Fertility Expectations and Outcomes: On the Role of Education

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Abstract

In this paper, we use longitudinal data from the US to compare fertility expectations and birth outcomes of young women over the period 1979-2004. We show that actual fertility rates lie significantly below the initially desired and expected levels, and that this "fertility gap" is highly correlated with educational attainment. The low fertility rates associated with higher educational attainment appear to be independent from initial fertility expectations or desires, and can not be explained by difference in the labor or marriage market experiences. Pursuing education does not appear to significantly change the degree to which respondents can meet their fertility goals, but appears to directly affect individual preferences. We show that the induced shift in preferences is particularly pronounced for minority groups and those respondents with limited previous exposure to higher education.

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1. Introduction

Compared to most other OECD countries, fertility rates in the US remain relatively high. According to the National Center for Health Statistics, the average number of children ever born among women aged 40-44 was 2.11 in 2004, one of the highest fertility rates observed since the 1970s (Chandra, Martinez, Mosher, Abma and Jones, 2005). The comparatively high fertility rates and the small increase in total fertility observed over the recent years (Vere, 2007) have taken away attention from pronounced differences in fertility outcomes across socioeconomic groups in the US, which seem to be inconsistent with initial fertility expectations.

In the nationally representative NLSY79 sample used in this paper, respondents aged 14-21 were first asked for their own fertility desires and expectations in 1979, and then closely followed through their fertile years. In 1979, the average respondent desired and expected to have 2.5 children. At the time of the last interview in 2004, the average female respondent in the NLS sample had 1.97 children. On average, women thus over-predicted their own fertility by about 0.6 children, a tendency that has been noticed in previous studies (Westoff and Ryder, 1977; Goldin and Katz, 2002).

What is more surprising is the fact that the lion share of this observed difference between actual and expected fertility rates is due to the highly educated. As shown in Table 1, women with 12 or fewer years of completed education exceeded, or at least got relatively close to their expected number of children. The same is not true for highly educated women. Women with some college have on average 1.99 children, falling 0.46 children short of their initial expectations. Women with four or more years of college - the group with the highest average expected number of children - had only 1.62 children on average, falling an astonishing 0.94 children short of their own initial expectations.

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Table 1: Fertility Expectations and Outcomes by Education Group

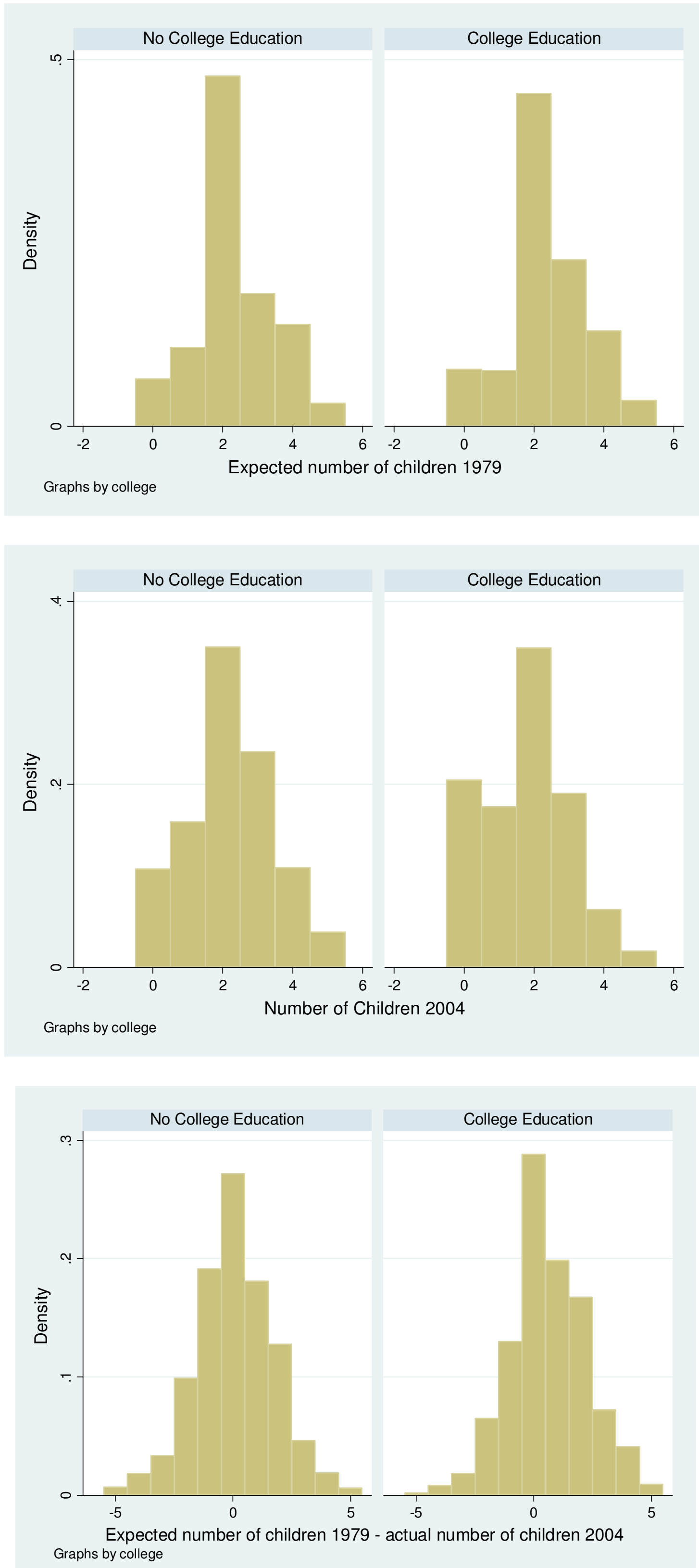
	Years of Education			
	y < 12	y = 12	12 < y < 16	y >= 16
	(n = 351)	(n = 1593)	(n = 1066)	(n = 872)
Expected number of children 1979	2.49	2.43	2.45	2.56
Actual number of children 2004	2.93	2.19	1.99	1.62
Difference	-0.44	0.24	0.46	0.94

Since there are only very small differences in initial fertility expectations across educational groups, observed differences in the "fertility gap" - the difference between actual and expected fertility rates - essentially reflect differences in fertility outcomes. While women with less than 12 years of education have on average 2.9 children, women with at least four years of college have on average only 1.62 children.

