Cognitive Ability, Education, and Fertility Risk*

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Abstract

The paper provides empirical evidence using NLSY79 data that cognitive ability affects pregnancy timing and intention. Then, I build and estimate a life cycle model to understand whether education groups' differences in opportunity cost and contraception efficiency explain this effect. I find that these mechanisms cannot explain why women in the lowest cognitive ability decile have nine times more pregnancies than those in the top. Finally, I use the model to show that policies that decrease contraception cost decrease early pregnancies but do not improve college attendance, as college is too costly for this group of women, even without a child.

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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. However, in the US, 41% of pregnancies are not at the right time or even wanted. Among teens aged 15 to 19 years old, the fraction increases to 75% [1].

Women whose first child was unintended are more likely to be single mothers or enter in 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. In this paper, I study how cognitive ability affects fertility decisions. Given their multiple implications, understanding fertility decisions is a first-order concern in economics. Women in the lowest ability quartile have nine times more teen pregnancies than women in the bottom quartile. The cognitive and noncognitive ability has been associated with better economics and social outcomes, among others, lower teen pregnancies (Heckman, 2006; Heckman et al., 2006). However, the channels through which affect fertility is an open question. The relationship between pregnancies and education has been extensively studied as the relationship between education and economic outcomes. For this reason, in this paper, I study whether education can completely account for the importance of cognitive ability on 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

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

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.

First, I document the relationship between cognitive ability with pregnancy timing and intention. Second, I build a life cycle model with agents heterogeneous in ability who decide on education, contraception, marriage, consumption, and child investment. Third, I estimate the model using U.S. data to measure how cognitive ability and education shape fertility, single motherhood, and marriage. Finally, I use the model to quantify how a decrease in contraception costs affects women's outcomes and how a decrease in college costs affects fertility.

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 education, marriage, and fertility, 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, early and unintended pregnancies, I use the National Longitudinal Survey of Youth 1979 (NLSY79) as it measures cognitive ability and 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 the cognitive ability to have a first pregnancy decreases and even changes signs. 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 cognitive ability improving women's fertility planning (see, Commendador (2007)).

I build and estimate a dynamic life cycle model with endogenous education, fertility, 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. 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 to measure the effect of cognitive ability on fertility.

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 observation 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. Finally, 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. Observation Summary

	Low Ability			High Ability			
Age First Pregnancy	HSD	HS	Coll	HSD	HS	Coll	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

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. Pregnancies affect the cost of education, labor outcomes, and marriage. Therefore, I focus on the data characteristic relating ability with pregnancy timing, early pregnancies with education outcomes, and education outcomes with marital and pregnancy 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 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%

We observe a positive relationship between ability and age at first birth that disappears with age. Between 14 and 17 years old, twenty-nine percent 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 percent of high school graduates had their first child after high school age, and seventy-three percent 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%

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. 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 decide to have children young because 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. However, on average, their husbands have lower wages than women without out-of-wedlock births.

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%

Table 4 compares the marriage probabilities of single mothers to non-single mothers, in the case of single mothers, I look at the probability of marriage conditional on the 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 considerably 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.	Child	No Child	Child	No Child	Child	No Child
14-17	36873	34546				
18-21	37473	41224	44785	48923		
22-29	43760	30448	47420	58889	63248	81521

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 the first pregnancy between 18 and 21 years old, the average penalty for an out-of-wedlock pregnancy is \$4000 yearly; meanwhile, for the one that had the 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 discuss 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, there is a higher future income opportunity cost that bias 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 of whether high ability individuals have better control of fertility.

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:

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

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, mother education, 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 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 for 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 year 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 33%

reduction, and the effect of college attendance is a 72% reduction on the same probability. Between 22-29 years old, a college education reduces the probability of a child by 17% and the probability of an unintended one by 14%. The interdecile range of wages is 42% for birth and 90% for unintended births. High school graduation does not affect birth or unintended birth once controlled by ability. However, attending college reduces the probability of pregnancy and unintended pregnancy to almost zero. The fact that college is relevant even after controlling for wages supports the evidence 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 , * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

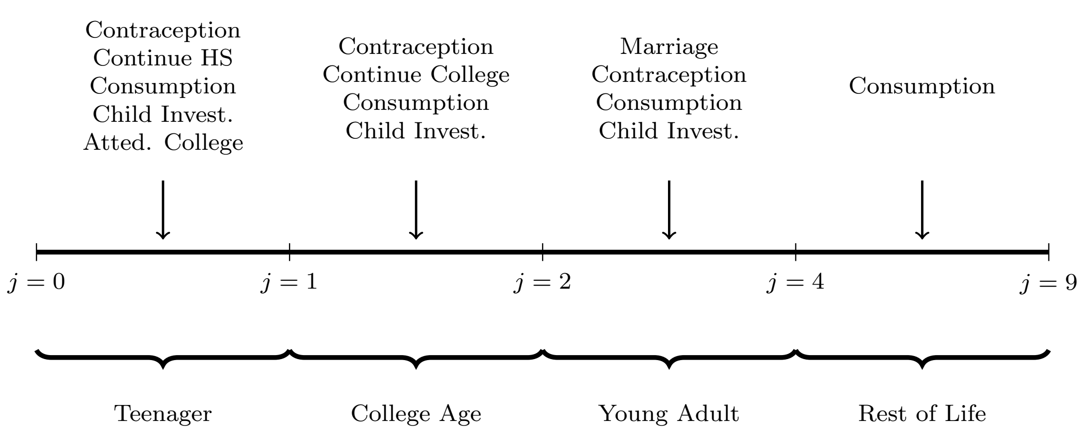
The previous results suggest that ability affects fertility beyond opportunity costs associated with education and wage. However, I can not control for the possibility that lower educational outcomes are caused by low ability women having more pregnancies which hinder their education outcomes, or that 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 timing and intention.

3 Model

In this section, I develop and estimate a life cycle model to measure whether cognitive ability affects fertility beyond education, wages, and marriage. Specifying a model allows dealing with the endogeneity caused by the fact that agents are forward looking, and their contraception choice depends on future opportunities related to their cognitive ability. Additionally, the model allows analyzing how fertility changes as future opportunities or contraception costs vary.

