.
[16] These trends conceal substantial differences between ultra-religious (haredi) and other Jews. Manski and Mayshar (2003) show that haredi fertility increased from 2.8. to 6.5 among Ashkenazi Jews, but fell slightly among Sephardi Jews. See also Berman (2000).

previous generation of parents, who determined their fertility long before time t. Therefore the reflection problem is not a major concern here.

In principle, the S variables refer to the period in which couples contemplate producing their next child. In practice S was averaged over the 3 year period following the birth of the last child. For example, a couple which had their first child in 1976 are hypothesized to be affected by the child benefit that they would receive if they had their second child during 1977 – 1980.

The first column in Table 3 is a logit model estimated with data from the 1983 census in which the dependent variable takes a value of unity if couples, who already have one child, subsequently had a second child, and zero otherwise. There were 11645 couples of which 9201 went on to have a second child. More able heads of households are more likely to have a second child, while the opposite applies to their spouses. The former effect is not statistically significant, whereas the latter effect is significant. More educated heads of households and spouses are more likely to have second child, and better-off households are more likely to have a second child. The censor variable takes account of the age of the mother when she had a first child. If she had her first child before she was 30 the second birth hazard varies directly with her age, otherwise it varies inversely. Second birth hazards vary directly with the duration of the marriage, which is measured when the previous child was born. The age of the household head at the time of the census is used to capture cohort effects. Given the duration of the marriage and spouses' age when the first child was born, older household heads in 1983 were less likely to produce a 2^{nd} child, suggesting that more recent birth cohorts were more likely to produce a 2^{nd} child.

An apparently surprising result is that non-Jews are considerably less likely to have a second child. Tests show that if education is dropped from the specification this coefficient becomes positive, suggesting the education intermediates for non-Jewish status. The same applies to the fertility norm for Non-Jews, i.e. Non-Jews are more likely to have a second child once their fertility norm and education are taken into consideration.

If the first child happened to be male, this has no effect upon the probability of having a second child, suggesting that parents do not have gender preference regarding second children. Not surprisingly fertility norms have a strong and positive effect upon fertility, while child benefit for 2 children reduces fertility. This effect though small is statistically significant, and does not conform to a priori expectations[17].

Looking across Table 3 as a whole, it may be seen that the latter environmental effects are stable and robust in 1995 and in 1983. In the hazard models for 3rd children the relevant level of child benefit is for 3 children, and so on for 4th and 5th children. Although parents do not seem to have any sex preferences for their children, they prefer to have at least one of each sex. This is particularly apparent in the hazard models for 3rd children in 1983 and 1995; parents with 2 children of different sexes are less likely to have a 3rd child. Parents with 3 sons or 3 daughters are more likely to have a 4th child. This effect may be more

Table 3 Birth Hazard Models: Logit Estimates of Equation (8)

