Cognitive Ability, Education, and Fertility Risk*

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Abstract

Women in the lowest cognitive ability quartile have nine times more teen pregnancies than those in the top quartile. In this paper, I provide empirical evidence using NLSY79 data about the importance of cognitive ability on pregnancy timing and intention. Next, I build and estimate a life cycle model to analyze whether higher opportunity costs and higher contraception efficiency by education explain the differences in fertility timing between high and low ability women. These mechanisms explain only half of the correlation between ability and teen pregnancy. In order to explain the data, I allow for heterogeneity in contraception efficiency by cognitive ability. Finally, I use the model to show that policies that decrease contraception costs decrease early pregnancies and improve women's welfare but do not improve teen mothers' college attendance, as college is too costly for this group of women, even without a teen pregnancy.

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1 Introduction

One of the most important economic decisions is when having children, as the timing affects parents' and children's welfare, fertility decisions have far-reaching social and economic consequences. Since the introduction of the pill, women potentially have almost complete certainty regarding pregnancies. However, in the US, women report that 41% of pregnancies are not at the right time or even wanted. Moreover, this fraction increase for younger women; for example, among teens aged 15 to 19 years old, the fraction increases to 75% [1], which suggests that an important fraction of women have children, not at the desired moment. In this paper, I study the mechanism behind the fact that teens and out-of-wedlock pregnancies, which in most cases are unintended, are mainly concentrated in low cognitive ability women, with the ones in the bottom ability quartile having nine times more teen pregnancies than women in the top quartile.

Heckman et al. (2006) show that noncognitive and cognitive ability affect multiple social outcomes, including teen pregnancies. However, the channels through which ability affect fertility is an open question. For this reason, in this paper, I study whether the relationship between ability, formal education, and wages can fully explain the role of ability in fertility. The two most studied explanations of why attending college affect pregnancies are the allocation of time theory and differences in contraception efficiency by education groups. The allocation of time theory (Becker, 1965) proposes that highly educated women have a higher opportunity cost of having children early in terms of labor and marriage opportunity. This theory has been explored in multiple studies showing its empirical relevance (Caucutt et al., 2002; Rosenzweig, 1999; Greenwood et al., 2000). The theory of differences in contraception efficiency by education groups comes from Rosenzweig and Schultz (1989), which found that college educated individuals are more efficient at using contraception. This paper shows that the relationship between ability and education partially explains the relationship between ability and fertility timing. However, a relevant fraction remains to be explained, making future research relevant.

The economic and social consequences of unintended pregnancies are multiple. For example, women whose first child was unintended are more likely to be single mothers or enter in

[1] https://www.cdc.gov/reproductivehealth/contraception/unintendedpregnancy/index.htm

shot-gun marriage with higher divorce probability (Kozlov, 2021). As a result, their children are more likely to grow up in single-parent houses performing worse in multiple educational and economic outcomes (Kearney and Levine, 2017). Moreover, mothers with early or unintended pregnancies also perform worse economically and socially (Amador, 2017; Foster et al., 2018; Levine and Painter, 2003). Additionally, out-of-wedlock pregnancies are more common in low income women decreasing intergenerational mobility.

The paper is related to several branches of economic literature. First, it relates to the literature on dynamic models with endogenous family formation and fertility choices. For example, Regalia et al. (2011) study how the change in relative wages affects the number of single mothers; Caucutt et al. (2002) study how child investment, marriage, and labor market outcomes shape women's fertility timing; Choi (2017) shows that to simultaneously account for the observed heterogeneity in births and abortion across educational groups, differences in fertility risk by education are necessary; Filote et al. (2019) study how the welfare state affects teenage childbearing behavior through a parental investment model with risky sexual behavior; Kozlov (2021) study how unintended pregnancies affect marriage and divorce. Finally, Seshadri and Zhou (2022) study how heterogeneity in fertility planning affects children's investment and shapes intergenerational mobility.

Second, it is related to the empirical literature on education and fertility. For example, Rosenzweig and Schultz (1989) shows that contraception method efficiency increases with education, and Musick et al. (2009) found that the gradient in fertility by education comes primarily from unintended childbearing, not differences in opportunity cost, which suggests a missing mechanism in the literature through which education affects fertility. Finally, it relates to the literature on the return on cognitive ability, noncognitive ability, and education on behavioral outcomes. For example, Heckman et al. (2006) found that cognitive and noncognitive abilities decrease the probability of teenage pregnancy; at the top of the cognitive and noncognitive ability distribution, the likelihood of unintended pregnancy is close to zero. Heckman et al. (2018) found that increasing cognitive endowments positively affects education, wages, smoking, and health outcomes. Meanwhile, increasing noncognitive endowments primarily affects smoking and health outcomes. Additionally, education affects the present value of health and smoking. Hai and Heckman (2022) found that an extra year of schooling reduces smoking by 21%.

I provide two contributions. First, I document a positive relationship between cognitive ability, fertility timing, and intention, which decreases with age. Second, I build and estimate a dynamic choice model with endogenous fertility, education, and marriage, in which contraception efficiency depends on cognitive ability. Then, I estimate the model to quantify the importance of cognitive ability and education on women's fertility timing and risk.

In order to study the relationship between ability and fertility, I use the National Longitudinal Survey of Youth 1979 (NLSY79) as it measures cognitive ability, women's fertility, and labor outcomes until their late forties. As said before, women in the lowest ability quartile are nine times more likely to have their first pregnancy between 14 and 17 years old than women in the top quartile (29% vs. 3%). However, after 22 years old, this gap disappears.

Next, I estimate a static linear model with the ability as a latent variable. This method allows control by measurement error and simultaneous causation bias (Hansen et al., 2004). I found that with age, the importance of cognitive ability in the first pregnancy decreases and even changes sign. The magnitude of cognitive ability is quantitively significant, with its interdecile range decreasing the probability of pregnancy by 98% between 14-17 years old and 65% between 18-22 years old. Interestingly, even when between 22-29 years old, women in the top ability decile are 27% more likely to have their first pregnancy than the ones in the bottom; they are 7% less likely to have an unintended pregnancy. This finding is consistent with research that argues that cognitive ability improves women's fertility planning (see, Commendador (2007)).

Then, I build and estimate a dynamic life cycle model with endogenous fertility, education, and marriage, finding that differences in opportunity cost by ability and differences in contraception cost by education cannot fully account for the relationship between ability and fertility and only explain half of the correlation between ability and teen pregnancies. Finally, I use the model to show that, consistent with empirical findings, improvements in contraception have a small effect on college attendance, as women who have teen pregnancies are too disadvantaged to attend college even without a child.

2 Empirical Evidence

In this section, I provide empirical evidence on the effect of cognitive ability on fertility using the National Longitudinal Survey of Youth (NLSY79) data. First, I describe the dataset. Second, I show descriptive statistics relating cognitive ability, early pregnancies, education, and marriage. Finally, I estimate a linear static model at different ages to measure the effect of cognitive ability on fertility across the lifecycle.

2.1 Data description

The National Longitudinal Survey of Youth 1979 follows a representative sample of American youth born between 1957-64 who were 14-22 years old when first interviewed in 1979. I use the observations from women whose first pregnancies end in a live birth. For this reason, in the paper, childbirth and pregnancy are synonymous. The survey has three essential characteristics for the paper: First, in 1980, participants' cognitive ability was measured through a cognitive test. Second, participants have been followed for more than 40 years, and women in the sample have already finished their reproductive life. Third, mothers in the survey were asked if the pregnancy was intended at the moment of conception.

In 1980 NLSY participants answered ten intelligence tests referred to as the Armed Services Vocational Aptitude Battery (ASVAB). Using a sub-sample of the ASVAB test, it is possible to construct an approximate score of a general cognitive ability test known as the Armed Forces Qualifications Test (AFQT). The test is the standard measure used in the literature to approximate cognitive ability. I use this measure to rank women in cognitive ability percentiles. After dropping the observations with missing ASVAB values, I have a panel of 5939 women.

Table 1. National Longitudinal Survey of Youth 1979 Sample Size Summary

	Low Ability			High Ability			
Age First Pregnancy	High School Drop.	High School	College	High School Drop.	High School	College	Total
14-17	233	425	19	13	126	22	838
18-21	178	818	52	12	434	54	1548
22-29	82	587	81	2	551	406	1709
No child at 30	67	528	93	11	544	601	1844
Total	560	2358	245	38	1655	1083	5939

Notes: Sample size by bins. Observations are bin by mother's age at first pregnancy, higher education achieved during the survey, and whether she is below or above the mean AFQT. The sample includes all NLSY79 women surveyed without missing AFQT scores and pregnancy information.

I divide women's fertility life into three periods. I focus on first birth before the age of 30, as 90% of firstborn children are born before this age. In the first period, women are in high school age (14 to 17 years old). In the second period, women are of college age (18-21 years old). Finally, in the third period, they are young adults between 22 and 29. I classify individuals as having high or low ability depending if they are above or below the sample mean. Table 1 shows the number of observations by age at first pregnancy, ability, and education. The relationship between ability and education outcomes is clear as almost no high ability women drop out high school and few low ability graduate from college.

2.2 Descriptive Statistics

In this subsection, I describe the data characteristic that I focus on. The purpose of the paper is to understand how cognitive ability affects fertility. Given that pregnancies affect the cost of education, labor supply, and marriage. I focus on the data characteristics that connect cognitive ability, pregnancy timing, education, wages, and marital outcomes.

2.2.1 Cognitive Ability and Age at First Childbirth

Table 2 displays the joint distribution between age groups, ability quartiles, and pregnancy outcomes conditional on not having childbirth in the previous age bin. For example, the interpretation of the first column, third row, is that half of the women in the first ability quartile who did not have childbirth before 22 years old had one between 22-29 years old.

Table 2. Joint Distribution First and Unwanted First Pregnancy by Age and Cognitive Ability

	Ability Quartile			
	First Quartile	Second Quartile	Third Quartile	Four Quartile
Age First Pregnancy	Pregnancy Probability			
14-17	26%	15%	9%	3%
18-21	54%	43%	28%	16%
22-29	48%	48%	45%	45%

Notes: Women are bin by cognitive ability scores and age. Women are separated by ability scores at the beginning of the sample. Each age-ability bin only considers the sample of women without a pregnancy before the initial age at each respective bin. The pregnancy probability is calculated as the ratio of women with a pregnancy at a particular age-ability bin over the total number of women in the respective bin.

We observe a positive relationship between ability and age at first birth that disappears with age. Between 14 and 17 years old, 26% of women in the bottom ability quartile had their first pregnancy; meanwhile, only 3% in the top cognitive quartile. This difference means nine times more pregnancies for women in the lowest ability quartile compared to those in the top. As women grow, the ratio reduces to 3.37 between 18-21 and just 1.06 between 22-29 years old.

2.2.2 Pregnancy Timing and Education

Table 3 shows the joint distribution of women's age at first pregnancy and the highest educational level achieved. First, we observe that most pregnancies occur at ages when women are expected to have completed their final education level. For example, 82% of high school graduates had their first child after high school age, and 73% of college graduates had their first pregnancy after college age.

Table 3. Conditional Distribution Age First Pregnancy by Education Outcomes

	Education Outcome		
Age at First Pregnancy	High School Dropout	High School Graduate	College Graduate
14-17	48%	18%	6%
18-21	40%	50%	21%
22-29	12%	32%	73%

Notes: The table shows the fraction of women that had their first pregnancy at each respective age group by the highest education achievement reported in the sample. Each column sum 100.