I build a nine-period model, each period represents four years of a woman's life. The timing of the model decision is depicted in figure 1. During the first four periods, women are fertile, deciding contraception. Then, in the period that a child is born, they decide on the children's investment. In the first period, they are teenagers (14-17 years old); in the second, they are at college age (18-21 years old); then, individuals are young adults for two periods (22-29 years old), and finally, they consume until their death (30-49 years old). Women differ by ability, marital status, motherhood, wage, and education. During each fertile period, women make different decisions: graduate from high school, attend and graduate from college, marry in the case of being single, use contraception in the case of not having a previous child, and invest in the child in the case of having one. Within each period, decisions are sequential, allowing us to divide them into sub-periods. In order to keep tractability, there is no saving in the model.

Figure 1. Women Attending College Life Cycle



In the model, 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. Child investment is a one-in-a-lifetime investment with a positive return. The optimal age for having a child is when parents have higher resources, which is increasing in age. However, waiting is costly, given the contraception cost. Mothers are altruistic to their children, and the utility received is increasing in children's monetary investment. Model child investment realistically is beyond the scope of the paper. This model choice is a reduced form to create incentives for high income people to postpone parenthood and is also consistent with the fact that child investment is increasing in income. Additionally, women meet a potential husband each period, and they can marry during it. There is no divorce in the model.

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 variables of the model and their notation are the following. The value of the problem at each moment is V_t^s, where t represents the period, and s 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 is continuous. Education has three levels $e \in \{HSD, HS, C\}$, 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 was a single mother or not. $k_t \in \{0,1,2,3,4\}$ keeps track of the child's birth period, and it is zero whether she does not have a child. The decision variables are consumption c, child monetary investment i, and the contraception amount s. In the rest of this section, I introduce the model backward to simplify the exposition.

3.1 Fifth to Nine Period (30-49 years old)

The model focuses on the decision between 14-29 years old as around 90% of first childbirth occurred between 14-29 years old. However, a relevant fraction of college wages return is backloaded after 30 years old, so I include the ages between 30-49 years old to avoid underestimating the value of college. During this period, agents consume their household income and do not make any choices. I only model until 49 years old, given the data limitations I will explain in the estimation section. The women's problem in these periods is:

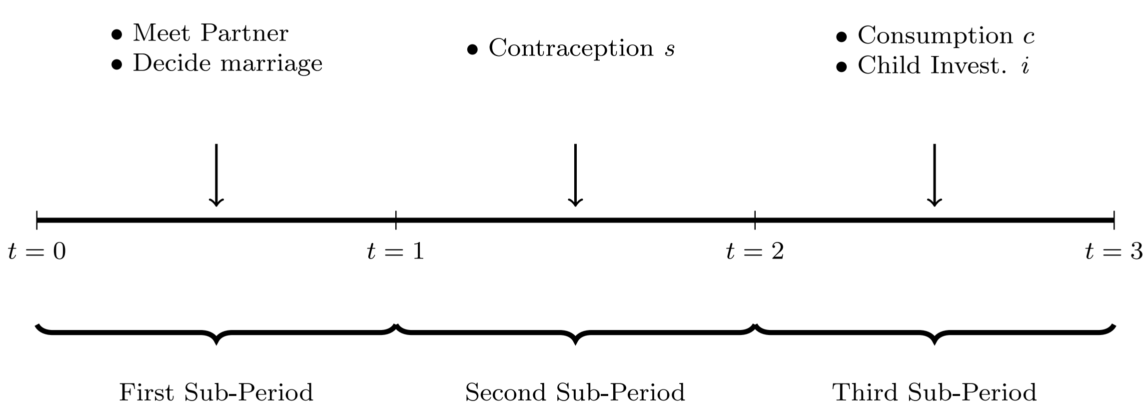
$$
\begin{aligned}
V_t(a, e, m, sm, k_t) &= \max_{c} \ u(c) \\
\phi_c(m, k_t) \cdot c &= \ w(t, a, e, m, sm, k_t) + 1_{m=1} w^h(t, e, sm, k_t)
\end{aligned}
$$

where $\phi_c(m, k_t)$ maps consumption expenditures and family composition into effective consumption. Women's wage w is a function of their age, ability, education, marital status, single motherhood, having a child, and maternal age at birth. Husband wage w^h 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 a single mother. The estimation of the wage process is discussed in section 4.2.

3.2 Third and Fourth Period (22-29 years old)

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

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



3.2.1 Third Sub-Period: Consumption and Child Investment

The women's problem in this sub-period depended on whether they had a child. Whether a woman has a child within the period, she has to decide on child investment and consumption, solving the following problem:

$$V_t^3(a,e,m,sm,k_t=t) = \max_{c,i}\ u(c) + V(i)^k + V_{t+1}(a,e,m,sm,k_t=t)$$
$$\phi_c(m,k_t)\cdot c = \ w(t,a,e,m,sm,k_t) + 1_{m=1}w^h(t,e,sm,k_t) - i$$

where $V^k(i)$ is the utility the child provides to the mother, which depends on monetary investment i. In the case of a woman with a child during a previous period, she only has to decide on consumption; then her problem is the following:

$$V_t^3(a,e,m,sm,k_t) = \max_{c}\ u(c) + V_{t+1}(a,e,m,sm,k_t)$$
$$\phi_c(m,k_t)\cdot c = \ w(t,a,e,m,sm,k_t) + 1_{m=1}w^h(t,e,sm,k_t)$$

Finally, a woman without childbirth during her fertile life receives a utility $\mu_{nk}(e)$. This utility is necessary to prevent all women from having a child in the last fertile period, giving a chance to the model to replicate that in the data, 10% of women do not have a child at 30 years old. Then, this group solves the following problem:

$$V_4^3(a,e,m,sm,k_t=0) = \max_{c}\ u(c) + \mu_{nk}(e) + V_5(a,e,m,sm,k_t=0)$$
$$\phi_c(m,k_t)\cdot c = \ w(4,a,e,m,sm,k_t) + 1_{m=1}w^h(4,e,sm,k_t)$$

3.2.2 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, solving the following problem:

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

where contraception has a utility cost of ϕ_s and $p(t,a,e,s)$ is the probability of having a pregnancy. 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 $\frac{\partial p(t,a,e,s)}{\partial a} < 0$. In the model, women only can have one child. In the case of already had a child, they do not choose contraception, and the value at this sub-period is:

$$V_t^2(a,k,e,m,sm,k_t) = V_t^3(a,k,e,m,sm,k_t)$$

3.2.3 First Sub-Period: Marriage

Single women meet a potential husband with probability $\mu(e,t)$, which depends on women's education achievement e and they marry if the utility of marriage is higher than remaining single. Then the problem during this stage is the following:

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

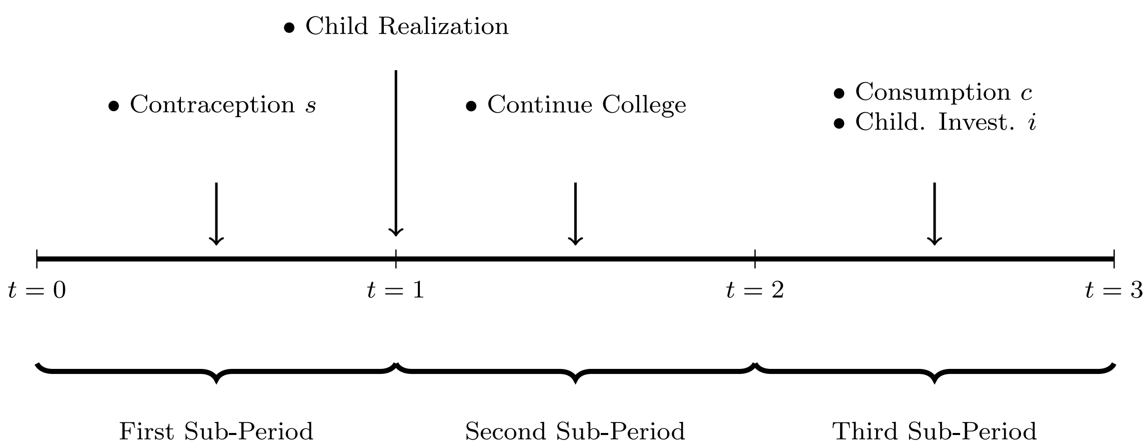
The model does not have divorces, so married women do not make marital decisions. Then, their value function is given by:

$$V_t^1(a,e,m=1,sm,k_t) = V_t^2(a,e,m=1,sm,k_t)$$

3.3 Second Period (18-21 years old)

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 3.2. Women attending college make three sequential decisions. First, they decide on contraception. Second, they observe their pregnancy outcome and decide about continuing college. In the case of having a child during college, there is a double penalty. First, graduation cost increases, and 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 consumption-investment sub-period with the wage of high school graduates.

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



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

In the third sub-period, we have two value functions. Women who continue attending college and graduate and those who drop out working as high school graduates. If a woman decides to graduate, she receives the wage of a college student and decides on consumption and child investment in the case of having a child. Then her problem is:

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

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

where G denote the value function of women who continue college and $\kappa_{\mathrm{k,C}}$ is the cost of attending college with a child. If the woman drops out from college, her problem is denoted by CD, and she faces the consumption-investment problem of a high school graduate. Then, her value function in this sub-period is:

$$V_2^{3,CD}(a, k_t) = V_2^3(a, e = \mathrm{HS}, m = 0, sm, k_t)$$

3.3.2 Second Sub-Period 18-21: Continue College

In this sub-period, a woman decides whether to continue college. The decision is made after she observes her pregnancy outcomes. Then the problem is:

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

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

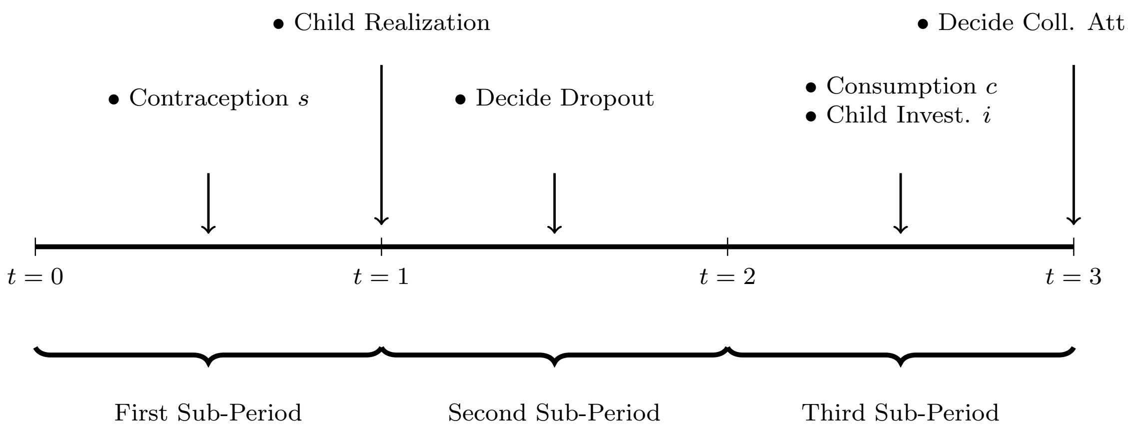
3.3.3 First Sub-Period 18-21: Contraception

In the first sub-period, college women choose the amount of contraception as in previous periods, solving the following:

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

3.4 First Period (14-17 years)

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



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 in the third sub-period work as high school dropouts. Finally, women who continue high school decide whether to attend college at the end of the third period.

3.4.1 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 the following:

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

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. $\kappa_c(a, k_t)$ is the psych cost of attending college that depends on the woman's ability and whether she has a child. Women who decide to continue high school receive an allowance $w(\mathrm{HS}_a)$ from their parents. In the case of those who drop out, they work as high school dropouts. Women who continue high school with a child solve:

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

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. Women attending high school without a child solve:

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

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

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

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

$$V_1^{3,HSD}(a, HS_a, sm = 0, k_t = 0) = \max_c \ u(c)$$

$$+\beta V_2^1(a, e = HSD, m = 0, sm = 0, k_t = 0)$$

$$c = w(t, HSD, a, k_t)$$

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

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

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

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.