	1983			1995			
	2nd Child	3rd Child	4th Child	2nd Child	3rd Child	4th Child	5th Child
Intercept	-2.8775 (7.49)	-12.418 (14.53)	-11673.2 (5.79)	-6723.2 (25.23)	-17046. (29.32)	-7391.9 (7.34)	-8063.7 (3.90)
Ability: head of household	1.047 (1.015)	1.000 (0)	-0.1926 (2.60)	-0.0501 (2.69)	-0.0768 (3.64)	-0.1944 (6.50)	-0.1640 (2.86)
Ability: spouse	0.765 (4.26)	0.708 (4.825)	-0.3295 (2.29)	-0.0831 (3.29)	-0.0155 (0.516)	0.0400 (0.92)	0.1398 (1.69)
Income	1.000 (2.06)	1.000 (0.454)	-2.06 (0.53)	2.21 (0.43)	-50.0 (8.47	-70.0 (7.06)	-80.0 (3.64)
School: head of household	1.015 (1.88)	0.994 (0.661)	-0.00406 (0.29)	-0.0215 (5.44)	-0.0702 (15.26)	-0.0449 (6.78)	-0.0271 (2.26)
Schooling: spouse	1.012 (1.276)	0.988 (1.126)	-0.00468 (0.28)	0.0073 (1.63)	0.0189 (3.69)	0.00023 (0.03)	0.0347 (2.69)
Age: head of household	0.900 (22.84)	0.797 (20.84)	-0.2280 (14.07)	-0.0884 (55.25)	-0.2213 (57.93)	-0.1506 (28.58)	-0.1696 (16.46)
Censor	>1000 (19.70)	>1000 (15.02)	24029.2 (5.76)	13849.7 (25.09)	35037.3 (29.17)	15116.3 (7.28)	16514.6 (3.88)
Censor^2	< 0.001 (17.86)	<0.001 (13.11)	-12371.4 (5.74)	-7130.7 (24.94)	-18004 (29.02)	-7729.7 (7.22)	-8449.9 (3.85)
Years married	1.130 (15.205)	1.442 (22.12)	0.4061 (14.15)	0.1994 (57.46)	0.4760 (59.50)	0.3107 (24.27)	0.2514 (10.79)
Non-Jew	0.074 (12.76)	0.002 (16.00)	-8.4949 (15.06)	-0.5614 (11.21)	-1.674 (21.01)	-0.8583 (6.48)	-0.8482 (3.70)
Haredi	0.884 (0.496)	1.485 (1.559)	0.6714 (2.12)	-0.00862 (0.12)	1.0205 (12.54)	1.5940 (17.77)	1.4244 (10.12)
Son & Daughter		0.811 (3.26)			-0.1045 (3.79)		
Son(s)	0.974 (0.543)		0.2893 (2.36)	0.00525 (0.26)		0.0726 (1.53)	0.1508 (1.31)
Daughter(s)		0.956	0.3175		-0.0147	0.3042	0.1669

[17] Prior to 1994 Non-Jews who did not serve in the army received lower child benefit. Estimating equation (8) for Jews only does not alter this result.

		(0.601)	(2.55)		(0.45)	(5.99)	(1.38)
Child Benefit	0.999 (6.785)	0.999 (17.74)	-0.00137 (13.66)	-0.00095 (27.94)	-0.0013 (33.25)	-0.0003 (27.27)	-0.0014 (20.59)
Fertility norm	3.040 (16.79)	20.201 (19.92)	3.8794 (17.10)	1.0572 (30.21)	2.9776 (47.49)	1.9504 (19.20)	1.2949 (7.59)
Residual12		>1000 (12.22)	10.5607 (10.52)		8.4374 (38.26)	7.8658 (19.98)	10.8377 (10.20)
Residual23			-0.1619 (0.42)			-0.9446 (4.96)	-1.0989 (2.30)
Residual34							-0.6739 (2.14)
Observations	12512 9890	9508 4799	1413 2798	49594 16633	24493 21646	7458 15400	1944 4905
-2logL	12846.6	13180.0	5373.6	74650.6	63786	28870	8171.4

See notes to Table 2.

pronounced in the case of daughters. Haredi parents, not surprisingly, have higher birth hazards beyond 3 children. This is particularly the case in 1995 suggesting that more recent haredi cohorts have been more fertile. Effects relating to birth cohorts, marriage duration and fecundity are also stable across Table 3. By contrast, the income effect is not stable. It tends to be positive in 1983 and negative and in 1995.

The generalized residuals are statistically significant for higher order birth hazards. For example, 3rd order birth hazards vary directly with generalized residuals obtained from 2nd order birth hazard models. This serial correlation captures unobserved heterogeneity in fertility. Higher order hazards depend upon a moving average of the generalized residuals obtained from lower order birth hazard models, especially in 1995. The sum of the moving average coefficients is positive, despite the occasional negative coefficient, suggesting that higher order birth hazards vary directly with unobserved fertility.