The negative correlation between educational attainment and completed fertility has been widely recognized (see, e.g. Dye, 2005), and several studies have attempted to explain the differences between initial expectations and actual fertility outcomes for the highly educated (Quesnel-Vallee and Morgan, 2003; Dye, 2005; Musick and Edgington, 2006; Musick, England, Edgington and Kangas, 2007).

In this paper, we use a large set of empirical strategies to closely evaluate existing explanations for the large correlation between educational attainment and fertility outcomes. Using instrumental variable estimation, we show that on average each additional year of school implies a reduction in subsequent fertility of 0.1 to 0.12 children per woman. We show that this fertility effect can not be explained by differential experience in the labor or marriage market; on average, more highly educated women are more likely to marry and still be married at age 40; while career choice is an important predictor for fertility, it does not appear change the effect of (higher) education on fertility outcomes.

Figure 1: Fertility Expectations and Outcomes: College vs. No College Education



We also investigate the role of unwanted fertility. Although the number of unwanted pregnancies is higher among respondents with less education, differences in family planning do not appear to explain the direct effect of education on fertility choice.

All the evidence provided in our empirical analysis strongly points towards a direct effect of education on (fertility) preferences. Continued exposure to new knowledge, and in the case of college also new social environments, are likely to affect individual attitudes towards families and the relative importance of careers and family. This interpretation appears to be consistent with the relatively larger effects found for the Hispanic and African American sub-samples: the more different the educational experience from the respondent's background, the larger the induced change in preferences is likely to be. We also test the "induced change in preferences" hypothesis by comparing the impact of educational attainment across parental education groups; on average, the fertility effect of education is significantly lower for respondents whose mother or father attended college than for respondents with less educated parents.

The rest of the paper is organized as follows: we briefly present the NLSY79 data in Section 2 and then show our main empirical results in Section 3. In Section 4, we discuss alternative explanations and provide further robustness checks. Section 5 concludes.

2. Data: The NLSY79 Survey

The data used in this paper are based on the National Longitudinal Survey of Youth (NLSY79) conducted by the U.S. Bureau of Labor Statistics. The NLSY79 consists of a nationally representative[2] sample of 12,686 young men and women, aged 14-22 years when first interviewed in 1979. Respondents were interviewed every year between 1979 and 1994, and in 2 year intervals since then. We restrict the sample to

[2] As summarized in the descriptive statistics in Table 1, the NLSY79 over-sampled black and Hispanic populations, with a respective fraction of 0.31 and 0.19 in the non-weighted sample

women with complete records for both 1979 and 2004, which leaves us with a sample of 3812 observations[3]. The NLSY79 is extremely rich in detail, and does not only offer detailed information on each individual's socioeconomic background, but also on respondents' health, social relationships and - most important for the purpose of this analysis - on respondents' family planning desires, actions and outcomes. As shown in Table 1, 13% of women were married when first interviewed in 1979, while 31% of women were still in school.

In 2004, when the youngest women in the sample completed their 40th birthday, 85% of women had been married at least once, and most women had completed their family planning. The average number of life births given by the women in the sample was 2.07. With only very few women still expecting children, this average seems consistent with current US total fertility estimates around 2.1 (Chandra, Martinez et al., 2005).[4] The NLSY79 1979 survey round contained three different fertility expectation questions: first, individuals were asked about the ideal family size in general;[5] in a second question, individuals were asked about how many children they themselves would like to have[6]; last, respondents were asked about how many children they actually expected[7].

While the first question is most likely to capture broad fertility norms, the second question directly aims at getting at individual fertility desires, while the last question directly asks about individual expectations. As shown in Table 1, the ideal number of children (2.97) was substantially larger than the desired number (2.52) in 1979, highlighting the differences between general (external) family ideals and own fertility desires. Even though the number of children desired and the number of children expected

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[3] Over the period 1979 to 2004, the initial sample of 12,686 has shrunk to 7661 respondents. 52% of these remaining respondents were the females.
[4] It should be noted though that African American and Hispanic women with higher average fertility outcomes are overrepresented in the sample. Using the NLSY sampling weights to generate a representative sample mean we find an average number of children around 1.9 in our sample.
[5] The survey question was "Now I'd like to ask you your opinions and expectations about family size: first, what do you think is the ideal number of children for a family?"
[6] The survey question was "How many children do you want to have?"
[7] The survey question was "Altogether, how many (more) children do you expect to have?". For those women who already had children, the (total) expected number of children is given by expected number of children plus the number of children already born.

coincide for 72% of respondents in our sample, the mean number expected is slightly below the mean number desired. We focus on the expected number of children in the rest of this paper since it appears to be the best predictor of future fertility outcomes from an individual perspective; given the high degree of correlation (0.7) between desired and expected family size most results look very similar if initial desires rather than expectations are used in the empirical analysis.