3.4.3 First Sub-Period 14-17: Contraception

In the first sub-period, all women are attending high school. Then, the sub-period decision is the amount of contraception, solving the following problem:

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

3.5 Functional Forms and Parameters

I use the following functional forms to take the model to the data. These functional forms have 30 unknown parameters, which I will discuss their estimation in section 4.

3.5.1 Preferences (2)

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.

3.5.2 Fertility (9)

In the case of the pregnancy probability, I follow Seshadri and Zhou (2022); Choi (2017), and the function is parameterized as a modified logistic function. 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 and ρ the elasticity of substitution in the contraception technology.

3.5.3 Marriage Market (7)

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

3.5.4 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, and κ_{kb} is the extra study cost 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; their learning is higher. Women who continue college having a child during that period face the extra cost $\kappa_{k,\text{coll}}$. Finally, the extreme value shock scale parameters for attending and continuing college are given by σ_{coll} and σ_{CD}.

3.5.5 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 Estimation

There are three sets of parameters in the model: 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 discount factor, the relative risk aversion, and the economies of scale in consumption values that are taken from the literature.

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

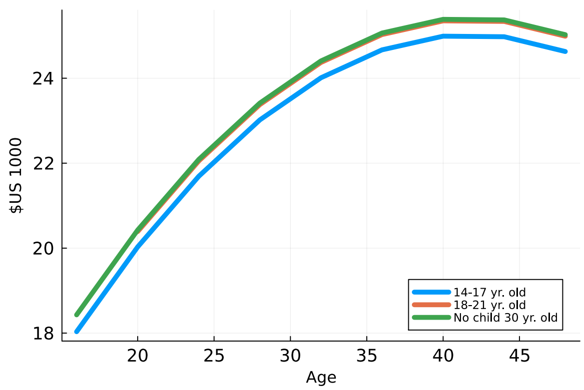
4.2 Wages Profiles

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 LSY79 individuals are currently in their early fifties, wages profiles are estimated using OLS for individuals between 14 to 50 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 equation for women's wages and husbands' wages are:

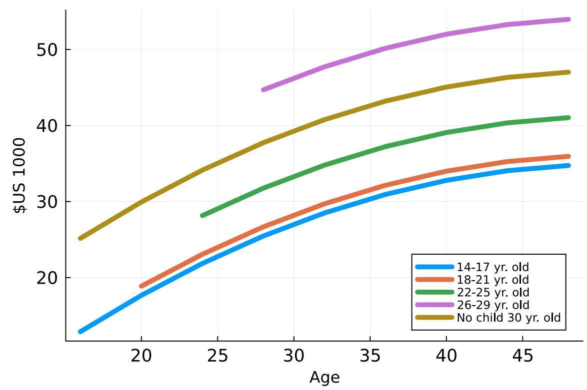
$$
\begin{gathered}
w_{i,t} = \alpha_0 + \alpha_t \cdot t + \alpha_{t^2} \cdot t^2 + \alpha_e e_i + \alpha_{\mathrm{HA}} \mathrm{HA}_i + \alpha_k k_i + \alpha_{et} \cdot e_i \cdot t + \\
\alpha_{et^2} \cdot e_i \cdot t^2 + \alpha_{e\mathrm{HA}} \cdot e_i \cdot \mathrm{HA}_i + \alpha_{k\mathrm{HA}} \cdot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

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

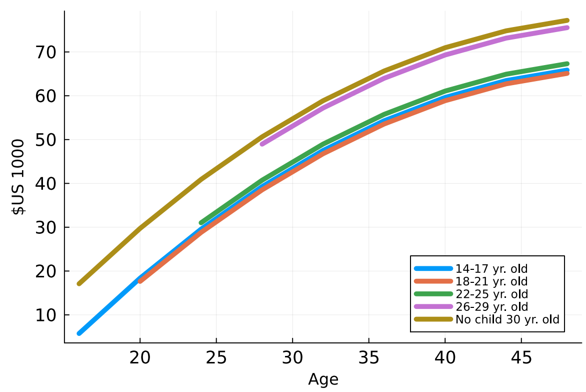
where w is the woman's wage, w^h is the husband's wage, t is the women's age, i is the individual, e and e^f is the women education level (HSD, HS, C), HA is a dummy if the individual test above the mean cognitive ability test score, k is a dummy that indicates the woman age at the first childbirth,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



(a) High School Dropout



(b) High School

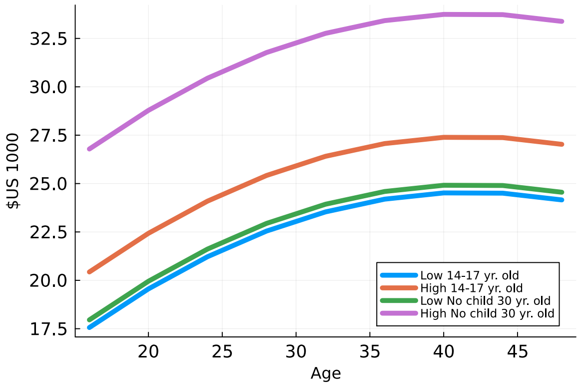


(c) College

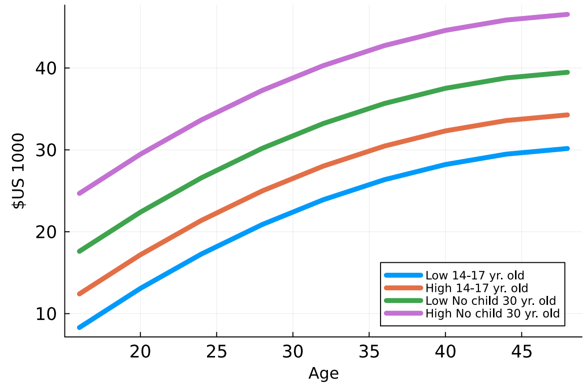
Figure 5. Women wage profile by education and age first birth

Women with early pregnancies have lower wages for all education groups, the penalty increases with ability, and women who married after an out-of-wedlock pregnancy had husbands with lower wages. Even when the magnitude of the decrease in husbands' wages linked to an out-of-wedlock pregnancy increase with the women's age at childbirth, the highest penalty is paid by college educates. In summary, high ability women are the ones who suffer the highest cost associated with early pregnancies as they are the ones that attend college more and married with college educated husbands.