Finally, we turn our attention to the relationship between ability and higher order birth hazards. Table 3 shows that more able household heads generally have lower birth hazards. Moreover, especially in 1995 this effect is more pronounced at higher order birth hazards as predicted by QQT2. In 1983 birth hazards vary inversely with spouses' ability, as predicted by QQT2, but this result does not carry over to 1995. When spouse ability is dropped from the model the effect of household heads' ability is clearly negative and statistically significant. As in the case of Table 2 this reflects assortative mating and the associated colinearity between the abilities of household heads and spouses.

5 Conclusion

Fertility data for Israel corroborate the hypothesis that, given everything else, more able parents produce fewer children. Parents' ability was measure by Mincer residuals obtained from an earnings regression. In terms of the model that has been proposed this happens because parents understand that their children partly inherit their ability, hence abler parents tend to have abler children. Because human capital and ability are complementary, abler parents wish to invest more in their children's education. Had the capital market been perfect these parents could have borrowed to pay for their children's education, by mortgaging the future income of their children. However, since parents cannot borrow against their children's future earnings, they decide to have fewer children. They trade-off quality for quantity. Less able parents expect their children to be less able, and invest less in their education. These parents have more children, who on average are less educated.

Two different tests were carried out of the hypothesis that abler parents have fewer children. The first focused upon fertility. The second focused upon birth hazards. The latter takes account of the sex composition of births, fertility norms, and child benefit. In both cases fertility was found to vary inversely with ability.

Previous research has found that fertility varies inversely with education. Since abler people tend to be more educated, it has not been clear whether this finding is consistent with the hypothesis that the opportunity cost of having children varies directly with education, or whether it is consistent with quality v quantity theory. By controlling for both ability and education our results indicate that both phenomena are empirically important. Given their education, abler parents have fewer children. Given their ability, more educated parents have fewer children because the opportunity cost of fertility is greater.

That abler parents have fewer children does not imply that the population is eventually dominated by less able strains. This happens in Galor and Moav (2002) because there is no intergenerational mobility in gene type. In the present model the ability of the members of dynasty j in generation t is assumed to be $A_{jt} = a + \rho A_{jt-1} + e_{jt}$ where e is a random variable capturing intergenerational mutation. This model implies that ability is equal to:

$$A_{jt} = \frac{a}{1-\rho} + \sum_{i=0}^{\infty} \rho^i e_{jt-i} + A_{i0}\rho^t \qquad (12)$$

where A_{j0} is an arbitrary constant reflecting the initial level of ability in dynasty j. Since $0 < \rho < 1$ equation (12) states that expected ability in the dynasty tends asymptotically to a/(1-ρ). This means that the initial level of ability has no long run consequences for dynastic ability due to regression to the mean. The asymptotic expected value of ability in all dynasties is the same and is equal to a/(1-ρ). The variance of ability tends to $\sigma_e^2/(1-\rho^2)$, which is constant as long as the mutation process is homoscedastic. Since births and education depend upon ability, the asymptotic number of people in dynasty j and their level of education tend to be the same. In short, each generation has more and less able people, but dynastic differences eventually disappear.