Education outcomes and pregnancies cause mutually. On the one hand, children are costly in time and money. Pregnancies make women more likely to drop out or not pursue higher education degrees, causing a relationship between early pregnancies and low educational outcomes. On the other hand, women with low cognitive ability attain lower education levels, which allows them to have children early, relating cognitive ability and pregnancy timing. For this reason, in the following section, I use a dynamic model to answer whether low ability women have low education achievement because they are young mothers or whether they have children young because it is the optimal time as pursuing higher education is too costly.

2.2.3 Early Pregnancies and Marriage

Becker (1991) argues that out-of-wedlock children decrease the likelihood of the mother's future marriage by reducing her net resources and raising the cost of searching for a husband. Bronars and Grogger (1994) find that women with unplanned births were, on average, 13 percentage points less likely to be married while their children were young, the differential narrowed only to 9 percentage points by the time their children were preteenagers.

Model tractability does not allow me to develop a model with a frequency such that I can study how out-of-wedlock pregnancies affect marriage timing. So instead, I study the out-of-wedlock birth effects on the probability of marriage during the mothers' lifetime and the husbands' quality measured by their income. Women with out-of-wedlock birth have a similar probability of marriage during their lifetime than women without it. However, on average, their husbands have lower wages.

Table 4. Probability of ever marriage single mother vs non single mothers

	High School Dropout	High School Graduate	College Graduate
Age at Pregnancy		Single Mothers	
14-17	77%	86%	91%
18-21	73%	84%	88%
22-29	48%	73%	83%
		Non Single Mothers	
	82%	83%	83%

Notes: The table shows the probability of ever marriage for women with and without out-of-wedlock childbirth. In the case of women with out-of-wedlock pregnancies, the probabilities are disaggregated by age at pregnancy. The probability is defined as the number of women who married at some point over the survey over the number of women in the respective bin. "Ever marriage" is defined as reporting at least one marriage during the survey.

Table 4 compares the marriage probabilities of single mothers to non-single mothers. In the case of single mothers, I look at the marriage probability conditional on their age at first pregnancy. The marriage probability for single mothers increases with education and decreases with age at childbirth. For example, 86% of high school graduate single mothers between 14 and 17 years old married after birth compared to 73% of single mothers between 22-29 years old with the same education level. Additionally, 73% of 18 to 21 years old high school dropout single mothers got married compared to 88% of college graduates. For non-single mothers, the fraction who married is around 83% for the three education groups. Out-of-wedlock pregnancies only decrease the probability of finding a husband for high school dropouts.

Table 5. Average Husband Wage by Education and Women Children at Marriage.

	High School Dropout		High School Graduate		College Graduate	
Age Fir. Preg.	Out-Wed.	No Out-Wed.	Out-Wed.	No Out-Wed.	Out-Wed.	No Out-Wed.
14-17	36873	34546				
18-21	37473	41224	44785	48923		
22-29	43760	30448	47420	58889	63248	81521

Notes: The table shows husbands' average yearly wage for women with and without an out-of-wedlock pregnancy. Wages are deflated to 2016 prices. I only consider married women with husbands who make more than 2.5 dollars per hour and work more than 2000 hours a year.

Table 5 compares husbands' wages for women with and without an out-of-wedlock birth after finishing their highest educational degree. The table shows the husband's average yearly wage by women's education, age at the first childbirth, and whether she had an out-of-wedlock child. High school and college graduates without an out-of-wedlock children have higher-income spouses. In the case of high school dropouts, husband income does not differ considerably. Surprisingly, high school dropout women with an out-of-wedlock child between 22-29 years old had, on average, a higher income husband. However, this group has few observations, and the sample size probably causes the result. In the case of high school graduates with their first pregnancy between 18 and 21 years old, the average penalty for an out-of-wedlock pregnancy is $4000 yearly; meanwhile, for women that had their first child between 22 and 29 years old, the penalty is $11000. For college graduates, the penalty increases to $18000.

2.3 The effect of cognitive ability on fertility

In subsection 2.2.1, I discussed the differences in fertility timing by cognitive ability. Two important mechanisms that delay childbirth are education and wages. Both increase the opportunity cost of having children young for high ability individuals. Additionally, high cognitive ability is related to family background. For this reason, I estimate a static linear model at three moments of women's life cycle: teens (14-17 years old), college age (28-21 years old), and young adults (22-29 years old) to measure the direct effect of cognitive ability on fertility.

An additional concern is that the dataset provides an intelligence test. Measurement error and reverse causality generate bias as the test is affected by family background and formal education. As Heckman et al. (2006) argue *"we note that there is an important distinction between intelligence tests (i.e., IQ tests) and achievement tests. Although IQ is fairly well set by age 8, achievement tests have been demonstrated to be quite malleable"*. The simple least square model overpredicts the impact of ability tests and understates the contribution of formal education on different outcomes as it imputes the impact of family background and education on ability. I follow Cawley et al. (1996); Heckman et al. (2006); Hansen et al. (2004) to estimate ability as a latent variable correcting reverse causality bias and measurement error.

As agents are forward-looking, future education and income affect teenager decision. Because a static linear model does not capture the effect of future outcomes on current fertility decisions, I estimate the model at three points of time explained before. First, for teens, the effect of ability is upward bias, as is capturing future wages and marital opportunities. Some of the education outcomes are already realized in the case of women at college age, but still, future income affects the opportunity cost and biases the estimators. Finally, for young adults, education is completely realized, and we already observe an important fraction of the wage realizations allowing a better imputation of the effect of ability, education, and wage on fertility. Additionally, I estimate the effect of ability on unintended childbirth, which provides additional evidence on whether ability affects women's fertility control.

The estimated linear model at each age is:

$$
\begin{aligned}
Y_i^{14-17} &= \beta_0 + \alpha_\theta \theta_i + \beta_X X_i + \epsilon_i \\
Y_i^{18-21} &= \beta_0 + \alpha_\theta \theta_i + \beta_{HS} HS_i + \beta_{CA} CA_i + \beta_X X_i + \epsilon_i \\
Y_i^{22-29} &= \beta_0 + \alpha_\theta \theta_i + \beta_w w_i + \beta_{HS} HS_i + \beta_C C_i + \beta_X X_i + \epsilon_i
\end{aligned}
$$

where Y_i^{age} is an outcome at a particular age (had a child and had an unintended child), θ is a latent measure of cognitive ability, HS is whether graduate from high school, CA is a dummy for attending college, C is a dummy whether graduate from college, w is the mean wage during the period and X are demographic controls (race, both parent education, and broken home at 14). The measurement system used to identify the latent variable α is:

$$T_i = \beta_T X_{i,D} + \alpha_i + \epsilon_{i,T}$$

where T is a vector of cognitive ability measures (math reasoning, numerical operations, and coding speed), X_T is a vector of control for each measure (race, both parent education, and broken home at 14, and years of completed education at the moment of the test). Finally, the linear model is estimated, maximizing a likelihood function assuming that F_θ follows a mixture of normal distributions.

Table 6 shows the models' results. First, we can observe that cognitive ability affects pregnancy timing and intention even after controlling for education and wages. In the case of pregnancy, higher ability decrease the pregnancy probability for teens and women at college age. However, as high-ability women wait until they are young adults, ability increases pregnancy probability for this age group. Consistent with the hypothesis that high ability women are better at planning pregnancy, cognitive ability decreases the probability of unintended pregnancies for the three age groups; however, the effect is small in young adults.

Teenagers between 14-17 years old in the top cognitive decile are 98% less likely to have a pregnancy and 65% less likely to have an unintended pregnancy than those in the bottom decile. For 18-21 years old, the difference between the top and the bottom deciles is 28% for a pregnancy and 33% for an unintended pregnancy. Finally, women between 22-29 years old in the top decile are 27% more likely to have a pregnancy but 7% less likely to have an unintended pregnancy than their pairs in the bottom.

Education achievement and income are relevant determinants of fertility timing. Higher wages and college education decrease the probability of pregnancy and unintended pregnancy. For 18-21 years old, the interdecile range effect of ability is a decrease of 28% in the probability of pregnancy, and attending college reduces pregnancy probability by 80%. In the case of unintended pregnancies, the interdecile range effect of ability on pregnancy probability is a reduction of 33%; meanwhile, college attendance reduces the pregnancy probability by 72%. Between 22-29 years old, a college education reduces the pregnancy probability by 17%

and the unintended pregnancy probability by 14%. The interdecile range of wages is a 42% decrease in pregnancies and 90% in unintended pregnancies. High school graduation does not affect pregnancies or unintended pregnancies once controlled by ability. However, attending college reduces the probability of pregnancies and unintended pregnancies to almost zero. The fact that college is relevant even after controlling for wages supports the theory that college increases contraception efficiency.

Table 6. Latent Factor Model: Pregnancies and Unintended Pregnancies

	(1)	(2)	(3)	(4)	(5)	(6)
	Preg.	Unint. Preg.	Preg.	Unint. Preg.	Preg.	Unint. Preg.
	14-17 yrs old	14-17 yrs old	18-21 yrs old	18-21 yrs old	22-29 yrs old	22-29 yrs old
Cog. Ab.	-.1049***	-.0414***	-.0774***	-.0391**	.1017***	-.0060
	(.0124)	(.0112)	(.0200)	(.0163)	(.0267)	(.0215)
Wage					-.0826***	-.0430***
					(.0117)	(.008)
HSG			.0435***	.003		
			(.0167)	(.0146)		
Att. Coll.			-.2706***	-.1038***		
			(.0175)	(.0152)		
College					-.0791***	-.0161
					(.0223)	(.0170)
Change in Probability						
$\Delta(d_{10}-d_1)$ Cog. Ab.	-98%	-65%	-28%	-33%	27%	-7%
$\Delta(d_{10}-d_1)$ Wage					-42%	-90%
HS			13%	2%		
Att. Col.			-80%	-72%		
College					-17%	-14%
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4390	3616	3801	3031	2412	1753

Standard errors in parentheses $\quad$ * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Static model estimated coefficients. Wage and test scores are standardized with a mean zero. Controls include race, both parent education, and broken home at 14. $\Delta(d_{10}-d_1)$ is the interdecile range for a particular variable showing the difference in probability between women at the top with women at the bottom of the respective variable. Each age group only considers women without a pregnancy at the initial age of each group.

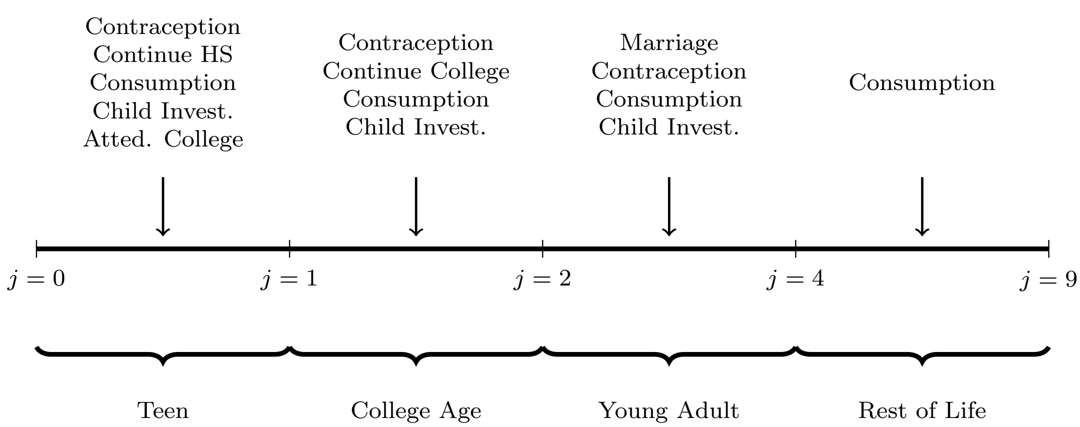
The previous results suggest that ability affects fertility beyond opportunity costs associated with education and wage. However, I can not control for the possibility that lower educational outcomes are caused by low ability women having more pregnancies which hinder their education outcomes, or that low ability women have children earlier because it is too costly to attend college. For this reason, in the following sections, I build and estimate a dynamic model to quantify the importance of cognitive ability and formal education in fertility.