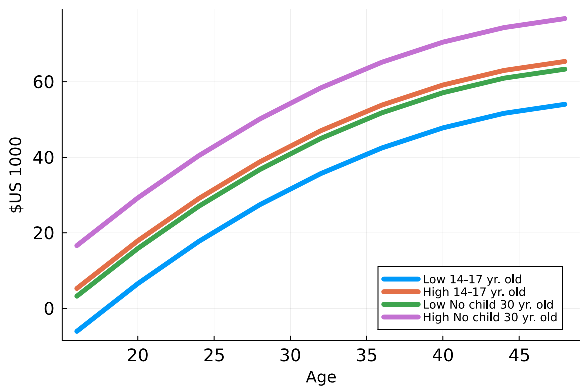
Women's wages profile by education and age at first childbirth are shown in figure 5. As expected, college women have the highest earnings, followed by high school graduates, and high school dropouts have the lowest wages. High school dropout profiles are shown in figure 5a. Early childbirth has a negligible effect on this group's earnings; a birth between 14-17 years old only reduces wages by $400. There are not enough observations to calculate the wage profiles for women with first childbirth between 22-29 years old for this education group, 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 groups, 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 group. The child penalty for college and high school graduates is similar in monetary terms. However, the relative magnitude is high for high school graduates as they have lower wages.



(a) High School Dropout



(b) High School

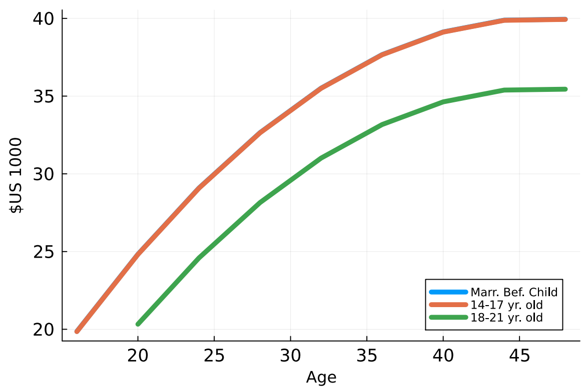


(c) College

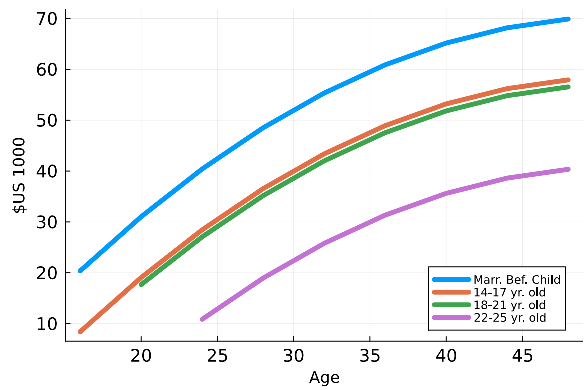
Figure 6. Women wage profile by education and ability

Figure 6 shows the relationship between ability and wage by women's education group. 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 years. 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 , 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.

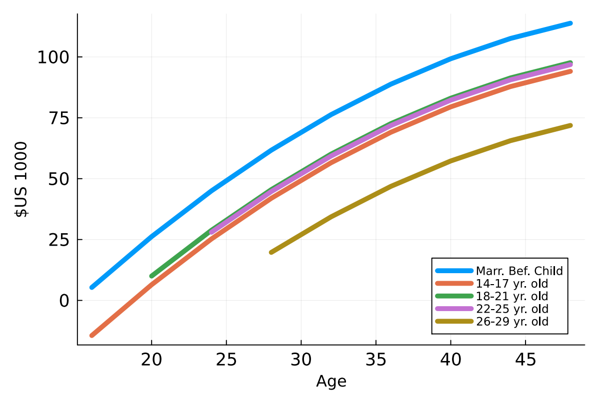
The penalty wage associated with early pregnancy is increasing in ability. In the case of low ability high school dropouts, are \$400 yearly and \$6300 yearly in the case of high ability. Low ability high school graduates face an early pregnancy penalty of \$6300 yearly and \$12200 yearly for the high ability. Finally, for college graduates, the penalty for low ability is \$9300 yearly and \$11340 yearly for high ability.



(a) High School Dropout



(b) High School



(c) College

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

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 with age and education;

the highest penalty is for college women who had an out-of-wedlock pregnancy between 26-29. Figure 7a shows high school dropouts. 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 increase to $42000 less.

4.3 Endogenous Parameters

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)	$-.4$	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
$w(HS), w(Coll)$ (1)	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.

The model has 31 unknown parameters estimated through 34 data moments using Simulated Method of Moments. Table 8 shows the parameters' respective interpretations. The model aims to understand how ability, education, wage, and marriage shape contraception and age at first pregnancy. For this reason, I estimate the model using moments that relate cognitive ability, education, and marital outcomes with fertility timing.

The data moments are conditional on not having a child before that particular age. I do this because, in the model and the data, I focus on first pregnancies as these are the most costly and significant for women's outcomes. For example, the fraction of women who have their first pregnancy between 18-21 years old is conditional on not having a child before 18. In the following sub-section, I describe each data moment and discuss whether the model fits it. To simplify the explanation, I divide the moments into three categories: cognitive ability and pregnancy, education, and marital outcomes.

In table 8 second column, we can observe the value of the estimated parameters. The estimated share of ability is 0.56, making ability a relevant input to planning fertility. Table A2 shows the probability of meeting a husband by age and education. High school dropouts' probability of meeting a husband after 22 years old is almost zero; for high school graduates between 18-21 to 22-29 years old, the probability falls to a third, and college graduates have the highest probability by education of meeting someone after 21 years old. The highest cost of pregnancy while studying is during college. The cost of teen pregnancy to attend college is low, so it is not a significant driver in the low college attendance of teen mothers. This result is surprising as women who had teen pregnancies and worked during college attendance periods do not provide child care, indicating that women with early pregnancies are not attending college even in the case of not having a pregnancy. The estimated parent allowance during high school is 21600 dollars. In section 5.3, I discuss how contraception costs vary by age and education.