Table 2: Descriptive Statistics - Sample Characteristics

Sample Characteristics	Mean	Std. Dev.	Min	Max
Year of birth	1960.58	2.20	1957	1964
African American	0.31	0.46	0	1
Hispanic	0.19	0.39	0	1
Respondent Status 1979				
Married	0.13	0.33	0	1
Currently working	0.39	0.49	0	1
Years of education completed	10.43	1.98	0	16
Currently enrolled in school/college	0.31	0.46	0	1
Number of births given	0.21	0.55	0	5
Expected number of children	2.47	1.41	0	20
Desired number of children	2.52	1.53	0	14
Ideal number of children	2.97	1.33	0	15
Respondent Status 2004				
Married	0.57	0.49	0	1
Never married	0.15	0.36	0	1
Years of education completed	13.36	2.48	0	20
Working	0.74	0.44	0	1
Number of children	2.07	1.41	0	11
Number of children expected	0.05	0.29	0	4

Notes:
Descritpive statistics are based on 3882 women with complete records.

3. Empirical Strategy and Main Results

Since we want to investigate the relationship between educational attainment and the fertility gap, the main equation that we wish to estimate takes on the following form:

$$F_i^{04} - E_{79}(F_i) = \alpha + \beta Educ_i + \gamma E_{79}(F_i) + \delta X_i + \varepsilon_i \quad (1)$$

where F_i^{04} is completed fertility (number of life births given) in 2004, $E_{79}(F_i)$ is the expected number of children in 1979, $Educ_i$ is the number of years of schooling completed by individual i, X_i is a vector of control variables, and ε_i is the residual. Given that the deviations from initial expectations are likely to depend on the initial level of expectations, we control for initial expectations in most of our empirical specifications. With the inclusion of initial expectations in the set of right-hand-side variables we can rewrite equation (1) as

$$F_i^{04} = \alpha + \beta Educ_i + (\gamma - 1)E_{79}(F_i) + \delta X_i + \varepsilon_i \qquad (2)$$

which means that analyzing the "fertility gap" is empirically identical to directly analyzing fertility outcomes.[8]

We start by estimating equation (1) in a basic OLS framework. In Table 3, we take the fertility gap as our dependent variable, and regress it on an increasing set of correlates. Column 1 of Table 3 shows the simple correlation between the highest grade completed and the fertility gap: a point estimate of 0.146 implies that additional five years of schooling increases the fertility gap by 0.73 children. This is very similar to the difference between the average fertility gap for respondents with high school (-0.24) and those with at least 4 years of college (-0.92) in Table 2.

In Column 2 of Table 3, we add indicators for the African American and Hispanic sub-samples, respectively; both groups get on average closer to their fertility expectations, even though this difference is not significant for African American women once we control for a more extensive set of covariates (Columns 4 and 5). In Column 3 we also control for the initial number of children expected and respondent's birth year to make sure that our result is not driven by respondent's from different initial cohorts or with particularly high (or low) initial expectations. Even though the younger cohorts

[8] Excluding initial expectations from the right hand side requires γ=1, a restriction which does not appear to be warranted from an empirical perspective.

(later birth years) seem to display a slightly larger average fertility gap, this difference is not significant in most specifications.

In Column 4, we add several family characteristic controls, and in Column 5 we also control for initial rural residence and family income. While parents' education does not appear to affect the fertility gap, a larger number of siblings appear to have a negative and highly significant impact on the fertility gap. One may interpret this as evidence for women growing up in larger families wanting to recreate their home environment; it also appears consistent with a recent study by Kuziemko (2006), who finds that young women are more likely to give births after any of their siblings give birth.

Rural residence in 1979 appears to have very little predictive power on later fertility outcomes. Family income - which unfortunately is only available for 80% of the sample, appears to have a small, and positive effect on fertility outcomes. A one standard deviation increase (US$ 12k) increases subsequent fertility by only about 0.05 children. We also test alternative specifications with family income in 2004 and find a negative, but very small effect on fertility without altering the estimated coefficient on education[9].

In Appendix Table A1 we repeat the regression displayed in Column 5 in different sub-samples to make sure that our estimates are not biased by specific parts of our sample. The results are very robust with respect to education: on average, each year of education appears to increase the fertility gap by roughly 0.1 children once individual and family characteristics are controlled for.

The results from Table 3 suggest that observable individual characteristics account for about 20-25% of the observed correlation between educational attainment and the fertility gap. Once we control for all available individual characteristics, the average fertility gap associated with 5 years of schooling (college) shrinks from 0.7 to somewhere between 0.50 and 0.55. Even though the conditional correlation is

[9] We exclude 2004 incomes in most of our specification since it appears to have little effect on fertility outcomes and raises additional endogeneity concerns.

significantly smaller than the unconditional one, the remaining correlation between educational attainment and the family gap is surprisingly large: an estimated effect of 0.1 per year of schooling implies that on average every second woman with 5 years of college education had one child fewer in 2004 than she expected in 1979.