3 Model

In this section, I develop and estimate a life cycle model to study whether cognitive ability affects fertility beyond the correlation with education, wages, and marriage. First, the model deals with the dynamic concern caused by agents being forward-looking. As children affect future opportunities, contraception choice depends on labor, marriage, and educational prospects. Second, we use the model to analyze how fertility, marital, and education outcomes change as future opportunities or contraception costs vary.

3.1 Environment and Timing

Figure 1. Women Attending College Life Cycle



Notes: The figure describes women's life cycle. The women's life cycle is divided into four stages: i) teen, ii) college age, iii) young adult, and iv) rest of life. Above the timeline, we can see women's decisions every period during each age.

The economic environment is discrete, and the time horizon is finite. The women's life cycle is divided into nine periods depicted in figure 1, each representing four years. All women are born as 14 years old teenagers with heterogeneity in ability a, who are fertile until 29 years old. In the sample, 90% of the first childbirth occurred between 14-29 years old. During each fertile period, they decide on contraception, and if a child is born, they decide on the children's investment. After their fertile years, individuals do not make choices and only consume their income. After knowing if a child is born, teenagers decide whether to continue high school and in case of continuing at the end of it, they decide on attending college. After knowing about their fertility outcomes, women in college decide whether to continue or drop out and work as high school graduates. During each fertile period in which women are nonstudying, single meet a potential husband and marry if the women's utility married is higher than continuing single. Husbands' only contribution is a wage, and women decide the household allocations.

In this economy, each woman can only have one child who lives only during the period that the child was born. During that period, mothers can invest money to increase the child's human capital, and the utility of having a child is increasing in the child's human capital. As a result, children are a once-in-a-lifetime investment opportunity. The optimal age for having a child is when parents have higher resources, which incentivizes women to postpone pregnancies. However, waiting is costly, given the contraception cost. In this economy, child investment is a reduced form to incentivize high income people to postpone parenthood. It is also consistent with the fact that child investment is increasing in income. However, modeling child investment realistically is beyond the scope of the paper. In order to have tractability, the model does not have assets, income uncertainty, or divorce.

A fundamental dimension in the model is contraception. By contraception cost, I consider all monetary, physical, psychological, and social costs associated with avoiding pregnancy and not a particular contraception method. Contraception, apart from being costly, is imperfect; women choose the optimal amount, but pregnancy can occur even when having a child is not optimal.

The model notation is the following. The indirect utility function is denote V_t^j, where t represents the period, and j is the sub-period. The state variables are ability, education, marital status, marital status at childbirth, and the period that a child was born. Ability $a \in [0, 1]$ is continuous, education take three states $e \in \{HSD, HS, C\}$, where HSD is high school drop-out, HS is high school graduate, and C is college graduate. Marital status is denoted by $m \in \{0, 1\}$ where 0 is single, and 1 is married, $sm \in \{0, 1\}$ represents whether the woman had an out-of-wedlock pregnancy, and $k_t \in \{0, 1, 2, 3, 4\}$ keeps track of the child's birth period. In the case of never having been a mother, this state variable is zero. The decision variables are consumption $c \in [0, \infty]$, child monetary investment $i \in [0, \infty]$, and the contraception amount $s \in [0, \infty]$, which are all continues. In the rest of this section, I introduce each period with its respective sub-period backward to simplify the exposition.

3.2 Rest of Life: Fifth to Ninth Period (30-49 years old)

The model focuses on ages 14 to 29, as most childbirth and education decisions occur at these ages. However, a relevant fraction of college wages return is backloaded after 30 years old, so I include in the model ages between 30-49 years old to avoid underestimating the value of college. In these periods, agents consume their household income and do not make any choices, so the period is composed of only one sub-period. I only model until 49 years old, given data limitations I will explain in the wage estimation section 4.2. Women are characterized by their age t, ability a, education e, marital status m, single motherhood sm, and maternal age at birth k_t. Then, women's utility at the beginning of the period is given by the following Bellman equation:

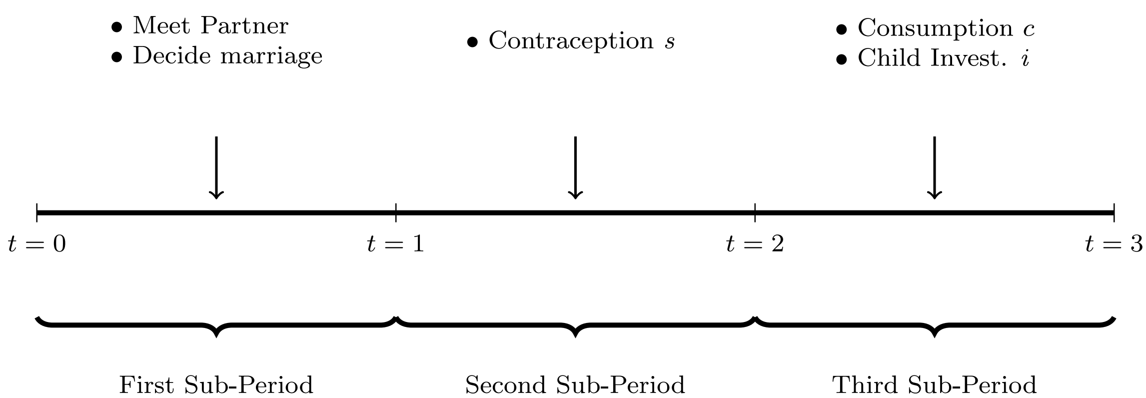
$$V_t(a, e, m, sm, k_t) = \max_c \; u(c) + \beta V_{t+1}(a, e, m, sm, k_t)$$

$$\phi_c(m, k_t) \cdot c = \; w(t, a, e, m, sm, k_t) + 1_{m=1} w^h(t, e, sm, k_t)$$

where $\phi_c(m, k_t)$ maps consumption expenditures and family composition into effective consumption. Women's wage $w(t, a, e, m, sm, k_t)$ is a function of their age, ability, education, marital status, single motherhood, and maternal age at birth. $1_{m=1}$ is an indicator function if the woman is married and the husband wage $w^h(t, e, sm, k_t)$ is a function that depends on age, the woman's education, whether she was a single mother, and in the case of being a single mother, at which age she was.

3.3 Young Adult: Third and Fourth Period (22-29 years old)

Figure 2. No child, Single Women between 22-30 yr. old



Notes: The figure describes the decision timing for young adult women (22-29 years old). Each period is divided into three sub-periods, and a decision is made on each: i) marriage, ii)contraception, and iii) consumption-investment.

In this period, women make three sequential decisions. Each decision is made during a sub-period. The decision timing within the period is displayed in Figure 2. In the first sub-period, single women meet a husband and decide on marriage. In the second, women without previous children decide on contraception. Finally, in the last sub-period, women consume and invest in the children whether a child is born.

3.3.1 Third Sub-Period: Consumption and Child Investment

The women's problem in this sub-period depended on whether they had a child. All women decide on consumption c. In the case of having a child within the period, she also has to decide on child investment i, having the following Bellman equation:

$$V_t^3(a, e, m, sm, k_t = t) = \max_{c,i} \; u(c) + V(i)^k + \beta V_{t+1}^1(a, e, m, sm, k_t = t)$$

$$\phi_c(m, k_t) \cdot c = \; w(t, a, e, m, sm, k_t) + 1_{m=1} w^h(t, e, sm, k_t) - i$$

where $V^k(i)$ is the utility the child provides to the mother, which is increasing on monetary investment i. $w(t,a,e,m,sm,k_t)$ and $w^h(t,e,sm,k_t)$ are the women and husbands wage. In the case of a woman without a child during the period, she only has to decide on consumption; then her Bellman equation is:

$$V_t^3(a,e,m,sm,k_t) = \max_c \ u(c) + 1_{t=4 \ \& \ k_t=0}\mu_{nk}(e) + \beta V_{t+1}^1(a,e,m,sm,k_t)$$
$$\phi_c(m,k_t)\cdot c = \ w(t,a,e,m,sm,k_t) + 1_{m=1}w^h(t,e,sm,k_t)$$

$1_{t=4 \ \& \ k_t=0}$ is an indicator function if a woman never have childbirth during her fertile life. In that case, she receives a utility $\mu_{nk}(e)$. This variable is necessary to prevent all women from having a child in the last fertile period, giving a chance to the model to replicate the data feature that 10% of women do not have a child at 30 years old.

3.3.2 Second Sub-Period: Contraception

If a woman has not had a child at the beginning of the period, she decides the amount of contraception s. The Bellman equation in this sub-period is:

$$V_t^2(a,e,m,sm,k_t) = \max_s p(t,a,e,s)\cdot V_t^3(a,e,m,sm,k_t=t)$$
$$+\big(1-p(t,a,e,s)\big)\cdot V_t^3(a,e,m,sm,k_t=0) - \phi_s s$$

where contraception has a utility cost of ϕ_s and $p(t,a,e,s)$ is the probability of having a pregnancy that depends on age t, ability a, education e, and the amount of contraception s. The pregnancy probability is decreasing in the amount of contraception $\frac{\partial p(t,a,e,s)}{\partial s} < 0$, and at the same amount of contraception, higher ability implies lower pregnancy risk $\frac{\partial p(t,a,e,s)}{\partial a} < 0$. Because women only can have one child, in the case of already had a child, they do not choose contraception, and the indirect utility at the beginning of the sub-period is $V_t^2(a,e,m,sm,k_t) = V_t^3(a,e,m,sm,k_t)$.

3.3.3 First Sub-Period: Marriage

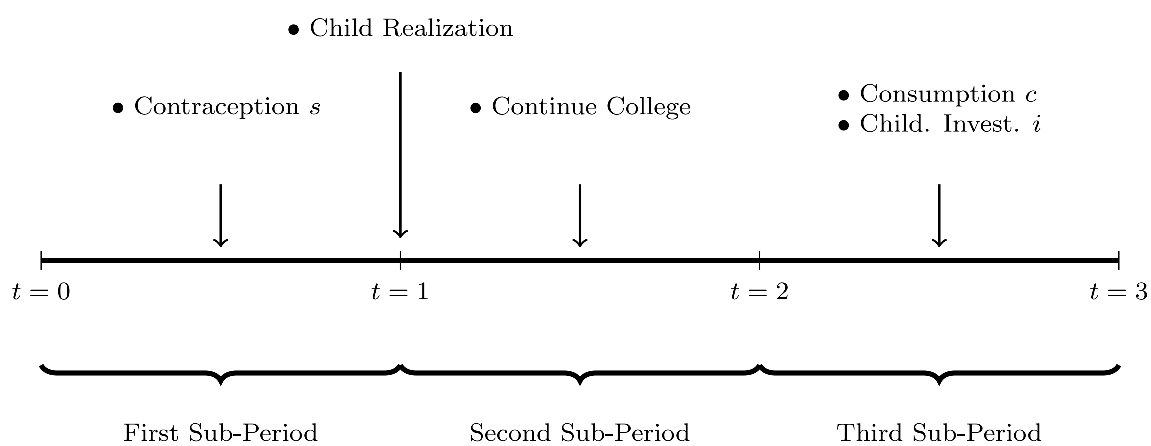
Single women meet a potential husband with probability $\mu(e,t)$, which depends on women's education achievement e and age t. They marry if the women's utility of marriage is higher than remaining single. Then, the Bellman equation is:

$$V_t^1(a,e,m=0,sm,k_t) = \mu(e,t)\cdot\max\{V_t^2(a,coll,m=1,sm,k_t), V_t^2(a,e,m=0,sm,k_t)\}$$
$$+\big(1-\mu(e,t)\big)\cdot V_t^2(a,e,m=0,sm,k_t)$$

The model does not have divorces, so married women do not make marital decisions, and their indirect utility is $V_t^1(a,e,m=1,sm,k_t) = V_t^2(a,e,m=1,sm,k_t)$.