5 Results

This subsection shows the model moments compared to 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.

5.1 Model Fit

This subsection shows the model moments compared to 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.

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%)

Values in parenthesis are model outcomes, and values without parenthesis are the data values.

Table 9 show 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 is similar. The model generates a positive relationship 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 because it generates a 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
Graduate College | No Pregnancy (<22)	0.62	0.51
Graduate College | Pregnancy (<22)	0.30	0.38

The model replicates the relationship between cognitive ability, pregnancy, and education attainment. Table 10 shows that it generates the same number of high school dropouts and college attendance. 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. Even when 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; the difference 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

NPP = No Previous Pregnancy.

Finally, I look at 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 the model fit. The model generally does a decent job, given its simplicity and the high number of data moments. The model is close to matching marriage, single mothers, and total pregnancies. The biggest model failure is in the number of high school graduates' total pregnancies, which the model considerably overpredicts.

5.2 Mechanism 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 $\lambda^{a} \geq 0, \rho \neq 0$. Each model is estimated separately. The model 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, and the bottom displays the percentual improvement in the model fit when each mechanism is added $(1 - \frac{\text{SSE}_1}{\text{SSE}_0})$. The full set of moments for each model specification is shown in Table C1.

Table 12. Decomposing the Model Fit

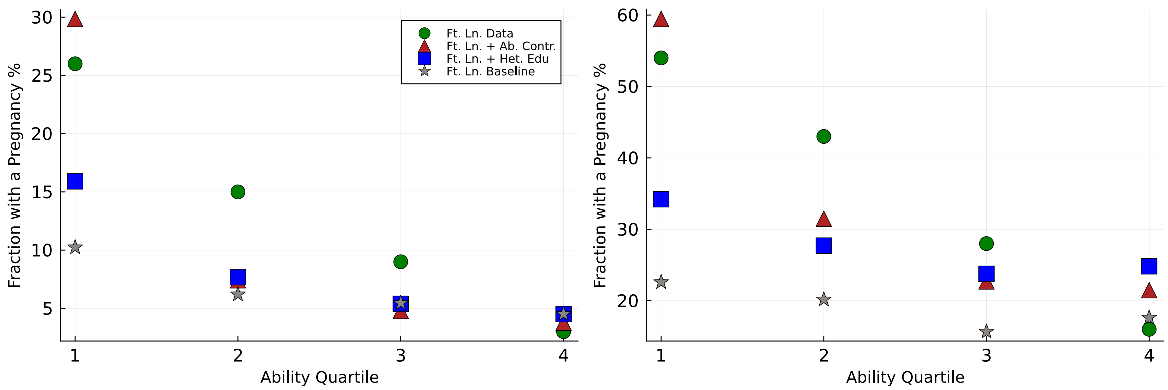
	(1) Baseline	(2) Baseline + Educ. Het.	(3) Baseline + Educ. Het. + Ab. Cont.
Total SSE	2.77	2.49	1.73
Pregnancies and Ability Moments SSE	1.61	1.73	1.12
Education Moments SSE	0.24	0.48	0.32
Marital Moments SSE	0.92	0.60	0.29
Fit Improvement $(1 - \frac{\text{SSE}_1}{\text{SSE}_0})$		+ Educ. Het.	+ Ab. Cont.
Total Fit		10%	30%
Pregnancies and Ability Moments		13%	21%
Education Moments		-103%	33%
Marital Moments		51%	51%

Table 12 shows the performance of each of the previous model specifications. The first column shows the fit of the "baseline" model, the second column shows the fit when I allow heterogeneity in the contraception costs across education groups, and the third column is when fertility depends on cognitive ability. Figure 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.

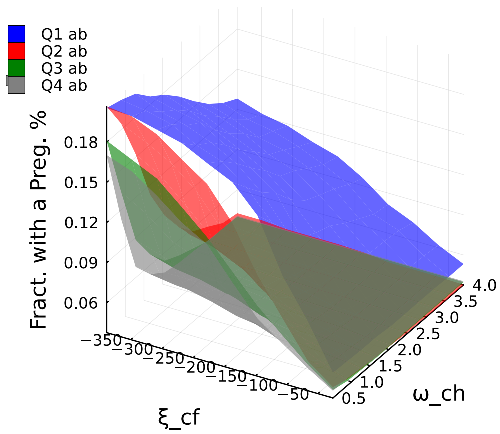
As shown in figures 8a and 8b, the "baseline" model is not able to generate a positive relationship between ability and education. Adding heterogeneity by education improves a 10% the total fit of the model and a 13% the fit of the moments relating ability with pregnancies. As education strongly correlates with ability, adding heterogeneity in this dimension increases the slope at which higher ability decreases teen pregnancies. However, the model is still far from explaining the high number of pregnancies in low ability women. The model uses the differences in contraception cost by education groups to create dispersion between ability and pregnancies, which is done at the expense of decreases by half the performance fitting the educational moments. Finally, adding ability to the contraception technology improves the fit for the previous model in 30% and 21% in the moments that relate pregnancies with ability. Additionally, now the model can explain the high pregnancy rate of the first and last ability quartiles but underpredict pregnancy rates for the second and third.

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

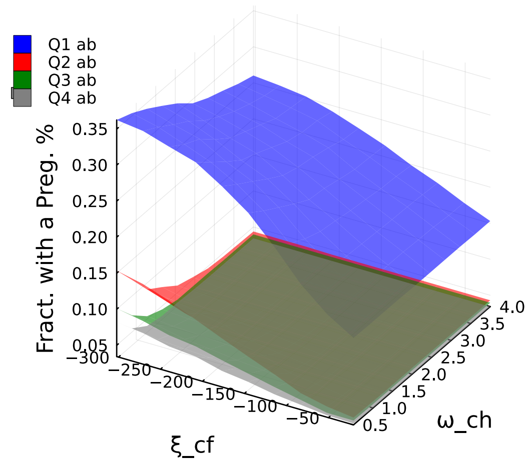
(a) First Period: Pregnancy between 14-17 years old (b) Second Period: Pregnancy between 18-21 years old



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 the relationship between ability and college psych cost. Figure 9c shows how the cost of college shape pregnancies between 14-17 years old when the contraception technology does not depend on ability ($\lambda_h = 0$). Figure 9d shows the case in which contraception technology depends on ability ($\lambda_h = -0.4$). A reduction in the cost of college cost decreases pregnancies for all ability groups. However, there is no point in the space parameter that generates a gap between groups of the magnitude we see in the data. The addition of the ability to the contraception technology creates a gap in the level of pregnancies between the low and high ability individuals, similar to the data.