Figure 1.1: Sibship Distribution in 1983

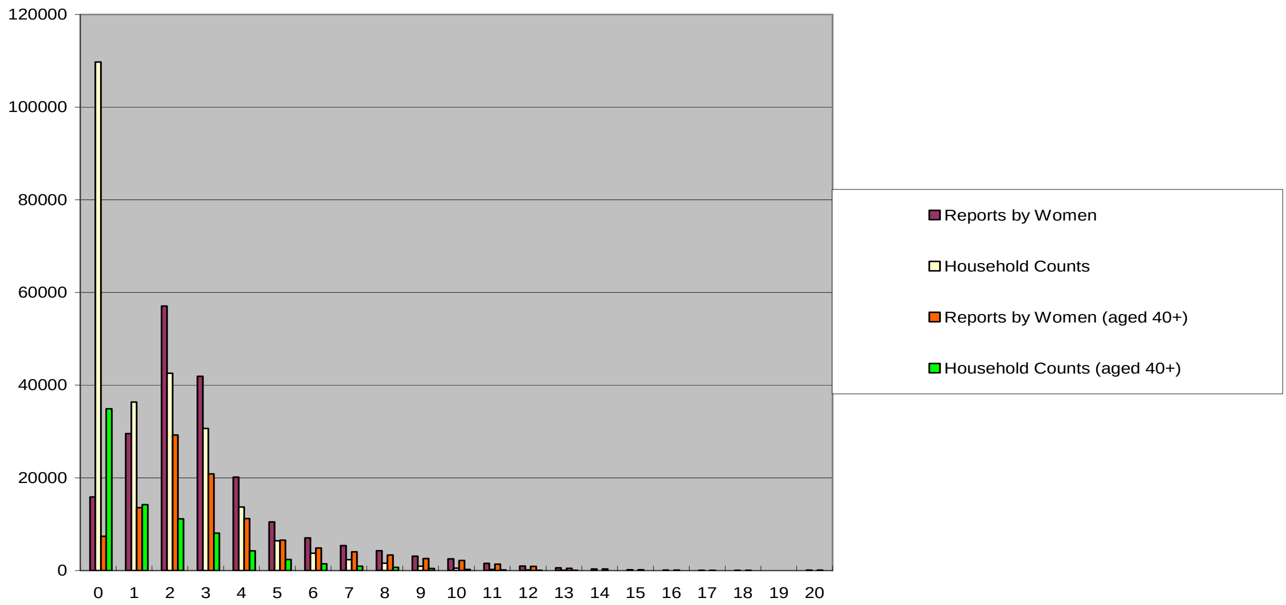


Figure 1.2: Sibship Distribution in 1995

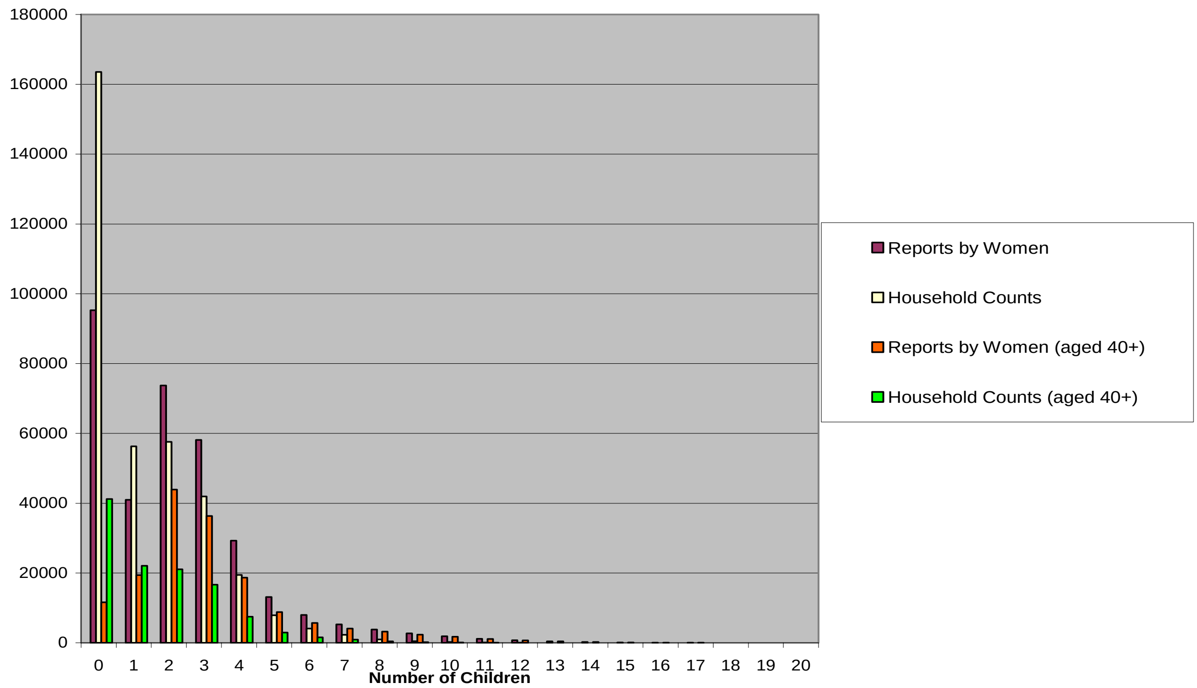