3.4 College Age: Second Period (18-21 years old)

Figure 3. Attending College (18-21 years old)



Notes: The figure describes the decision timing for women attending college. Each period has three sub-periods, and a decision is made on each: i) contraception, ii) continuing college, and iii) consumption-investment.

In this period, women attended college or joined the labor market. Women who do not attend college have the same decision sequence as in subsection 3.3. Women attending college make three sequential decisions. First, they decide on contraception. Second, after observing their pregnancy outcome, they decide whether continue college. In the case of having a child during college, there is a double penalty. First, the cost of continuing college increases in $\kappa_{\mathrm{k,C}}$; second, college students have few monetary resources to invest in their child. Women who continue in college receive an allowance w_c. College dropouts move to the last sub-period with the wage of high school graduates. Finally, in the third sub-period, women decide on consumption and child investment when having a child.

3.4.1 Third Sub-Period 18-21: Consumption and Child Investment

In this sub-period, women are attending college or, in the case of dropping out in the previous sub-period, working as high school graduates. Women attending college decide on consumption and child investment. Then, their Bellman equation is:

$$V_2^{3,G}(a, k_t) = \max_{c,i} u(c) - \kappa_{\mathrm{k,C}} + V^k(i) + \beta V_3^1(a, e = \mathrm{C}, m, sm, k_t)$$

$$\phi_c(k) \cdot c = w(a, e = \text{attend-coll}, s, k_t) - i$$

where G denote the value function of continuing college and $\kappa_{\mathrm{k,C}}$ is the cost of attending college with a child. For women who dropped out of college, their problem is denoted by CD, and they face the consumption-investment problem of a high school graduate. So then, they have the following Bellman equation $V_2^{3,CD}(a, k_t) = V_2^3(a, e = \mathrm{HS}, m = 0, sm, k_t)$.

3.4.2 Second Sub-Period 18-21: Continue College

In this sub-period, women decide whether continue college. The decision is made after they observe their pregnancy outcomes. Then the problem is:

$$V_2^2(a, coll_a = 1, k_t) = \max_{i \in \{G, CD\}} \{V_2^{3,G}(a, k_t) + \sigma_{Coll}\epsilon_i, V_2^{3,CD}(a, k_t) + \sigma_{Coll}\epsilon_i\}$$

where ϵ_i is an i.i.d. extreme value shock drew from a Type I extreme value distribution, and σ_{Coll} is the scale parameter.

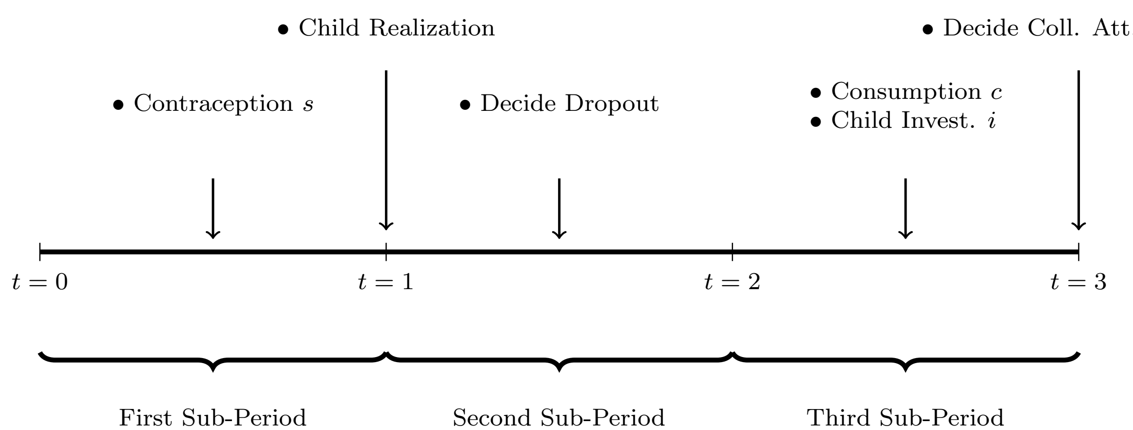
3.4.3 First Sub-Period 18-21: Contraception

In the first sub-period, college women choose the amount of contraception c as in previous periods. The indirect utility function at the beginning of the period is:

$$V_2^1(a, coll_a = 1, k_t = 2) = \max_s \; p(t, a, e = coll_a, s) \cdot V_2^1(a, coll_a = 1, k_t)$$
$$+\big(1 - p(t, a, e = coll_a, s)\big) \cdot V_2^1(a, coll_a = 1, k_t = 0) - \phi(s)s$$

3.5 Teen: First Period (14-17 years)

Figure 4. Teens (14-17yr. old)



Notes: The figure describes the decision timing for teens. Each period has three sub-periods, and a decision is made on each: i) contraception, ii) continuing high school, and iii) consumption-investment. At the end of the third period, teens that finish high school decide on college attendance.

Women between 14-17 years old face the following decisions. At the beginning of the period, all attend high school and decide on contraception. After observing the fertility outcome in the second sub-period, they decide whether to continue high school. A teenager who continues high school receives an allowance in the third sub-period. Teens who drop out of high school work as high school dropouts. Finally, women who continue high school decide whether to attend college at the end of the third period.

3.5.1 Third Sub-Period 14-17: Consumption, Child Investment, and College Attendance

At the end of the period, women who graduated from high school decide whether attend college. The decision problem is characterized for the following Bellman equation:

$$V_1^{CD}(a, e = \text{hs}, sm, k_t) =$$
$$\max_{i \in \{C,NC\}} \{V_2^1(a, coll_a = 1, k_t) - \kappa_c(a, k_t) + \sigma_{CD}\epsilon_i, V_2^1(a, e = HS, m = 0, sm, k_t) + \sigma_{CD}\epsilon_i\}$$

where ϵ_i is an i.i.d. extreme value shock drawn from a Type I extreme value distribution, and σ_{CD} is the scale parameter. The psych cost $\kappa_c(a, k_t)$ of attending college depends on the woman's ability and whether she has a child.

In the case of women attending high school without a child, they solve the following decision problem:

$$V_1^{3,HSG}(a, HS_a = 1, sm = 1, k_t = 1) = \max_{c,i} \; u(c)+$$
$$\kappa_{k,HS} + V^k(i) + \beta V_1^{CD}(a, e = \text{HS}, sm, k_t)$$
$$\phi_c(k) \cdot c = w_{HS} - i$$

where κ_{HS} is the utility cost of attending high school with a child, w_{HS} is the parents' allowance, and V_1^{CD} is the value of deciding college attendance.

The decision problem of women attending high school without a child is:

$$V_1^{3,HSG}(a, HS_a, k = 0, sm = 0, k_t) = \max_c u(c) + \beta V_1^{CD}(a, e = \text{HS}, sm, k_t)$$
$$c = w_{HS}$$

Women who drop out of high school earn the wage of a high school dropout. In the case of having a child, they also decide on child investment. So then, their problem is:

$$V_1^{3,HSD}(a, coll_a = 1, sm = 1, k_t = 1) = \max_{c,i} u(c) + \kappa_{k,HS} + V^k(i)$$
$$+\beta V_2^1(a, e = HSD, m = 0, sm = 1, k_t = 1)$$
$$\phi_c(k) \cdot c = w(t, a, HSD, k_t = 1) - i$$

where $w(t, a, HSD, k_t = 1)$ is the wage of a high school dropout. Women who drop out without a child solve:

$$V_1^{3,HSD}(a, HS_a, sm = 0, k_t = 0) = \max_c \; u(c)$$
$$+\beta V_2^1(a, e = HSD, m = 0, sm = 0, k_t = 0)$$
$$c = w(t, a, HSD, k_t = 0)$$

3.5.2 Second Sub-Period 14-17: Continue high school

After observing their pregnancy outcome, women decide whether continue high school. Then, the problem is the following:

$$V_1^2(a, sm, k_t) = \max_{i \in HSD, HSD} \{V_1^{3,HSG} + \sigma_{HS}\epsilon_i, V_1^{3,HSD} + \sigma_{HS}\epsilon_i\}$$

where ϵ_i is an i.i.d. extreme value shock drew from a Type I extreme value distribution, and σ_{HS} is the scale parameter.

3.5.3 First Sub-Period 14-17: Contraception

In the first sub-period, all women attend high school; the only heterogeneity is the amount of ability. The decision at this stage is the amount of contraception, which is decided in the following problem:

$$V_1^1(a) = \max_s \; p(1,a,s) \cdot V_2^1(a, sm, k_t = 1) + \big(1 - p(1,a,s)\big) \cdot V_2^1(a, sm, k_t = 0) - \phi(s)s$$

3.6 Functional Forms and Parameters

The model is parametrized with the following functional forms to take it to the data. There are 34 unknown parameters plus the income process, which I will discuss their estimation in section 4.

3.6.1 Preferences (4)

Consumption:

Agents have standard CRRA preferences:

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma} \tag{1}$$

Child Utility:

The utility that parent perceive from a child is given by:

$$V(i) = \omega_0 + \omega_1 i^{\omega_2} \tag{2}$$

where ω_0, ω_1, and ω_2 determine the value of having a child.

3.6.2 Fertility (9)

In the case of the pregnancy probability, I follow Seshadri and Zhou (2022); Choi (2017), who used a modified logistic function to bound the probability to one. In their papers, the only input is contraception. In the case of this paper, the pregnancy probability depends on two inputs: contraception and ability. Given its flexibility to aggregate both inputs, I use a CES production function. Finally, the probability depends on age t, education e, and contraception s:

$$p(t,a,e,s) = \frac{2\exp(-\lambda_{e,t}(\lambda_a \cdot a^\rho + (1-\lambda_a)\cdot s^\rho)^{\frac{1}{\rho}})}{1+\exp(-\lambda_{e,t}(\lambda_a \cdot a^\rho + (1-\lambda_a)\cdot s^\rho)^{\frac{1}{\rho}})} \tag{3}$$

The parameter that determinate the fertility decision are $\lambda_{e,t}$, λ_a, ρ and $\phi(s)$. Given that $\phi(s)$ and $\lambda_{e,t}$ determinate the contraception cost, I normalize $\phi(s)$ to 1. λ_a determinate the share of ability in the contraception function and ρ is the contraception technology elasticity of substitution.

3.6.3 Marriage Market (7)

The marriage outcomes depend on the probability of meeting a potential husband $\mu(e,t)$, which depends on education and age.

3.6.4 College Attendance and Graduation (6)

College attendance is determined by the psych cost of attending college $\kappa_c(a,k_t) = \frac{\xi_c}{a^{\omega_c}} + 1_{k_t=1}\cdot\kappa_{kb}$. ξ_c is the psych cost of attending college, ω_c gives the concavity at which the psych cost decrease with ability, and κ_{kb} is the extra cost of study for teen mothers. The psych cost decrease with cognitive ability as studying is less painful for high ability kids, or at the same amount of study time; they learn more. Women who continue college having a child during that period face the extra cost $\kappa_{k,\mathrm{C}}$. Finally, the extreme value shock scale parameters for attending and continuing college are given by σ_{Coll} and σ_{CD}.