(c) $\lambda_h = 0$



(d) $\lambda_h = -0.4$

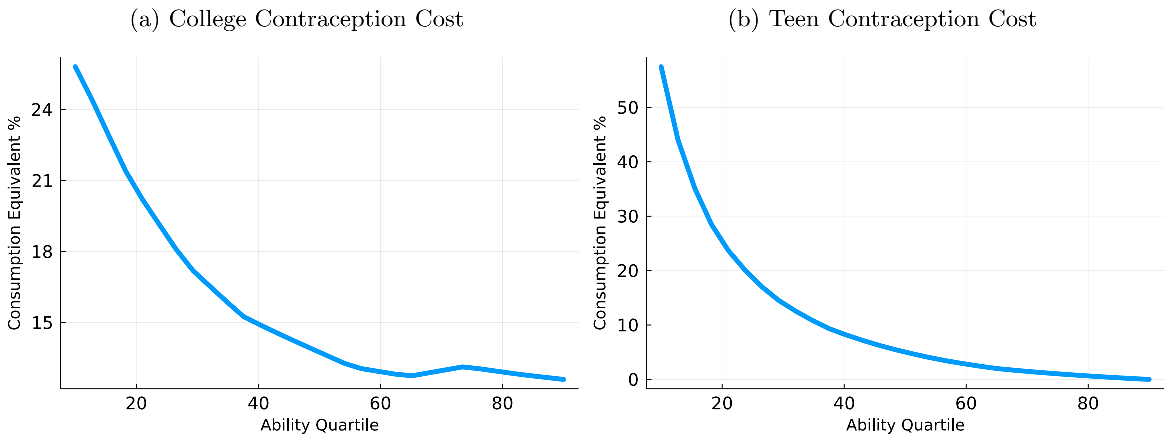
Figure 9. Relationship between ability and pregnancies.

5.3 Contraception Cost by Ability and Education

The model has 30 unknown parameters 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 contraception and age at first pregnancy. For this reason, I estimate the model using moments that relate cognitive ability, education, and marital outcomes with fertility timing. The data moments are conditional on not having a child before a particular age. I focus on first pregnancies because these are the most costly and significant for women's outcomes. In the results section, I describe each data moment and discuss whether the model fits. Then, to simplify the explanation, I divide the moments into three categories: cognitive ability and pregnancy, education, and marital outcomes.

Table 8 shows the estimated parameters. The share of ability in contraception is 0.08. Even when the share is small, it is very relevant to explain the differences in pregnancies by ability, as shown in figure . 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 college 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.

Figure 10. Equivalent Consumption by Ability Percentiles



6 Contraception Cost and Education Opportunities

Single motherhood and teen pregnancies are essential policy concerns as these groups are considerably disadvantaged. 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. Additionally, whether early pregnancy causes disadvantages or women who have early pregnancies are disadvantaged since early on in life, 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 this group, policies that decrease the child burden 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).

Table 13. Counterfactual Results

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

Previous research has found that the correlation between early pregnancies and poor educational outcomes highly overstates the effect of the child on mothers 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 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, and wages.

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 does that the cost of attending college is too high even without a child. However, decreasing the contraception cost reduces teen pregnancies by almost 90% and before 22 by 46%, as postponed pregnancies are still optimal for this group.

Column 2 shows the effect of reducing the pysch 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 an 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 , implementing these policies without improving education opportunities for low ability individuals will have little impact on educational outcomes.

7 Reduce Contraception Cost

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%			

NPP = No Previous Pregnancy.

In this section, I use the model to analyze women's educational outcomes, marriage, and pregnancies if all women have the contraception cost of college graduates. 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 high school dropouts and high school graduate contraception cost is set to the cost of college graduates.

If all women have contraception costs of college graduates, pregnancies decrease for all age groups. Teen 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 are dropping high school because of the cognitive cost of education and not unplanned pregnancies. In the model, access to better contraception technology is an important reason to acquire education, especially for women with high fertility risk. 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 constant. 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.

8 Conclusion

In this paper, I empirically and quantitatively explore cognitive ability's effects on fertility timing. I argue that differences in education contraception efficiency and wage and marital opportunity cost cannot fully explain differences in fertility timing and pregnancy intention across women with different levels of cognitive ability.

The paper jointly studies how cognitive ability, education, wages, and marriage affect early pregnancies in a dynamic life-cycle model. First, consistent with the empirical results, cognitive ability affects teen and young adult fertility risk beyond the difference 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 a decrease in contraception cost decreases teen pregnancies and increase college attendance. Even when I find that teen pregnancies decrease, college attendance remains constant as college is too costly for women with young pregnancies.

The paper 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 will extend the model to allow for children's human capital accumulation and assess the effect of early pregnancies on children's educational outcomes and intergenerational inequality when at least part of cognitive ability is persistent across generations.

References

Amador, Diego, "The consequences of abortion and contraception policies on young women's reproductive choices, schooling and labor supply," *Documento CEDE*, 2017, (2017-43).

Becker, Gary S, "A Theory of the Allocation of Time," *The economic journal*, 1965, *75* (299), 493–517.

_ , *A treatise on the family: Enlarged edition*, Harvard university press, 1991.

Bronars, Stephen G and Jeff Grogger, "The economic consequences of unwed motherhood: Using twin births as a natural experiment," *The American Economic Review*, 1994, pp. 1141–1156.

Caucutt, Elizabeth M., Nezih Guner, and John Knowles, "Why Do Women Wait? Matching, Wage Inequality, and the Incentives for Fertility Delay," *Review of Economic Dynamics*, 2002, *5* (4), 815–855.

Cawley, John, Karen Conneely, James Heckman, and Edward Vytlacil, "Cognitive Ability, Wages, and Meritocracy," Working Paper 5645, National Bureau of Economic Research July 1996.