Figure 2: Child Benefit: 1-9 Children

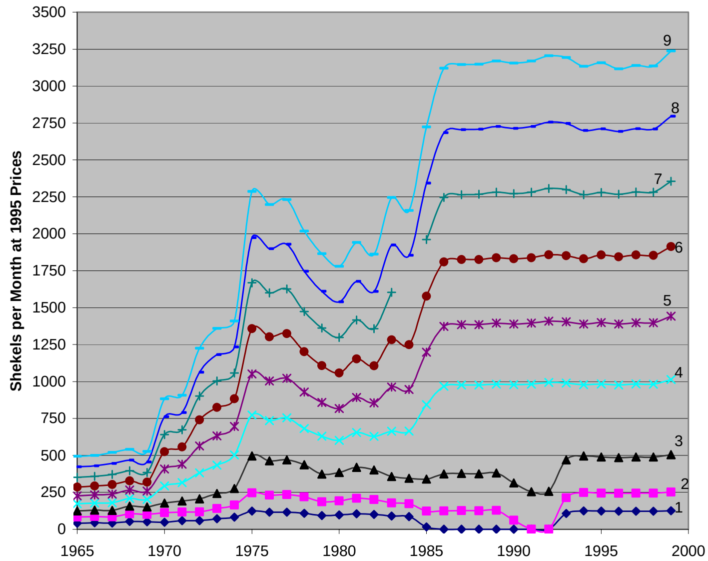
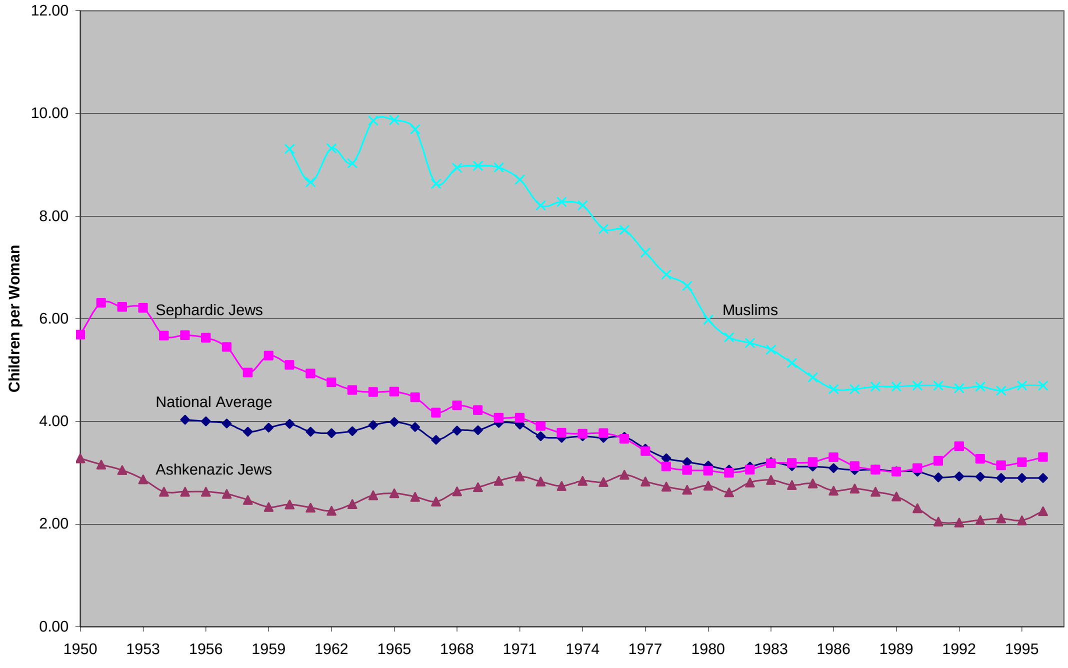


Figure 3: Completed Fertility



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