Table 3: Educational Attainment, Fertility Expectations and Outcomes

Dependent Variable	**Expected Number 1979 - Actual Number of Children 2004**				
	(1)	(2)	(3)	(4)	(5)
Highest grade completed	0.146***	0.139***	0.130***	0.104***	0.111***
	(0.013)	(0.013)	(0.0096)	(0.011)	(0.013)
Hispanic		-0.143*	-0.315***	-0.206***	-0.205**
		(0.082)	(0.059)	(0.077)	(0.086)
African American		-0.337***	-0.203***	-0.0214	-0.0168
		(0.069)	(0.051)	(0.060)	(0.068)
Birth year			0.0157	0.0176*	0.0112
			(0.0098)	(0.011)	(0.012)
Expected children 1979			0.877***	0.888***	0.877***
			(0.018)	(0.019)	(0.021)
Siblings				-0.0612***	-0.0626***
				(0.011)	(0.013)
Father years of schooling				0.00328	0.000608
				(0.0086)	(0.0097)
Mother years of schooling				0.00456	-0.00412
				(0.011)	(0.012)
Father foreign born				-0.0179	-0.0219
				(0.11)	(0.12)
Mother foreign born				0.0790	0.0999
				(0.10)	(0.11)
Rural residence 1979					0.0288
					(0.056)
Family income 1979 (US$ k)					0.00397*
					(0.0021)
Constant	-1.554***	-1.336***	-4.329***	-4.035***	-3.650***
	(0.18)	(0.19)	(0.60)	(0.67)	(0.76)
Observations	3882	3882	3882	3208	2585
R-squared	0.04	0.04	0.48	0.49	0.48

Notes:
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Educational Attainment and the Fertility Gap: Correlation or Causality

Despite the strong and robust correlation between educational attainment and the fertility gap found, little can be deduced in terms of a causal link from education to the fertility gap from the results displayed in Table 3. From an individual perspective, education and fertility are choice variables which are unlikely to be independent from each other. As much as going to college may condition later fertility choices, child birth (especially if it occurs at young ages) is likely to affect educational choices. Since we observe both education and fertility outcomes around age 40, the observed correlation may be due to causality going in either direction, or, alternatively, be due to unobserved shocks of shifts in preferences affecting both choice variables at the same time.

To deal with these simultaneity issues, we instrument for educational attainment and estimate equation (1) in a Two-Stage-Least-Squares framework. The instrumental variable approach allows us to identify the causal effect of educational attainment on the fertility gap under two conditions: first, the instrument needs to predict the actual educational attainment; second, the instrument needs to be orthogonal to the error term in equation (1), which implies that the variable is not influenced by fertility and also does not affect fertility choices through channels other than education.

The first set of instruments we use is the years of education completed by the respondent's mother and father, respectively. Parents' education has frequently been used as instrument for educational attainment; it generally works well as predictor or educational attainment. From a theoretical viewpoint, one might argue that parental education might have a direct effect on fertility outcomes: highly educated parents might be more likely to be geographically mobile and economically active making them less available for childcare support. On the other hand, more highly educated parents may on average be healthier and financially independent, and thus be more supportive of more children. Empirically, we find support for neither claim: the direct effect of parental education on fertility appears does not appear to be significantly different from zero[10].

The second instrument we use is educational expectations. In the 1979 survey, respondents were asked about their own educational expectations, as well as about the educational expectations of their closest friend[11]. The average expected years of schooling was 13.7 years, slightly higher than the actual outcome (13.4 years). Educational expectations were on average quite accurate: the correlation between expected and actual years of education is 0.64 in the full sample, and 0.55 when only those respondents under age 18 are taken into account. The respective correlations between the educational expectations of the closest friend and actual educational attainment are 0.44 (full sample) and 0.37 (under age 18 in 1979).

To make sure that our results are not affected by the choice of a particular instrument we first show the two expectation instrument separately in Columns 1 to 2 of Table 4, and then jointly in Column 3. In Column 4, we show the results when parental education is used as instrument rather than the educational expectations variables; last, in Column 5, we use all the instruments at the same time.

The instrumentation appear to work very well, and produce highly consistent estimates. As shown in Appendix Table A2, the instruments are highly significant in the first stage; the Cragg-Donald F-stat for weak identification ranges between 226 (parental education only) and 1407 (own educational expectations only). In Columns 3 to 5, where we use more than one instrument, we also perform the Hansen over-identification test to evaluate the exogeneity of our instruments; p-values between 0.75 and 0.98 speak strongly against potential endogeneity of the variables.

[10] The positive effect of parental income found in Table 3 points towards a small and positive effect of parental income (but not education) on fertility.

[11] The survey question was: "Now think about your best or closest friend. What is the highest grade or year of regular school that this friend wants to complete?"

Table 4: Educational Attainment, Fertility Expectations and Outcomes: 2SLS Estimation

Dependent Variable	**Number of Children 2004 - Expected Number 1979**				
	(1)	(2)	(3)	(4)	(5)
Highest grade completed[a)]	0.126***	0.118***	0.125***	0.117***	0.123***
	(0.019)	(0.030)	(0.019)	(0.029)	(0.016)
Constant	-4.048***	-3.953***	-4.037***	-3.941***	-4.032***
	(0.71)	(0.74)	(0.70)	(0.81)	(0.70)
Instrument I[b)]	E(educ)	E(educ_f)	E(educ)	educ_m	all
Instrument II[b)]			E(educ_f)	educ_f	
Cragg-Donald F-stat	1407	458.9	729.7	226.7	530.9
Hansen OID test			0.749	0.952	0.983
Observations	3147	3147	3147	3147	3147
R-squared	0.49	0.49	0.49	0.49	0.49

Notes:
a) Variable is instrumented.
b) E(educ), E(educ_f) are the expected years of education of respondent and respondent's best friend respectively. Educ_m and Educ_f are the years of education completed by respondent's mother and father, respectively.
All specification include controls for race, birth year, expected number of children 1979, number of siblings and parental background controls. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As to educational attainment, our main variable of interest, the point estimates from the 2SLS regressions are very similar to the basic OLS results displayed in Table 3. On average, each year of schooling seems to increase the fertility gap by 0.11 to 0.12, very similar to the results obtained from the basic OLS regressions. A standard Hausman specification test fails to reject the hypothesis of coefficient equality across the two estimates.