Choi, Sekyu, "Fertility risk in the life cycle," *International economic review*, 2017, *58* (1), 237–259.

Commendador, Kathleen, "The relationship between female adolescent self-esteem, decision making, and contraceptive behavior," *Journal of the American Academy of Nurse Practitioners*, 2007, *19* (11), 614–623.

Filote, Andra, Georgi Kocharkov, Jan Mellert et al., "Teenage childbearing and the welfare state," Technical Report, mimeo 2019.

Foster, Diana Greene, M Antonia Biggs, Lauren Ralph, Caitlin Gerdts, Sarah Roberts, and M Maria Glymour, "Socioeconomic outcomes of women who receive and women who are denied wanted abortions in the United States," *American journal of public health*, 2018, *108* (3), 407–413.

Greenwood, Jeremy, Nezih Guner, and John A Knowles, "Women on welfare: A macroeconomic analysis," *American Economic Review*, 2000, *90* (2), 383–388.

Hai, Rong and James J Heckman, "The Causal Effects of Youth Cigarette Addiction and Education," Technical Report, National Bureau of Economic Research 2022.

Hansen, Karsten T, James J Heckman, and Kathleen J Mullen, "The effect of schooling and ability on achievement test scores," *Journal of econometrics*, 2004, *121* (1-2), 39–98.

Heckman, James J, "Skill formation and the economics of investing in disadvantaged children," *Science*, 2006, *312* (5782), 1900–1902.

— , **John Eric Humphries, and Gregory Veramendi**, "Returns to education: The causal effects of education on earnings, health, and smoking," *Journal of Political Economy*, 2018, *126* (S1), S197–S246.

— , **Jora Stixrud, and Sergio Urzua**, "The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior," *Journal of Labor economics*, 2006, *24* (3), 411–482.

Hotz, V Joseph, Susan Williams McElroy, and Seth G Sanders, "Teenage childbearing and its life cycle consequences exploiting a natural experiment," *Journal of Human Resources*, 2005, *40* (3), 683–715.

Kearney, Melissa S and Phillip B Levine, "The economics of nonmarital childbearing and the marriage premium for children," *Annual Review of Economics*, 2017, *9*, 327–352.

Kozlov, Egor, "Collective Household Models with Limited Commitment." PhD dissertation, Northwestern University 2021.

Levine, David I and Gary Painter, "The schooling costs of teenage out-of-wedlock childbearing: Analysis with a within-school propensity-score-matching estimator," *Review of Economics and Statistics*, 2003, *85* (4), 884–900.

Lichter, Daniel T and Rukamalie Jayakody, "Welfare reform: How do we measure success?," *Annual review of sociology*, 2002, pp. 117–141.

Musick, Kelly, Paula England, Sarah Edgington, and Nicole Kangas, "Education differences in intended and unintended fertility," *Social Forces*, 2009, *88* (2), 543–572.

Regalia, Ferdinando, José-Vıctor Rıos-Rull, and J Short, "What accounts for the increase in the number of single households," *Unpublished manuscript*, 2011.

Rosenzweig, Mark R, "Welfare, marital prospects, and nonmarital childbearing," *Journal of Political Economy*, 1999, *107* (S6), S3–S32.

— **and T Paul Schultz**, "Schooling, information and nonmarket productivity: contraceptive use and its effectiveness," *International Economic Review*, 1989, pp. 457–477.

Seshadri, Ananth and Anson Zhou, "Intergenerational mobility begins before birth," *Journal of Monetary Economics*, 2022.

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

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

B Perfect Contraception

Appendix Table B1. Reduce Contraception Cost

Moments	Data	Perfect Contr.	Moments	Data	Perfect Contr.
Preg. < 18 yr. old	0.11	-94%	Pregnancy 18-21 yrs. old | HSD, NPP	0.47	-100%
Preg. < 22 yr. old	0.40	-93%	Pregnancy 18-21 yrs. old | HS, NPP	0.40	-93%
Preg. < 29 yr. old	0.64	-82%	Pregnancy 18-21 yrs. old | Attend Coll, NPP	0.17	-96%
Drop HS | No Preg	0.06	82%	Single Mom 22-29 yrs. old | HSD, NPP	0.18	-72%
Drop HS | Preg	0.27	63%	Single Mom 22-29 yrs. old | HS, NPP	0.10	-95%
Attend Coll, NPP | No Preg	0.38	-3%	Single Mom 22-29 yrs. old | Coll, NPP	0.02	-100%
Attend Coll, NPP | Preg	0.08	-100%	Married 22-29 yrs. old | HSD, NPP	0.50	-20%
Grad. Coll., NPP | No Preg	0.51	-6%	Married 22-29 yrs. old | HS, NPP	0.68	3%
Grad. Coll., NPP | Preg	0.38	39%	Married 22-29 yrs. old | Coll, NPP	0.64	0%
Married 18-21 yrs. old | HSD, NPP	0.35	-5%	Pregnancy 22-29 yrs. old | HSD, NPP	0.48	-69%
Married 18-21 yrs. old | HS, NPP	0.34	0%	Pregnancy 22-29 yrs. old | HS, NPP	0.37	-95%
Single Mom 18-21 yrs. old | HSD, NPP	0.36	-100%	Pregnancy 22-29 yrs. old | Coll, NPP	0.49	-30%
Single Mom 18-21 yrs. old | HS, NPP	0.24	-91%			

NPP = No Previous Pregnancy.

C Model Mechanism Contribution

Appendix Table C1. Pregnancy and Wages

Moments	Data	Baseline + Educ. Het + Ab. Cont.	Baseline + Educ. Het.	Baseline
% Preg Q1 14-17 yrs. old	0.26	0.30	0.16	0.11
% Preg Q2 14-17 yrs. old	0.15	0.07	0.08	0.07
% Preg Q3 14-17 yrs. old	0.09	0.05	0.05	0.05
% Preg Q4 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. Q1	0.12	0.10	0.07	0.11
Att. Coll. Q2	0.25	0.32	0.30	0.29
Att. Coll. Q3	0.40	0.46	0.46	0.44
Att. Coll. Q4	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

NPP = No Previous Pregnancy.

Appendix Table C2. 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.	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

NPP = No Previous Pregnancy.