3.6.5 High School Graduation (2)

High school graduation depends on the continuation values, the cost of attending high school with a child $\kappa_{k,HS}$, and the extreme value shock scale parameter σ_{HS}.

4 Model Estimation

The parameters in the model are divided into three sets: those that I take from the literature, the wage process that is estimated exogenously to the model, and those that are estimated within the model using the simulated method of moments, conditional on the two previous sets.

4.1 Exogenous Parameter

Table 7 shows the exogenous parameters taken from the literature: discount factor, relative risk aversion, and the economies of scale in consumption.

Table 7. Exogenous Parameters

Parameter	Interpretation	Value	Source
		Preferences	
β	Discount Factor	.96	Regalia et al. (2011)
γ	Relative Risk Aversion	.43	Regalia et al. (2011)
ϕ_s	Contraception Cost	1.00	Normalization
		Household Parameters	
$\phi_c(m,k)$	Economies of Scale in Consump.	$\{.5, .7\}$	OECD

Notes: Model parameters that take values from previous results in the literature.

4.2 Wages Profiles

Women's and husbands' wage profiles are essential in the model because they determine the opportunity cost of early and out-of-wedlock pregnancies. Women's wages vary by age, education, marital status, age at childbirth, and ability. Husbands' wage depends on the wife's education, the wife's marital status at childbirth, and the wife's age at birth. Because NLSY79 individuals are currently in their early fifties, wage profiles are estimated using OLS for individuals between 14 to 49 years old. The decision to not include wages after their fifties can understate the value of college or the child penalty. However, wages later in life are discounted heavily when fertility decisions are taken in the model. Wages are reported by NLSY79 surveyed individuals and are deflated to 2016 prices. Individuals who make less than 2.5 dollars per hour or work less than 2000 hours a year are not considered. Finally, the estimated equations for women's wages and husbands' wages are:

$$w_{i,t} = \alpha_0 + \alpha_t \cdot t + \alpha_{t^2} \cdot t^2 + \alpha_e e_i + \alpha_{\text{HA}}\text{HA}_i + \alpha_k k_i + \alpha_{et} \cdot e_i \cdot t +$$
$$\alpha_{et^2} \cdot e_i \cdot t^2 + \alpha_{e\text{HA}} \cdot e_i \cdot \text{HA}_i + \alpha_{k\text{HA}} \cdot k_i \cdot \text{HA}_i + \alpha_{e\text{HA}} \cdot e_i \cdot \text{HA}_i +$$
$$\alpha_{ek} \cdot e_i \cdot k_i + \alpha_{ek\text{HA}} \cdot e_i \cdot k_i \cdot \text{HA}_i + \alpha_m \cdot m_{i,t} + \epsilon_{i,t}$$

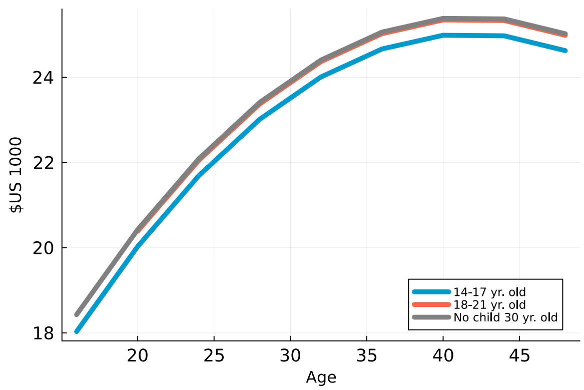
$$w^h_{i,t} = \gamma_0 + \gamma_t \cdot t + \gamma_{t^2} \cdot t^2 + \gamma_m \cdot m_i + \gamma_{e^f t} \cdot e^f_i \cdot t +$$
$$\gamma_{e^f t^2} \cdot e^f_i \cdot t^2 + \gamma_{e^f m} \cdot e^f_i m_i + \epsilon_{i,t}$$

where w is the woman's wage, w^h is the husband's wage, t is the women's age, i is the individual, e and e^f is the women education level (HSD, HS, C), HA is a dummy whether the individual test above the mean cognitive ability test score, k is a dummy that indicates the woman age at the first childbirth, m is a dummy whether the woman is married, and m^f is a dummy whether the woman is married at the moment of the childbirth.

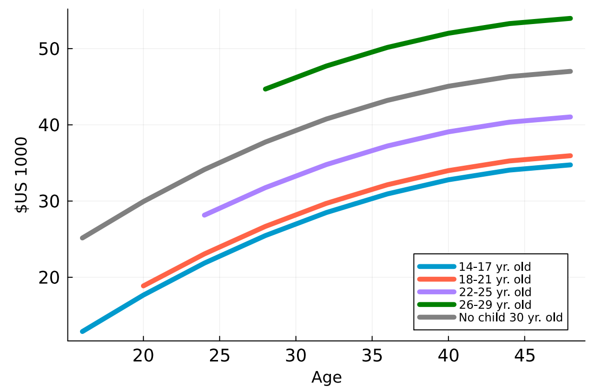
Early pregnancies decrease women's wages for all education groups and the penalty increases in ability. Women who married after an out-of-wedlock pregnancy had husbands with lower wages. The size of the husband's wage penalty increases with the women's age at childbirth, and college educates bear the highest penalty. As a result, the cost of an early pregnancy increases in ability, as high ability women are more likely to attend college and have a college graduate husband.

Figure 5. Women wage profile by education and age first birth

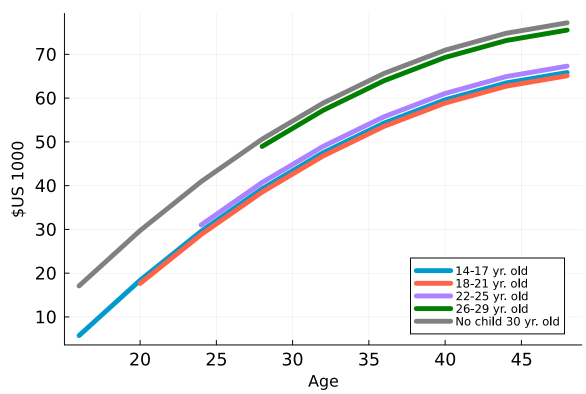
(a) High School Dropout



(b) High School



(c) College



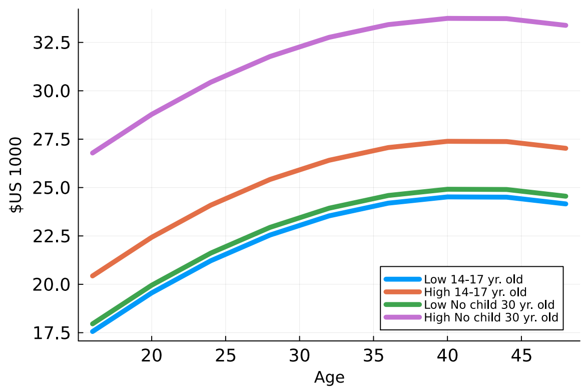
Notes: Wage profiles across age, education, and women's age at first child estimated as explained in section 4.2. Light blue lines show women with their first childbirth between 14-17 years old, red between 18-21, purple between 22-25, green between 26-29 years old, and grey no childbirth before 30 years old.

Women's wages profile by education and age at first childbirth are shown in figure 5. As expected, college women have the highest earnings, followed by high school graduates, and finally, high school dropouts have the lowest wages. High school dropout profiles are shown in figure 5a. Early childbirth has a negligible effect on this group's earnings; a birth between 14-17 years old only reduces wages by $400. For high school dropouts, there are not enough observations to calculate the wage profiles for women with first childbirth between 22-29 years old, as for them, having the first child at these ages is infrequent. In the model, I assume they have the same profiles as high school dropout women without kids before 30.

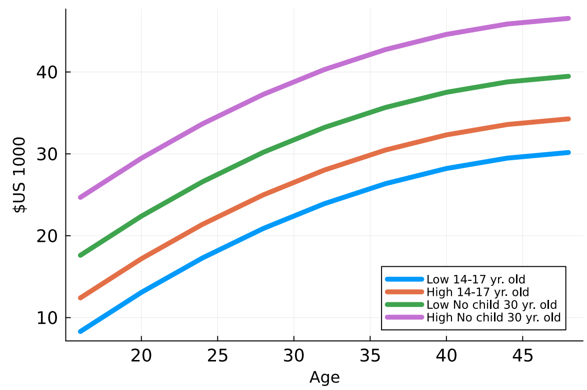
High school graduates' wage profiles are displayed in figure 5b. Women who have children between 26-29 years old have the highest wages, and early children bring a considerable wage penalty. For example, women with a child between 14-17 years old each year earn $12200 less than women who had the first child between 26-29 years old. Finally, college women's wage profiles are in figure 5c. We can see two wage paths, women who had a child before 26 and women who had a child after 26 or did not have one before 30. The first group earns around $12000 less than the second. The child penalty for college and high school graduates is similar in monetary terms. However, the relative magnitude is higher for high school graduates as they have lower wages.

Figure 6. Women wage profile by education and ability

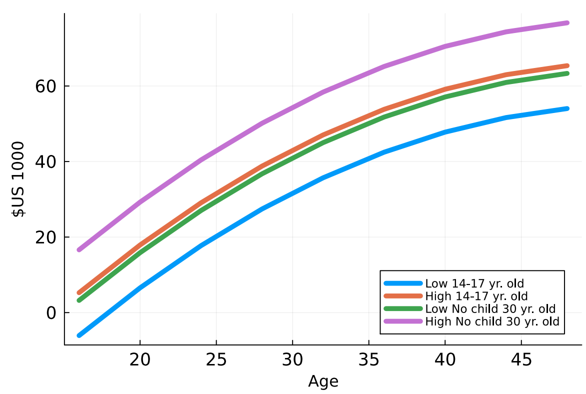
(a) High School Dropout



(b) High School



(c) College

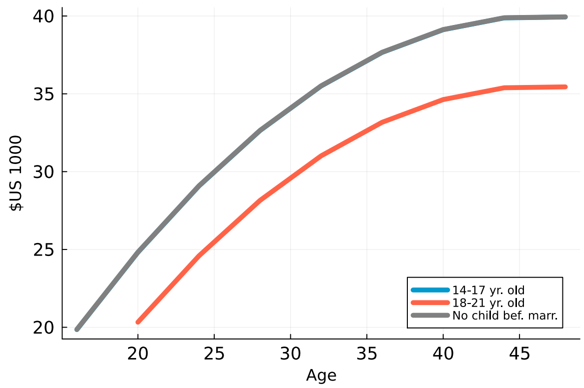


Notes: Wage profiles across age, education, women's age at first child, and ability type estimated as explained in section 4.2. Light blue lines show low ability and red high ability teen mothers. Green lines show low ability and purple high ability women without a child at 30 years old.

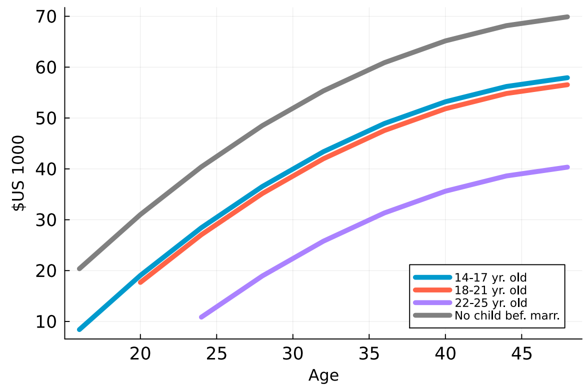
Figure 6 shows the relationship between ability and wage by women's education. The effect of ability on wage is increasing with education. For simplicity, I plot four wage profiles: high and low ability women with childbirth between 14-17 years old and high and low ability women without a child at 30. Cognitive ability increases wages in every education group. Figure 6a shows the case of high school dropouts. High ability women with childbirth between 14-17 years old earn $3000 more yearly than low ability. In the case of high ability women without a child at 30, they earn $9000 more yearly than low ability. Next, women high school graduates are depicted in figure 6b. The difference between high and low ability is $4000 yearly for women with childbirth between 14-17 years old and $7000 yearly for women without childbirth at 30 years old. Finally, college graduates are in figure 7, high ability women with childbirth between 14-17 make $11000 more yearly than low ability, and this difference is $13000 for women without a child at 30 years old. The penalty wage associated with early pregnancy is increasing in ability. In the case of low ability high school dropouts, are $400 yearly and $6300 yearly in the case of high ability. Low ability high school graduates face an early pregnancy penalty of $6300 yearly and $12200 yearly for the high ability. Finally, for college graduates, the penalty for low ability is $9300 yearly and $11340 yearly for high ability.