The results from our instrumental variable estimation imply that the effect of education on fertility are neither generated by feedback effects from fertility to education, nor by any common factor affecting both fertility and educational choices at later stages of life. Given that we use ex-ante knowledge (expectations, parental background) to predict education, the results imply that it is the education choice itself that determines later fertility outcomes which are not initially expected by the respondents. This is hard to reconcile with the traditional Becker model. In the traditional Becker framework (Becker, 1960), more human capital implies a higher opportunity cost for women, and thus less time spent on child rearing. From a theoretical viewpoint, it is not clear how much the traditional model applies to the US; if women have rational expectations about their future education and income, they should correctly forecast the true cost of child bearing, and no systematic differences between fertility expectations and outcomes should occur. Second, and more importantly, the traditional model of women staying at home with their kids does not really describe the US situation very well, where a large majority of women return to the labor force very quickly after giving birth. On average, 54% of women work more than 26 weeks in the year following birth as compared to 64% in the full sample. If a majority of women outsource child-care, higher education should actually reduce rather than increase the true cost of child-bearing. Musick et al. (2007) directly test the income and wage effects and find not clear relation between incomes and birth probabilities in a dynamic setting.

The robust results from our IV estimation allow two interpretations: first, individuals who (intend to) get higher education are more likely to systematically underestimate the cost or difficulties associated with child birth at later stages of life. Second, the exposure to higher education (and the associated later entry into the labor market) itself make individuals change their relative family preferences. While it is possible that individuals with higher education may underestimate the true cost of child-bearing, it is not obvious why this would be the case. As we will show below, highly educated respondents are more likely to get married, and have higher personal (and family) on average, which should make child bearing much more affordable. It is also unlikely that women systematically underestimate their future income - individuals do well in predicting their education, and should therefore also be able to predict future incomes relatively well.

In the light of our results, the second hypothesis - that education changes preferences - appears more likely. Going to college (which is the critical educational cutoff in the sample) is likely to affect norms and also to induce young women to break with classical role models. One way to investigate this claim is to analyze different sub-groups in our sample. If it is true that going to college changes preferences, this effect should be particularly pronounced in groups where college education was relatively uncommon among the parent generation. While close to 50% of respondents in our sample ended up enjoying at least 1 year of college,[12] college was still relatively uncommon among the Hispanic and African American families[13]. Thus, if it is true that education changed preferences through the continued exposure to new and different values and environment, this effect is likely to be larger for respondents whose families with smaller previous exposure to higher education.

In Table 5 we split the sample into "African American", "Hispanic" and "Other"; the point estimates on fertility change remarkably: while the coefficient on education increases by more than fifty percent to 0.20 when we analyze the African American or Hispanic samples only, it drops by nearly 50% to 0.06 in the "White" sample.

Table 5: Ethnic Background and Educational Effect

Dependent Variable	**Number of Children 2004 - Expected Number 1979**				
	(1)	(2)	(3)	(4)	(5)
Highest grade completed[a)]	0.123*** (0.016)	0.210*** (0.029)	0.206*** (0.043)	0.204*** (0.038)	0.0640*** (0.018)
Sample restriction I	-	non-white	African-American	Hispanic	White
Observations	3147	1396	833	563	1751
R-squared	0.49	0.52	0.53	0.52	0.45

Notes:
a) Variable is instrumented by the expected years of education of respondent and respondent's best friend as well

[12] 53% of white women, 50% of African American and 42% of Hispanic women in our sample had completed at least one year of college in 2004.
[13] 23% of White mothers had completed at least one year of college. Out of the African American sample, this was the case for only 11%; out of the Hispanic sample, for only 7%.

as parental education.
All specification include controls for race, birth year, expected number of children 1979, number of siblings and parental origin. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Another, and more direct, way of testing the "preference change hypothesis" is to directly interact parental background with education. If it is true that more years of education change fertility preferences through the exposure to new ideas and social environments, then this effect should be particularly pronounced for those young women whose parents did not experience higher education.

In Table 6, we test this claim by adding an interaction term between educational attainment and parental college experience to our empirical specifications.

Table 6: Parental College Experience

Dependent Variable	**Number of Children 2004 - Expected Number 1979**					
	(1)	(2)	(3)	(4)	(5)	(6)
Highest grade completed	0.116***	0.149***	0.105***	0.116***	0.139***	0.107***
	(0.013)	(0.029)	(0.014)	(0.013)	(0.029)	(0.015)
Mother College	1.152***	0.309	1.218***			
	(0.42)	(1.11)	(0.45)			
Mother College * highest grade completed	-0.0745***	-0.00450	-0.0810***			
	(0.028)	(0.072)	(0.029)			
Father College				0.732*	-1.165	0.957**
				(0.39)	(1.39)	(0.39)
Father College * highest grade completed				-0.0510**	0.0797	-0.0663**
				(0.026)	(0.089)	(0.026)
Sample restriction I	-	African American	Non African American	-	African American	Non African American
Observations	3208	850	2358	3208	850	2358
R-squared	0.49	0.53	0.47	0.49	0.53	0.47

Notes:
All specification include controls for race, birth year, expected number of children 1979, number of siblings and parental origin. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Columns 1-3, we test the effect of having a mother with college experience, and in Columns 4-6 we test the effect of having a father with college experience. As expected, the interaction term is negative: the effect of education on fertility is smaller if either parent has attended college. This effect appears to be highly significant in the White and Hispanic samples, but less pronounced in the African American sub-sample. In the Non-African-American sample we get a point estimate of -0.08, which means that education has close to zero effect on fertility if the respondent's mother had at least one year of college.