Figure 7. Husband wage profile by marital status at birth and age first birth

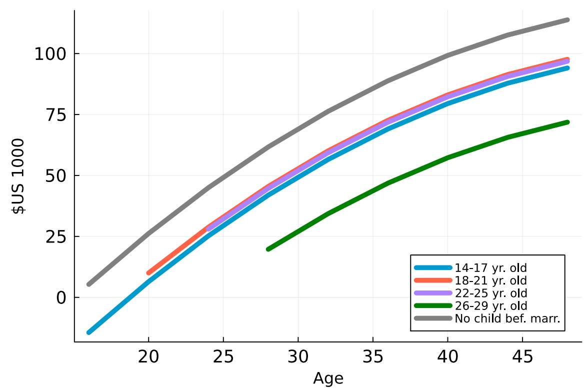
(a) High School Dropout



(b) High School



(c) College



Notes: Husband wage profiles across women's age, education, and women's age at first child estimated as explained in section 4.2. Light blue lines show women with an out-of-wedlock child between 14-17 years old, red between 18-21, purple between 22-25, green between 26-29 years old, and grey are women without childbirth before marriage.

Finally, I analyze husbands' wages. Early pregnancies are associated with out-of-wedlock births. Single motherhood affects the husband's quality measured by his wage. Figure 7 shows husbands' wages by education, whether they marry before childbirth, and in the case of an out-of-wedlock pregnancy, the mother's age at birth. Single mothers have husbands with lower wages in all education groups. The penalty is increasing in age and education; the highest penalty is for college women who had an out-of-wedlock pregnancy between 26-29 years old. Figure 7a shows high school dropouts. For this group, an out-of-wedlock child between 18-21 years old is associated with a husband that earns $4000 less than the husbands of women who married before having the child. High school graduates are shown in figure 7b. For them, an out-of-wedlock child reduces husbands' wages by \$12000 between 14-21 years old and by \$30000 between 23-26 years. Finally, figure 7b shows that college graduates with an out-of-wedlock child between 14-25 years old earn \$25000 less and between 26-29 years old, the penalty increases to \$42000 less.

4.3 Endogenous Parameters

The remainder 30 unknown parameters are estimated through 38 data moments using the Simulated Method of Moments. Table 8 shows the parameters' respective interpretations. The model aims to understand how ability, education, wage, and marriage shape fertility. For this reason, I estimate the model using moments that relate cognitive ability, education, and marital outcomes with fertility.

Table 8. Parameters estimated through the indirect method of moments

Contraception Technology and Child Return		
Parameter	Value	Interpretation
λ_a (1)	.08	Ability Share Contr. Tech.
ρ (1)	$-.40$	Elasticity of Substitution Contr. Tech.
$\lambda_{e,t}$ (7)	Table A1	Scale Parameter by Ability and Education
$\omega_0\ \omega_1\ \omega_2$ (3)	2.39, 0.09, .55	Child Return
Marriage Outcomes		
Parameter	Value	Interpretation
$\mu(e,t)$ (5)	Table A2	Probability Meeting a Husband
Education Outcomes		
Parameter	Value	Interpretation
$\kappa_{Coll.}\ \xi_c\ \omega_c$ (3)	$-27, -201, 1.19$	College Psych Cost
κ_{HS}, κ_{kb} (2)	$-2, -16$	Cost Child Dif. Edu. Stages
$\mu_{nk}(e)$ (3)	34, 14, 1	Terminal Value no Child
$w(HS), w(Coll)$ (2)	US\$48600, US\$10000	Teen and Coll. Allowance
σ_{HS}, σ_{CD}, σ_C (3)	50, 68, 13	EV Shock HS, Attend Coll., Grad Coll.

Notes: Model parameters that are estimated using the Simulated Method of Moments.

Table 8 shows the estimated parameters. The share of ability in contraception is 0.08;

even when it is small, it is relevant to explain the differences in pregnancies by ability, as discussed in section 5.2. The elasticity of substitution between ability and contraception is -0.4, making ability and contraception complements. The cost of teen pregnancy during high school is low, which indicates that in the model, the reason women with pregnancy are dropping high school is not the child. The estimated parent allowance during high school is $48600, and the allowance during college is $10000. In section 5.3, I discuss how contraception costs vary with education and ability.

5 Results

In this section, I discuss the estimation results. First, I discuss how the model fits the data. Second, I argue that ability is a necessary input in the fertility function, and it is not possible to explain the relationship between fertility and ability only through education and wages. Finally, I quantity the difference in contraception cost by education and ability in terms of equivalent consumption.

5.1 Model Fit

This subsection compares the model moments with the empirical counterpart used to estimate the parameters. In general, the model does a good job considering its simplicity and the fact that it uses 38 moments for 30 parameters. In order to simplify the exposition, I group the moments into three sets: moments that connect ability with pregnancies, moments related to education outcomes, and moments related to marital outcomes.

5.1.1 Cognitive Ability and Pregnancies

Table 9. Fit Model Pregnancy and Ability

	Ability Quartile			
	First Quartile	Second Quartile	Third Quartile	Four Quartile
Age First Pregnancy	Pregnancy Probability | No Prev. Preg.			
14-17	30%	7%	5%	4%
	(26%)	(15%)	(9%)	(3%)
18-21	59%	32%	23%	21%
	(54%)	(43%)	(28%)	(16%)
22-29	64%	51%	33%	29%
	(48%)	(48%)	(45%)	(45%)

Notes: The table shows moments relating cognitive ability with age at first pregnancy. Values without parenthesis are moments generated by the model, and values in parenthesis are the data analogous.

Table 9 shows the moments that relate cognitive ability with pregnancy timing. These moments are the fraction of women who had their first child between 14-17, 18-21, and 22-29 years old by cognitive ability quartiles, conditionally on being childless at the beginning of each age interval. Between 14-17 and 18-21 years old, the fraction of pregnancies for the bottom and top quartiles generated by the model is similar to the data. The model can replicate the positive correlation between ability and pregnancy. However, this relationship is considerably more concave than in the data. In the case of women between 22-29 years old, the model fails as it generates a positive relationship between ability and pregnancies considerably higher than in the data.

5.1.2 Education Outcomes

Table 10. Education Outcomes and Pregnancy Moments

Moments	Data	Model
Drop out High School | No Pregnancy (<18)	0.06	0.06
Drop out High School | Pregnancy (<18)	0.28	0.27
Attend College | No Pregnancy (<18)	0.41	0.38
Attend College | Pregnancy (<18)	0.08	0.08
Attend College | Ability Q1	0.12	0.10
Attend College | Ability Q2	0.25	0.32
Attend College | Ability Q3	0.40	0.46
Attend College | Ability Q4	0.67	0.50
Graduate College | No Pregnancy (<22)	0.62	0.51
Graduate College | Pregnancy (<22)	0.30	0.38

Notes: The table shows moments relating age at first pregnancy with education outcomes.

The model replicates the relationship between cognitive ability, pregnancies, and education attainment. Table 10 shows that it generates the same number of high school dropouts and college attendants. Even when the model generates a smaller college attendance for the top ability quartile than in the data, it generates the right college attendance for the lowest ability quartile, which is the one that we are particularly interested in as a result of the high number of teen pregnancies within this group. Although the relationship between ability and college attendance is smaller at the top of the ability distribution than in the data, the fit is pretty good considering the lack of financial friction to attend college and the relationship between ability and parent income, which is not modeled. Finally, the model generates a gap in college graduation between women with childbirth during college compared to those without; however, it is smaller than in the data.

5.1.3 Marital Outcomes

Table 11. Fit Marital Outcomes and Pregnancies by Education Group

Moments	Data	Model	Moments	Data	Model
Married 18-21 yr. old | HSD, NPP	0.39	0.34	Sing. Mom 22-29 yr. old | HS, NPP	0.12	0.10
Married 18-21 yr. old | HS, NPP	0.41	0.34	Sing. Mom 22-29 yr. old | Coll, NPP	0.02	0.02
Married 22-29 yr. old | HSD, NPP	0.61	0.50	Preg. 18-21 yr. old | HSD, NPP	0.42	0.47
Married 22-29 yr. old | HS, NPP	0.66	0.68	Preg. 18-21 yr. old | HS, NPP	0.35	0.40
Married 22-29 yr. old | Coll, NPP	0.68	0.64	Preg. 18-21 yr. old | Att. Coll, NPP.	0.16	0.17
Sing. Mom 18-21 yr. old | HSD, NPP	0.44	0.36	Preg. 22-29 yr. old | HSD, NPP	0.43	0.48
Sing. Mom 18-21 yr. old | HS, NPP	0.29	0.24	Preg. 22-29 yr. old | HS, NPP	0.43	0.37
Sing. Mom 22-29 yr. old | HSD, NPP	0.22	0.18	Preg. 22-29 yr. old | Coll, NPP	0.42	0.49

Notes: The table shows moments relating age at pregnancy with martial outcomes by education. All moments are conditional on no pregnancies before the respective age (NPP).

Finally, we have the moments related to contraception and marriage choices conditional on education and age. These moments are total pregnancies, single motherhood, and fraction married. Table 11 shows that the model is close to matching marriage, single mothers, and total pregnancies. However, the number of high school graduates' total pregnancies is considerably overpredicted.

5.2 Mechanisms Decomposition and the Importance of Ability

The paper argues that cognitive ability affects pregnancy timing beyond education, wages, and marriage opportunities. In this section, I analyze how the model performs when contraception is independent of cognitive ability, and cognitive ability only affects fertility decisions through education and wage opportunity cost. First, I estimate the model with homogeneous contraception technology in education and ability. In this case, the only heterogeneity in contraception is by age $\lambda_{1t}^{HSD} = \lambda_{1t}^{HS} = \lambda_{1t}^{Coll}, \lambda^a = 0, \rho = 0$. I call this the "baseline model". Then, I make contraception depend on education. Finally, contraception depends on education and ability $\lambda^a \geq 0, \rho \neq 0$. Then, each model is estimated separately, and the fit with the data is assessed using the sum squared error (SSE) normalized by the data moment:

$$\text{SSE} = \sum \Big(\frac{m_i - m_i(\hat{\theta})}{m_i}\Big)^2$$

where m_i is the data moments and $m_i(\hat{\theta})$ is the model moments for the parametrization θ. As in the previous section, I group the moments into three categories: Cognitive Ability and Pregnancies, Education, and Marital Moments. The top of table 12 shows the total SSE for each different version of the model. The bottom displays the percentual improvement in the model fit when each mechanism is added $(1 - \frac{\text{SSE}_1}{\text{SSE}_0})$ and the correlation between ability and teen pregnancies $Corr(P_{14-17}, ability)$. The full set of moments for each model specification is shown in table B1. Figure 8 shows the relationship between pregnancies and ability for women between 14-17 and 18-21 years old for the three model specification and the data.