4. Discussion, Alternative Theories and Robustness checks

The results presented in the previous section have yielded one central result: higher educational attainment leads to lower fertility and - since there are essentially no differences in initial fertility expectations[14] to a larger fertility gap. There are, however, several other factors which might explain the negative correlation between education and fertility outcomes.

One such alternative explanation for the differences in fertility observed across educational attainment group (highlighted in Musick et al (2007)) are differences in the degree to which respondents manage to control their fertility. According to the 2002 National Survey of Family Growth, 21% of women with high school as highest degree completed reported an unwanted birth, while only 5% of women with a college degree report to ever have had an unwanted birth (Chandra, Martinez et al., 2005). In our sample, the average number of unwanted pregnancies[15] among college educated women was 0.03; the average number of unwanted pregnancies was 0.096 among women with 12 or fewer years of completed education. Re-estimating our main equations with the "adjusted fertility gap" (expected number of children - actual *wanted* number of children)

[14] The correlation between the highest grade completed and fertility expectations is 0.01; the correlation between the highest grade expected and the total number of children expected 0.03.

[15] Respondents were asked in the survey round following the birth whether the pregnancy was wanted. The possible answers were "yes", "didn't matter", "mistimed" and "unwanted".

yields an education coefficient between 0.10 and 0.12, nearly identical to the results found in Table 4. Musick et al. (2007) argue that also "mistimed" pregnancies should be taken into account. This, however, is not obvious; "mistimed" children are by definition desired; even if the timing may be inconvenient, it is not clear why these births should not account towards the fulfillment of individual fertility expectations.[16]

Another potentially important factor is the timing of events; at the time of the first interview, respondents were between 14 and 22 years; some were married, some already had children; both factors are clearly correlated with educational and fertility outcomes. In Table 5 below, we show how the estimated coefficient on educational attainment changes under various censoring conditions. In Column 1 of Table 5, we show the unrestricted results from Column 5, Table 4. In Column 2, we exclude those women who were already married in 1979, and in Column 3 we exclude both those married and those who already have kids. Both exclusions lower the estimated effect of education, which is intuitive. Out of all women with high school or lower education, 25% were married by age 18, and 55% had given birth at least once by age 21. Restricting the sample to those without children and non married does not cut out outliers, but, quite on the contrary, cuts out those respondents with less education who are most likely to achieve their fertility goals and thus biases the results.

In Columns 4 and 5 of Table 5 we directly test this hypothesis. If it is true that it is sample selection that drives the lower coefficients in Columns 2 and 3, then we should see much more pronounced differences for the older age cohorts than for the younger ones. Before age 18, marriage and child birth is relatively uncommon for both the highly and the less educated, so that sample selection should be a minor issue. After age 18, this changes, with a large fraction of high school graduates starting to get married and have children. Since sample selection will bias the estimated coefficient towards zero, we should thus see a much smaller estimate in the group above age 17 than in the group aged 17 or less. This is exactly what we find. When we restrict our analysis to single

[16] On average, the highly educated have fewer "mistimed" children than the less educated; taking only the "correctly timed" births into account, results in a point estimate of 0.9-0.1.

respondents without kids aged 17 or younger in 1979 (Column 5, Table 5), the estimated coefficient is virtually identical to the full sample results (0.12). When we impose the same restrictions on respondents aged 18 and older in 1979 (where the selection bias will be largest), the estimated coefficient drops sharply, and is no longer significantly different from zero.

Table 7: Sample Restrictions

Dependent Variable	**Number of Children 2004 - Expected Number 1979**				
	(1)	(2)	(3)	(4)	(5)
Highest grade completed[a)]	0.123***	0.0988***	0.0668***	0.0211	0.127***
	(0.016)	(0.018)	(0.018)	(0.021)	(0.030)
Sample restriction I	-	single	single	single	Single
Sample restriction II	-		No kids	No kids	No kids
Sample restriction III				age >17	age <18
Observations	3147	2720	2535	1363	1172
R-squared	0.49	0.51	0.53	0.52	0.53

Notes:
a) Variable is instrumented by the expected years of education of respondent and respondent's best friend as well as parental education.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7 highlights a more general point. Since women with higher education start having children significantly later, comparing parities across educational groups is problematic, and does not allow valid inference regarding the effect of delaying birth to later ages.

Another potentially important factor for explaining fertility differential is the marriage market. Marriage markets might be more difficult for highly educated women, and the additional time spent in school therefore reduce fertility. The NLSY79 provides little evidence for the first claim: in 2004, 69.6% of women with at least 4 years of college are married, while the same is true only for 51.7% of women with high school or lower education. Similar, the percentage of women never married is 16.7% among those with high school or lower education, but 13.2% for those with 4 or more years of college.

One might still argue that higher education implies that later wedding dates, and may thus limit the degree to which individuals can achieve their fertility expectation. In Table 8, we directly test the effect of first marriage on the fertility gap for those woman in the sample who ever got married. While the estimated coefficient on educational attainment does not change, we find a negative coefficient on the age of first marriage, which is somewhat surprising. The estimated magnitude, however, is very small: a delay in the age of first marriage leads to an increase in fertility of around 0.01 children per woman.

Table 8: Age at First Marriage

Dependent Variable	**Expected Number of Children 1979- Number of Children 2004**				
	(1)	(2)	(3)	(4)	(5)
Highest grade completed[a)]	0.123***	0.123***	0.231***	0.199***	0.0506***
	(0.016)	(0.016)	(0.044)	(0.037)	(0.018)
Age at first marriage		-0.000969***	-0.000715***	-0.00114***	-0.00139***
		(0.000072)	(0.00011)	(0.00017)	(0.00011)
Sample	All	All	African-American	Hispanic	White
Observations	3147	3089	813	552	1724
R-squared	0.49	0.52	0.55	0.56	0.50

Notes:
a) Variable is instrumented by the expected years of education of respondent and respondent's best friend as well as parental education.
All specification include controls for race, birth year, expected number of children 1979, number of siblings and parental origin. Robust standard errors in parentheses
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Another potentially confounding factor is location; if it is true that the highly educated systematically self-select to specific (urban) areas characterized by high housing or child care cost, this might at least partially explain the observed correlation between educational attainment and the fertility gap. To investigate this, we estimate equation (1) and include fixed effects for respondent's county of residence in 2004. Even though there seem to be significant fertility difference across counties, the effect of education on fertility is not affected by the inclusion of county fixed effects[17].

One additional aspect which may be correlated with education is career choice. Since it is hard to argue that the final position attained in 2004 is independent of fertility choices, we use initial (1979) career expectations as proxy for the career path chosen. In Table 9, we include indicator variables for the 20 most frequently expected job in 1979. Among respondents, secretarial work was the most commonly expected job at age 35 (11.2%), followed by nurses (9.3%) and school teachers (6%). On average, about 30% ended up in the sector they expected.

The differences across (expected) professions are surprisingly large and in many cases significant. Respondents who expected to work as hair dresser, social worker and school teacher did on average best in the whole sample. Accountants appear to fare particularly well in the Hispanic and African American sample. While the initial career expectations have large effects on fertility outcomes, they do not change the basic relation between education and fertility outcomes: once we control for the aspired sector of work in Table 9, even though the point estimate on education is not significantly different from our previous results.

4. Summary and Conclusions

In this paper we have used longitudinal data from the US to highlight the important effects of educational choices on subsequent fertility outcomes. We have shown that on average each additional year spent in school reduces fertility by about 0.1 children per woman, and that this effect is particularly large among the minority groups, and among respondents from families without higher education background.

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[17] The Geocode data is confidential and not shown in this version of the paper. Separate result tables are available on request.

Table 9: Career Plans

Dependent Variable	Expected Number of Children 1979- Children 2004			
	(1)	(2)	(3)	(4)
Highest grade completed[a)]	0.138***	0.281***	0.182***	0.0856***
	(0.023)	(0.061)	(0.063)	(0.026)
Expected job:				
Secretary/office clerk	-0.0626	0.190	-0.413*	-0.125
	(0.091)	(0.16)	(0.22)	(0.13)
Nurse	-0.245**	-0.172	-0.181	-0.330**
	(0.10)	(0.19)	(0.26)	(0.14)
Primary or Secondary School teacher	-0.340***	-0.128	-0.476	-0.434***
	(0.11)	(0.22)	(0.29)	(0.15)
Manager	-0.0865	-0.426	-0.306	-0.0328
	(0.12)	(0.34)	(0.30)	(0.14)
Accountant	-0.108	-0.603**	-0.890***	0.272*
	(0.14)	(0.31)	(0.26)	(0.15)
Hair dresser	-0.558***	-0.598**	-0.701	-0.499**
	(0.18)	(0.29)	(0.50)	(0.23)
Physician	-0.277*	-0.502*	-0.202	-0.325
	(0.16)	(0.28)	(0.33)	(0.26)
Lawyer	0.127	-0.0937	0.419	-0.0806
	(0.18)	(0.27)	(0.51)	(0.29)
Social worker	-0.655***	-0.781**	-0.689	-0.609*
	(0.21)	(0.32)	(0.42)	(0.36)
Designer	-0.0192	0.0772	-0.798	-0.00468
	(0.18)	(0.38)	(0.72)	(0.18)
Psychologist	-0.0991	-0.277	0.278	-0.144
	(0.19)	(0.39)	(0.45)	(0.24)
Therapist	-0.218	-0.626	-0.731	0.0185
	(0.23)	(0.43)	(0.58)	(0.30)
Programmer	-0.000165	0.373	-0.797	-0.190
	(0.19)	(0.26)	(0.54)	(0.30)
Sample	All	African-American	Hispanic	White
Observations	2168	668	378	1122
R-squared	0.48	0.53	0.45	0.46

Notes:

a) Variable is instrumented by the expected years of education of respondent and respondent's best friend as well as parental education.

All specification include controls for race, birth year, expected number of children 1979, number of siblings and parental origin. Robust standard errors in parentheses

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All of the evidence collected in this paper strongly speaks against (higher) education as a "hard" constraint for fertility: on average, highly educated women are more likely to get (and remain) married, and also to have the income necessary to finance child care and education. There also appears to be little evidence for women running out of time in their family planning. Even though highly educated women marry and have their first child on average significantly later than women who enter the labor market after high school, the fraction of women expecting to have children after age 38 is very small, both among the group of the highly and less educated[18].