Table 12. Decomposing the Model Fit

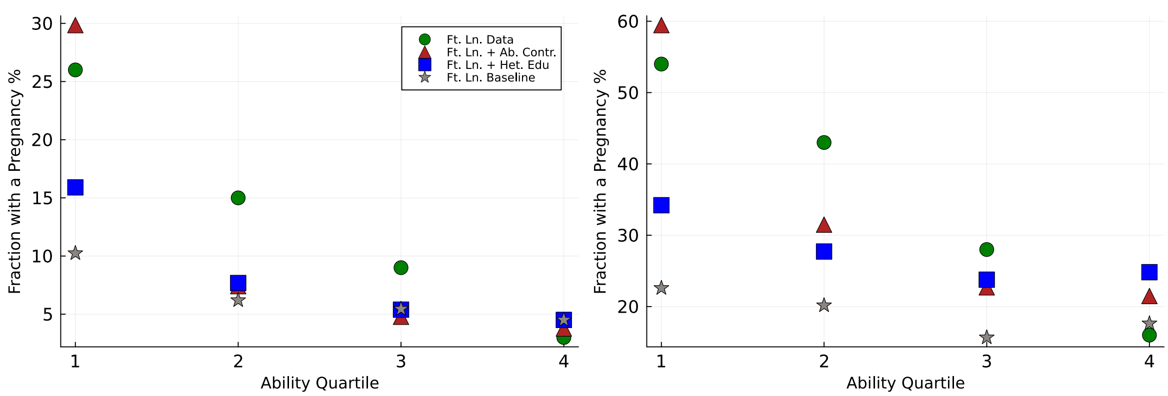
	(1) Baseline	(2) Baseline + Educ. Het.	(3) Baseline + Educ. Het. + Ab. Cont.
Total SSE	2.77	2.49	1.73
Pregnancies and Ability Moments SSE	1.61	1.41	1.12
Education Moments SSE	0.24	0.48	0.32
Marital Moments SSE	0.92	0.60	0.29
Fit Improvement $(1 - \frac{\text{SSE}_1}{\text{SSE}_0})$		+ Educ. Het.	+ Ab. Cont.
Total Fit		10%	30%
Pregnancies and Ability Moments		13%	21%
Education Moments		-103%	33%
Marital Moments		35%	51%
Corr(P_{14-17}, ability) Data=-.27	-.09	-.14	-.28

Notes: The table shows the sum of square moments (SSE) for each set of moments and the respective fit improvement at adding a layer of heterogeneity to the model. Corr(P_{14-17}, ability) is the correlation between teen pregnancies and ability generated in the model.

The "baseline" model only generates a third of the correlation between ability and teen pregnancies. In figures 8a and 8b, we can observe that the relationship between ability and pregnancies is almost flat. Adding heterogeneity by education improves a 10% the total fit of the model and a 13% the fit of the moments relating ability with pregnancies. As education strongly correlates with ability, adding heterogeneity in this dimension increases the slope at which higher ability decreases teen pregnancies, and now the model explains half of the correlation between ability and teen pregnancies. However, the model is still far from explaining the high number of pregnancies in low ability women. Furthermore, the improvement in the fit of pregnancies and ability moments is made at the expense of decreases by half the model performance in fitting education moments. Finally, adding the ability to the contraception technology allows the model to generate the same correlation between ability and teen pregnancies as in the data and improves the total fit compared to the model without in 30% and 21% in the moments that relate pregnancies with ability. Additionally, the model replicates the pregnancy rates of the first and last ability quartiles but underpredicts pregnancy rates for the second and third.

Figure 8. Fraction of Pregnancies by Age and Cognitive Ability Quartile

(a) First Period: Pregnancy between 14-17 years old (b) Second Period: Pregnancy between 18-21 years old

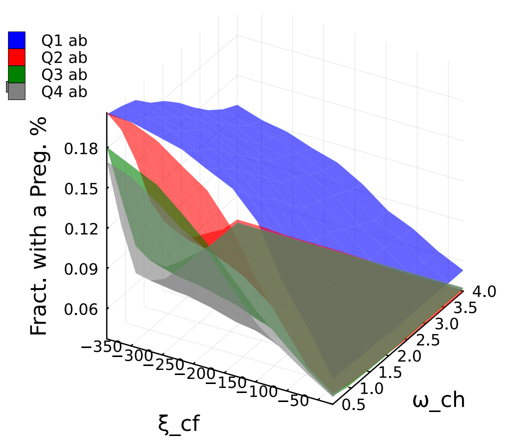


Notes: The left figure shows the fraction of women with teen pregnancy (14-17 years old) by ability quartile in the data and each model. The left side shows the fraction of women with pregnancies at college age (18-21 years old). Dots are the data, triangles are the full model, squares are the model with heterogeneity by education, and stars are the baseline model.

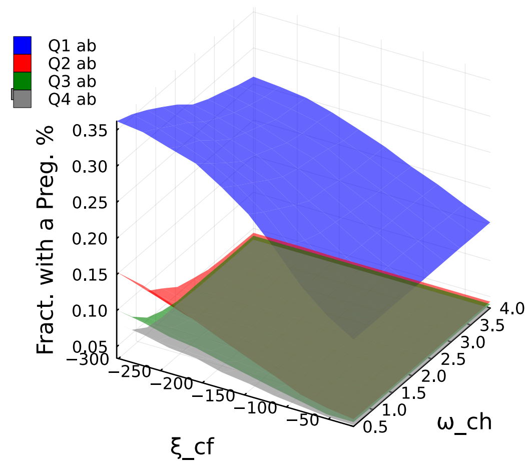
Three parameters mainly drive the relationship between ability and pregnancies: the share of ability on the contraception function λ_a, the cost of attending college ξ_c, and ω_h that give the concavity at which ability decreases the college psych cost. Figure 9a shows how the cost of college shape pregnancies between 14-17 years old when the contraception technology does not depend on ability ($\lambda_a = 0, \rho = 0$). Figure 9b shows how the cost of college shapes pregnancies when the contraception technology depends on ability at the values estimated from the data ($\lambda_a = 0.08, \rho = -0.4$). A reduction in college costs decreases pregnancies for all ability groups. However, there is no point in the parameter space that generates a gap between groups of the magnitude we see in the data. On the other hand, adding the ability to the contraception technology creates a gap in the level of pregnancies between the low and high ability individuals, as we observe in the data.

Figure 9. Relationship between ability and pregnancies.

(a) $\lambda_a = 0, \rho = 0$



(b) $\lambda_a = 0.08, \rho = -0.4$

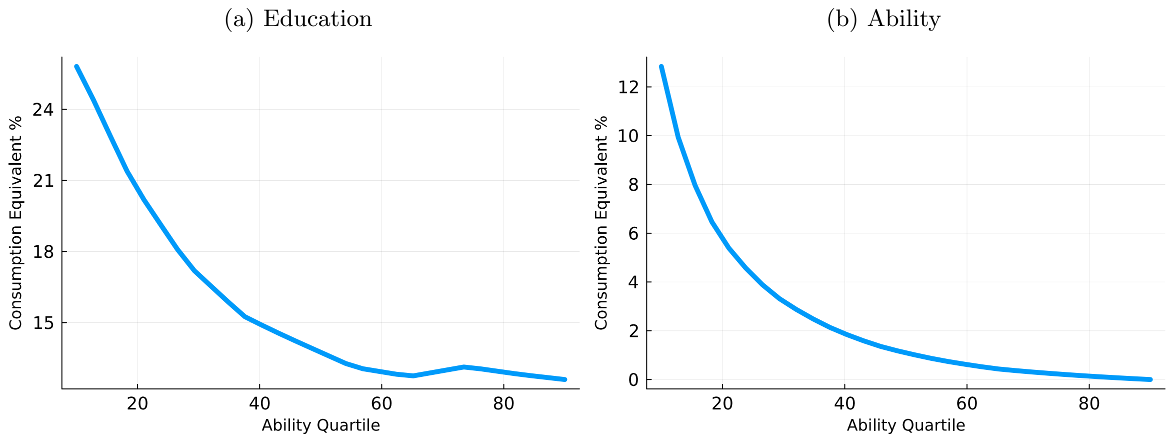


Notes: The left figure shows the fraction of teen pregnancies by ability quartiles for different college costs ξ_{cf} and convexity in how ability decreases this cost in a model without ability heterogeneity in the contraception technology. The right figure shows the behavior in the fraction of teen pregnancies when we change the same parameters in a model with ability heterogeneity in the contraception technology. Both figures are calculated with the remaining parameters fixed in the estimated parameters.

5.3 Contraception Cost as Consumption Equivalent

In this subsection, I quantify the value of improvements in contraception technology in terms of consumption. In the model, formal education and ability decrease contraception costs. First, I quantify the difference in contraception cost by education. Second, I quantify the difference in contraception cost by ability.

Figure 10. Equivalent Consumption by Ability Percentiles



Notes: The left figure shows the change in lifetime consumption required to make women indifferent between having the estimated contraception cost by education or all education groups having the same contraception cost as college. The right figure shows the increase in lifetime consumption require to make a teenager indifferent between using the amount of contraception necessary to have the same pregnancy probability as a teen in the top ability decile and her current choice.

To measure the difference in contraception cost by education, in figure 10a, I calculate the increase in women's lifetime consumption if all education groups have the same contraception cost as college graduates. For women in the first ability decile, equalizing contraception cost by education groups is equivalent to an increase of 26% in lifetime consumption; meanwhile, for women in the top decile is around 10%. Low-ability women benefit most from this change as they are less likely to attend college; meanwhile, college attendance in the top decile is high, so the contraception cost remains the same for most women in the decile. Next, in figure 10b, I quantify the difference in contraception cost by teenagers' ability through the increase in lifetime consumption necessary to make a teenager indifferent between using the amount of contraception necessary to have the same pregnancy probability as a teen in the top ability decile and her current choice. This exercise shows that the cost for a teen in the bottom decile to avoid a pregnancy is around 12% of her lifetime consumption.

6 Contraception Cost and Education Opportunities

Single motherhood and teen pregnancy are essential policy concerns as these women are considerably disadvantaged in multiple economic and social dimensions. Additionally, the effect of mistiming in children's outcomes is persistent over time, affecting multiple economic dimension as human capital accumulation, labor force participation, intergenerational inequality, and family formation.

An open question is the effect of the children on their mothers' outcomes. Whether early pregnancies cause disadvantages or women who have early pregnancies are disadvantaged early in life, with pregnancies not increasing their disadvantage, it is fundamental to design policies that can help them. For example, whether the cause of teen mothers' low education achievement is the pregnancy's timing, reducing contraception costs would have significant consequences on education achievement; however, if early inequalities cause the low education outcomes of these women, policies that decrease the cost of children for teens and single mothers will not improve educational achievement and can increase the number of early pregnancies. The effect of the U.S. welfare system on nonmarital and teenage pregnancies has been discussed since Becker (1991), who argue that at least part of the high number of nonmarital childbirth is caused by government aid. Rosenzweig (1999) find supportive evidence that welfare policies induce young women to choose to have a child outside of marriage. The relevance of this question is such that in 1996 the Personal Responsibility and Work Opportunity Reconciliation Act reformed the welfare system, stating that one of its goals was reducing nonmarital and teen pregnancies (Lichter and Jayakody, 2002).

Previous research has found that the correlation between early pregnancies and poor educational outcomes highly overstates the effect of the child on the mother's outcomes. Hotz et al. (2005) using miscarried as an IV found that teenage pregnancies have an insignificant effect on high school graduation at 28. Levine and Painter (2003) using a propensity score matching to deal with endogeneity found that only half of the correlation between teenage pregnancy is causal and teenage pregnancy decrease college attendance by 20% half of what is found on simple regression. In order to assess this question, I use the model to realize three counterfactuals:

1. High ability for contraception: All women are in the top ability percentile for contraception purposes.
2. High ability for education and wages: All women have the same college cost and income profile as women in the top ability percentile.