Are fertility expectations irrational then? Not necessarily. When respondents initially indicate their fertility expectations these expectations are largely based on the knowledge and preferences they have before entering college. Once the highly educated start their own families, they have experienced several years of college and lived through their first labor market experience. One may argue that young females simply underestimate the difficulty associated in combining work and family. If this was true, the education effect would depend on the actual job selected since some jobs clearly are more family friendly than others. We did not find any evidence for this in the NLSY sample: when we control for job intentions in our empirical specifications, the effect of education on fertility remains the same. Also, if it was true that women in the 1970s could not foresee later labor market conditions, we should have observed an adjustment in expectations over time. In the NLS survey data, there is no evidence for this. The average number of children expected by young women who later completed college education was 2.5 in 1968, 2.5 in 1979 and still 2.3 in 1997, when the latest NLS young cohort was first interviewed.

Given the evidence presented in this paper the much more likely hypothesis is that continued education changes individuals' preferences towards children. Initial fertility expectations are essentially fertility desires; later adjustments do not mean that initial

[18] In the NLSY79 sample, 6% of women with high school as highest grade completed and 9% of women with at least 4 years of college still expect children.

expectations were wrong - they may simply mean that preferences have changed over time.

The results found in this paper are consistent with the broad evidence on female and education found across countries, and also fit well with the simultaneous increase in tertiary education and declines in fertility observed in many developed countries over the last decades. Our estimates imply that each year of average schooling among young woman lowers total fertility by 0.1 children; with the rapid increase in tertiary education in many OECD countries over the last decades, education has likely contributed significantly to the lower fertility rates observed.

Appendix

Table A1: Educational Attainment, Fertility Expectations and Outcomes: Multivariate Analysis - Robustness Checks

Dependent Variable	Expected Number of Children 1979- Number of Children 2004				
	(1)	(2)	(3)	(4)	(5)
Highest grade completed	0.105***	0.0820***	0.109***	0.0988***	0.111***
	(0.011)	(0.012)	(0.016)	(0.014)	(0.011)
Hispanic	-0.183***	-0.218***	-0.107	-0.149*	-0.181**
	(0.071)	(0.075)	(0.100)	(0.090)	(0.072)
African American	-0.0154	0.143**	0.0177	0.0170	-0.0181
	(0.060)	(0.063)	(0.082)	(0.075)	(0.062)
Birth year	0.0176*	-0.0339***	-0.00442	0.000343	0.0168
	(0.011)	(0.011)	(0.031)	(0.022)	(0.011)
Expected children 1979	0.889***	0.910***	0.908***	0.913***	0.832***
	(0.019)	(0.018)	(0.025)	(0.021)	(0.024)
Siblings	-0.0620***	-0.0666***	-0.0495***	-0.0657***	-0.0622***
	(0.011)	(0.012)	(0.016)	(0.015)	(0.011)
Father years of schooling	0.00332	0.00398	0.0137	0.0102	0.00730
	(0.0085)	(0.0091)	(0.013)	(0.011)	(0.0087)
Mother years of schooling	0.00306	-0.00802	0.00955	0.00341	0.00152
	(0.011)	(0.011)	(0.015)	(0.014)	(0.011)
Rural residence 1979	0.0355	0.0147	0.0705	0.0665	0.0469
	(0.050)	(0.052)	(0.072)	(0.064)	(0.051)
Constant	-4.030***	-0.419	-3.020	-3.026**	-3.970***
	(0.67)	(0.74)	(1.96)	(1.41)	(0.67)
Sample Restriction	none	No children in 1979	Age > 18 in 1979	Age < 19 in 1979	Expected children <5
Observations	3208	2761	1698	2123	3007
R-squared	0.49	0.52	0.50	0.51	0.35

Notes:
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2: Educational Attainment, Fertility Expectations and Outcomes: 2SLS Estimation - First Stage Results

Dependent Variable	Highest Grade Completed (2004)				
	(1)	(2)	(3)	(4)	(5)
Expected years of education	0.592***		0.537***		0.537***
	(0.018)		(0.020)		(0.020)
Expected years of education for best friend		0.382***	0.110***		0.110***
		(0.018)	(0.019)		(0.019)
Father years of schooling	0.0650***	0.0886***	0.0587***	0.132***	0.0587***
	(0.012)	(0.013)	(0.012)	(0.014)	(0.012)
Mother years of schooling	0.0643***	0.135***	0.0614***	0.184***	0.0614***
	(0.016)	(0.017)	(0.016)	(0.019)	(0.016)
Hispanic	-0.170*	0.0935	-0.190*	0.322***	-0.190*
	(0.099)	(0.11)	(0.098)	(0.12)	(0.098)
African American	-0.212***	0.0223	-0.220***	0.176*	-0.220***
	(0.080)	(0.087)	(0.080)	(0.092)	(0.080)
Birth year	-0.0111	0.0123	-0.00194	-0.0236	-0.00194
	(0.015)	(0.017)	(0.015)	(0.018)	(0.015)
Expected children 1979	0.0219	0.0261	0.0134	0.0718***	0.0134
	(0.023)	(0.026)	(0.023)	(0.027)	(0.023)
Siblings	-0.0481***	-0.0618***	-0.0487***	-0.0651***	-0.0487***
	(0.015)	(0.016)	(0.015)	(0.018)	(0.015)
Rural residence 1979	0.140*	0.130	0.129*	0.178**	0.129*
	(0.074)	(0.085)	(0.074)	(0.091)	(0.074)
Constant	4.760***	5.097***	3.550***	11.47***	
	(0.96)	(1.10)	(0.97)	(1.13)	(0.97)
Cragg-Donald F-stat	1407	458.9	729.7	226.7	530.9
Hansen OID test			0.749	0.952	0.983
Observations	3147	3147	3147	3147	3147
R-squared	0.44	0.29	0.44	0.18	0.44

Notes:
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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