3. High ability for contraception, education, and wages: All women are in the top ability percentile for contraception, college cost, and wages.

Table 13. Counterfactual Results

Moments	(1) Same Cont. Ab.	(2) Same Ab. Edu. + Same Ab. Wage	(3) Same Cont. Ab. + Same Ab. Edu. + Same Ab. Wage
Attend Coll	5%	77%	83%
Preg < 18	-87%	-33%	-91%
Preg < 22	-46%	-30%	-49%

Notes: The table shows the change in college attendance, pregnancies before 18 years old, and pregnancies before 22 years old of three different policies: i) all women have are high ability for contraception, ii) all women are high ability for education and labor, and iii) all women are high ability for contraception, education, and labor.

The counterfactual results are displayed in table 13. In the first column, we see how pregnancies and education change when low ability women have the same contraception cost as women in the top-ability percentile. Consistent with previous empirical studies, I found that reducing contraception costs has little effect on college attendance. In the model, give to low ability women the same contraception cost as high ability women only increase college attendance by 5% as women who are teen mothers are in the lowest ability quartiles, which makes attending college too costly even without the child. However, even when education outcomes do not change, decreasing the contraception cost reduces teen pregnancies by 87% and before 22 by 46%. Additionally, in subsection 5.3, we see a considerable increase in low ability women's welfare. Column 2 shows the effect of reducing the psych cost of attending college for low ability individuals and keeping the contraception cost fixed. In this case, college attendance increase by 77%, and teen pregnancies are reduced by a third. Finally, column 3 shows the effect of reducing contraception and the psych college cost. In this case, college attendance increase by 80%, and teen pregnancies are reduced by almost half.

In conclusion, differences in contraception costs and education opportunities cause the difference in teen pregnancies by ability. However, even when policies that decrease contraception costs are welfare improving, especially for low ability individuals, as shown in figure 10, implementing these policies without improving education opportunities for low ability individuals has little impact on educational outcomes.

7 Reduce Contraception Cost

In this section, I use the model to analyze the effect on educational outcomes, marriage, and pregnancies of a policy that reduces the cost of contraception for all women to the cost of a college graduate. In order to do it, I set the contraception cost (λ) for high school dropouts equal to the contraception cost of high school graduates between 18-21 years old and between 22-29 years old, the contraception cost of high school dropouts and high school graduates is set to the cost of a college graduate.

If all women have contraception costs of college graduates, pregnancies decrease in every age group. In teens, pregnancies decrease by 24%, before 22 by 15%, and before 29 by 42%. The decrease in teenage pregnancy is driven by expectations about the future, given that the contraception cost between 14-17 years old remains the same. The decrease in the contraception cost increases high school dropouts; as discussed in the previous section, teenagers drop high school because of the cognitive cost of education and not because of teen pregnancies. In the model, for low ability women, access to better contraception technology is an important reason to acquire education. When this motive disappears, education is less attractive, then high school dropouts double, and college attendance decrease by 12%. Single mothers decrease between 18-21 years old by half for high school dropouts and by 35% for high school graduates. Between 22-29 years old, noncollege single mothers almost disappear but remain constant for college graduates as their contraception costs remain unchanged. Finally, the number of marriages remains constant for high school graduates and college graduates but decline by 20% for high school dropout, as marriage work as insurance in the case of a pregnancy.

Table 14. Reduce Contraception Cost

Moments	Data	Coll. Cost	Moments	Data	Coll. Cost
Preg. < 18 yr. old	0.11	-24%	Pregnancy 18-21 yrs. old | HSD, NPP	0.47	-46%
Preg. < 22 yr. old	0.40	-15%	Pregnancy 18-21 yrs. old | HS, NPP	0.40	-38%
Preg. < 29 yr. old	0.64	-42%	Pregnancy 18-21 yrs. old | Attend Coll, NPP	0.17	-10%
Drop HS | No Preg	0.06	130%	Single Mom 22-29 yrs. old | HSD, NPP	0.18	-98%
Drop HS | Preg	0.27	-6%	Single Mom 22-29 yrs. old | HS, NPP	0.10	-94%
Attend Coll, NPP | No Preg	0.38	-12%	Single Mom 22-29 yrs. old | Coll, NPP	0.02	0%
Attend Coll, NPP | Preg	0.08	12%	Married 22-29 yrs. old | HSD, NPP	0.50	-16%
Grad. Coll., NPP | No Preg	0.51	-5%	Married 22-29 yrs. old | HS, NPP	0.68	3%
Grad. Coll., NPP | Preg	0.38	6%	Married 22-29 yrs. old | Coll, NPP	0.64	1%
Married 18-21 yrs. old | HSD, NPP	0.35	-2%	Pregnancy 22-29 yrs. old | HSD, NPP	0.48	-97%
Married 18-21 yrs. old | HS, NPP	0.34	-1%	Pregnancy 22-29 yrs. old | HS, NPP	0.37	-89%
Single Mom 18-21 yrs. old | HSD, NPP	0.36	-52%	Pregnancy 22-29 yrs. old | Coll, NPP	0.49	-2%
Single Mom 18-21 yrs. old | HS, NPP	0.24	-35%			

Notes: The table shows the changes in different model moments of decreasing the contraception cost to the level of a college graduate for all education groups. The moments are conditional on not having previous pregnancies (NPP).

8 Conclusion

In this paper, I empirically and quantitatively explore cognitive ability's effects on fertility timing. The main finding is that education, wage, and marital opportunity cost cannot fully explain differences in fertility timing between women with different levels of cognitive ability. Women in the lowest ability quartile have nine times more teen pregnancies than women in the top. However, this difference in pregnancies disappears after 22 years old. The cognitive ability remains relevant in fertility after controlling for education and wage, decreasing the number of pregnancies at early ages.

The paper develops and estimates a dynamic life-cycle model with endogenous fertility, education, wages, and marriage to evaluate how cognitive ability affects fertility. First, consistent with the empirical results, cognitive ability affects teens' and young adults' fertility risk beyond the differences in time opportunity cost and fertility risk by education. Then, through the lens of the model, I show the welfare gains of improvement in contraception cost by ability. Finally, I use the model to analyze whether single mothers' poor educational outcomes result from the cost of early pregnancy or previous inequalities. Although improving contraception for teens is welfare improving, college attendance remains constant as the cause of many teen mothers' poor educational outcomes is that higher education is too costly for low ability individuals, even without the child.

Finally, this work contributes to the increasing literature showing cognitive ability's importance in noneconomic outcomes and highlights its importance in understanding fertility timing and intention. Additionally, it provides a framework to understand the effects on early pregnancies and educational outcomes of policies targeting contraception cost and cognitive ability. In future work, I expect to extend the model to allow for children's human capital accumulation and evaluate the effect of early pregnancies on children's educational outcomes and intergenerational inequality with persistent cognitive ability between generations.

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A Calibration Parameters

Appendix Table A1. Contraception Cost by Education and Age Group

Education / Age Group	13-17 yr. old	18-21 yr. old	22-29 yr. old
High School Dropout	1.18	2.70	0.38
High School Graduate	1.18	0.63	0.91
College	1.18	0.57	6.28

Notes: Estimated contraception cost λ by age and education.

Appendix Table A2. Probability Meeting a Husband

Education / Age Group	18-21 yr. old	22-29 yr. old
High School Dropout	0.33	0.29
High School Graduate	0.48	0.31
College		0.33

Notes: Estimated probability of meeting a men μ by age and education.

B Model Mechanisms Contribution

Appendix Table B1. Pregnancy and Wages

Moments	Data	Baseline + Educ. Het + Ab. Cont.	Baseline + Educ. Het.	Baseline
% Preg AQ1 14-17 yrs. old	0.26	0.30	0.16	0.11
% Preg AQ2 14-17 yrs. old	0.15	0.07	0.08	0.07
% Preg AQ3 14-17 yrs. old	0.09	0.05	0.05	0.05
% Preg AQ4 14-17 yrs. old	0.03	0.04	0.05	0.05
Drop HS | No Preg	0.06	0.06	0.07	0.06
Drop HS | Preg	0.28	0.27	0.21	0.29
Att. Coll. | No Preg	0.41	0.38	0.35	0.35
Att. Coll. | Preg	0.08	0.08	0.09	0.07
Att. Coll. AQ1	0.12	0.10	0.07	0.11
Att. Coll. AQ2	0.25	0.32	0.30	0.29
Att. Coll. AQ3	0.40	0.46	0.46	0.44
Att. Coll. AQ4	0.67	0.49	0.49	0.48
Graduate College | No Preg	0.62	0.51	0.55	0.55
Graduate College | Preg	0.30	0.38	0.33	0.36
% Preg AQ1 18-21 yrs. old | NPP	0.54	0.59	0.34	0.30
% Preg AQ2 18-21 yrs. old | NPP	0.43	0.31	0.28	0.25
% Preg AQ3 18-21 yrs. old | NPP	0.28	0.23	0.24	0.20
% Preg AQ4 18-21 yrs. old | NPP	0.16	0.21	0.25	0.21

Notes: The table shows the moments generated by the full model, the model with heterogeneity by education, and the baseline model. Moments are conditional on not having previous pregnancies (NPP).

Appendix Table B2. Pregnancy and Wages

Moments	Data	Baseline + Educ. Het + Ab. Cont.	Baseline + Educ. Het.	Baseline
Married 18-21 yrs. old | HSD, NPP	0.39	0.35	0.29	0.44
Married 18-21 yrs. old | HS, NPP	0.41	0.34	0.32	0.36
Single Mom 18-21 yrs. old | HSD, NPP	0.44	0.36	0.36	0.35
Single Mom 18-21 yrs. old | HS, NPP	0.29	0.24	0.19	0.17
Pregnancy 18-21 yrs. old | HSD, NPP	0.42	0.47	0.48	0.57
Pregnancy 18-21 yrs. old | HS, NPP	0.35	0.40	0.33	0.29
Pregnancy 18-21 yrs. old | Attend Coll., NPP	0.16	0.17	0.15	0.11
% Preg AQ1 22-29 yrs. old | NPP	0.48	0.64	0.50	0.51
% Preg AQ2 22-29 yrs. old | NPP	0.48	0.51	0.47	0.49
% Preg AQ3 22-29 yrs. old | NPP	0.45	0.33	0.44	0.46
% Preg AQ4 22-29 yrs. old | NPP	0.45	0.29	0.39	0.45
Single Mom 22-29 yrs. old | HSD, NPP	0.22	0.18	0.14	0.18
Single Mom 22-29 yrs. old | HS, NPP	0.12	0.10	0.10	0.13
Single Mom 22-29 yrs. old | Coll., NPP	0.02	0.02	0.02	0.02
Married 22-29 yrs. old | HSD, NPP	0.61	0.50	0.56	0.51
Married 22-29 yrs. old | HS, NPP	0.66	0.68	0.57	0.83
Married 22-29 yrs. old | Coll., NPP	0.68	0.64	0.65	0.99
Pregnancy 22-29 yrs. old | HSD, NPP	0.43	0.48	0.57	0.40
Pregnancy 22-29 yrs. old | HS, NPP	0.43	0.37	0.45	0.52
Pregnancy 22-29 yrs. old | Coll., NPP	0.42	0.49	0.42	0.35

Notes: The table shows the moments generated by the full model, the model with heterogeneity by education, and the baseline model. Moments are conditional on not having previous pregnancies (NPP).